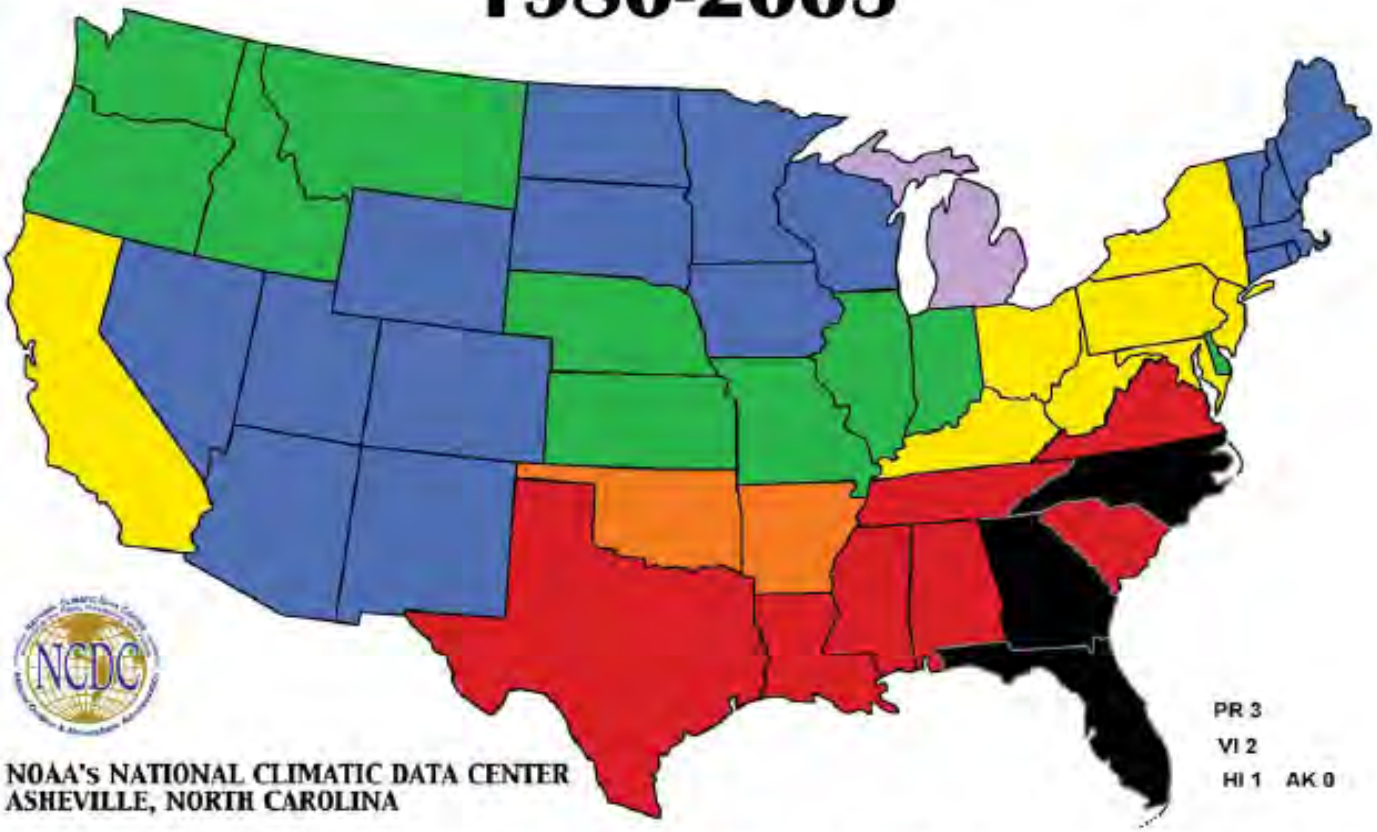
# DARE COUNTY
# Hazard Mitigation Plan

Adopted by the Dare County Commissioners

June 21, 2010

# BILLION DOLLAR CLIMATE AND WEATHER DISASTERS 1980-2005




NOAA's NATIONAL CLIMATIC DATA CENTER
ASHEVILLE, NORTH CAROLINA

| NUMBER OF EVENTS |
|---|
| 21 - 25 |
| 16 - 20 |
| 13 - 15 |
| 10 - 12 |
| 7 - 9 |
| 4 - 6 |
| 1 - 3 |

| DISASTER TYPE | NUMBER OF EVENTS | PERCENT FREQUENCY | NORMALIZED DAMAGES (Billions of Dollars) | PERCENT DAMAGE |
|---|---|---|---|---|
| Tropical Storms/Hurricanes | 23 | 34.9% | 259 | 51.1% |
| Non-Tropical Floods | 12 | 18.2% | 55 | 10.8% |
| Heatwaves/Droughts | 11 | 16.7% | 145 | 28.6% |
| Severe Weather | 7 | 10.6% | 13 | 2.6% |
| Fires | 6 | 9.1% | 13 | 2.6% |
| Freezes | 2 | 3.0% | 6 | 1.2% |
| Blizzards | 2 | 3.0% | 9 | 1.8% |
| Ice Storms | 2 | 3.0% | 5 | ~1.0% |
| Noreaster | 1 | 1.5% | 2 | ~0.3% |
| | 66 | | 507 | |

Please note that the national map color-coded by state reflects a summation of billion dollar events, for each state affected – ie, it does not mean that each state shown suffered at least $1 billion in losses for each event.

# Dare County Hazard Mitigation Plan

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**DARE COUNTY**
**HAZARD MITIGATION PLAN**
**(Update 2010)**

## I. Introduction

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards, either natural or man-made. Mitigation activities may be implemented prior to, during, or after an incident. However, it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs.
The requirements for local mitigations plans and updates are established under the Federal Emergency Management Agency's (FEMA) Mitigation Planning regulations under Code of Federal Regulations (CFR), Title 44, Part 201.6(d)(3).

### A. Statement of the Problem

Dare County is steeped in history, dating back 420 years to our 16th century Elizabethan roots as the site of England's first attempt at colonizing the New World from 1585 to 1587. Fort Raleigh National Historic Site is the acclaimed birthplace if Virginia Dare, the first English child born in the New World.

Dare County is easy to find along the North Carolina coat, as a string of sandy barrier island approximately 120 miles long that bow out into the Atlantic Ocean and cup the shoreline. Dare County covers' 800 square miles, comprising 391 square miles of land and 409 square miles of water. Dare County is truly an island, connected to the mainland of North Carolina by numerous bridges and causeways that connect the municipalities of Duck, Southern Shores, Kitty Hawk, Kill Devil Hills, Nags Head and Manteo north of Oregon Inlet to the villages of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras Village to the south of Oregon Inlet and Manns Harbor, Stumpy Point and East Lake to the west.

The current population of the County and municipalities within the County is approximately 35,000 (break down of population by location provided). The daily population of the County during peak visitation months of June, July, August, and September can be as many as 300,000, with an anticipated yearly tourist visitation of approximately 6 million. The unique geographical location, natural and historic attraction is the basis for a very large, year around tourist population supplemented by seasonal fishing activities that bring sportsmen from all over the world. Dare County includes within its boundaries: a large portion of the Cape Hatteras National Seashore including numerous historic sites, the Alligator River National Wildlife Refuge, two Atlantic Ocean Inlets, marinas and extensive boating traffic (commercial and recreational), two military bombing ranges, U.S. Coast Guard facilities, two non-controlled airports and one fixed based facility in Manteo and a North Carolina Department of Transportation ferry operation which connects the southern end of Hatteras Island to Ocracoke Island (Hyde County). Dare County has an approximate 650 million dollar tourist economy according to a county by county comparison of economic impact at www.nccommerce.com, which is the fourth largest in the state.

There are approximately 40,000 buildable commercial and private properties in Dare County with more than 11,000 rental properties available.

The main traffic roadways in Dare County are U.S. 158, which connects northern Dare County to Currituck and is a five lane divided highway, U.S. 64/264, which connects Dare County with Tyrell County and Hwy. N.C. 12 which connects southern Dare County with Ocracoke (Hyde County) and northern Dare County with Corolla (Currituck County).

Dare County is served by the North Carolina Division of Emergency Management from the Eastern Branch office in Kinston and is part of the Area 1 group of counties served by the Eastern Branch. North Carolina is part of The Department of Homeland Security FEMA Region IV, with headquarters in Atlanta, GA.

**Dare County Firsts:**

- The first English child born in the New World was Virginia Dare on August 18, 1587, at Fort Raleigh on Roanoke Island.

- Reginald Fessenden, in 1902, made the first application of a successful, commercially adaptable technique of radio communications in North America.
- Orville and Wilbur Wright, on December 17, 1903, made the first successful flights in motor-driven, heavier-than-air machines, ushering in the age of human flight.
- The Cape Hatteras National Seashore, encompassing more than 28,000 acres along the Outer Banks, was established by the Federal Government.
- Richard Etheridge became America's first black lifesaving station keeper in 1880.

Dare County is exposed to many hazards, all of which have the potential to disrupt the community, in part or totally, cause damage and create causalities. Potential hazards for Dare County are:

- Tidal Flooding
- Hurricane
- Earthquakes
- Landslides
- Nor'easters
- Severe Thunderstorms
- Tornadoes / Waterspouts
- Wildfires
- Winter Storms
- Tsunami
- Coastal Erosion
- Rip Currents
- Drought
- Terrorism
- Transportation (Bridges)
- Pandemic

The occurrence of any one or more of the emergency/disaster events listed above could have significant impact on Dare County and produce the following consequences:

- Loss of electrical power
- Failure of the water distribution system
- Severance of roadway network
- Creation of new ocean inlet
- Necessity of mass care and feeding operations
- Evacuation of people from the county
- Mass causality
- Loss of continuity of government

The occurrence of one or a combination of more than one of the listed hazards could result in a true catastrophic disaster situation, which would grossly overwhelm local and state resources and necessitate federal involvement.

It is necessary for the County to plan for and carry out disaster response and short term recovery operations utilizing local resources (i.e., the Dare County Emergency Operations Plan); however, it is likely that outside assistance would be necessary in most any major disaster situations affecting the County. Dare County has developed an all hazards emergency operations plan that provides guidance to the local officials in all phases of emergency response. This plan is reviewed annually and at the conclusion of all major disasters; and revisions are made as necessary to comply with lessons learned and with local, state and Federal guidelines.

Officials of the County are aware of the possible occurrences of an emergency or disaster and they have acknowledged their responsibilities in the execution of this plan and will fulfill these responsibilities as needed.

For the purpose of this plan Dare County will focus on the four (4) hazards that mostly affect this region, the rest of the hazards are described in Appendix A. Also, see the table on page 7 for the Hazard Identification and Analysis Hazard Index scores.

**Participating Jurisdictions**

The Town of Manteo is participating in the development of the hazard mitigation plan in conjunction with Dare County as the two governmental jurisdictions share similar boundaries and infrastructure and are susceptible to similar natural hazards. The Town of Manteo, in compiling their hazard mitigation plan, completed an independent vulnerability analysis, mitigation goals and strategies, hazard identification and community capability assessment. (See Appendix G for their Plan)

On September 30, 2009 Dare County Emergency Management held a meeting with all the municipalities that were interested in merging with the Dare County Hazard Mitigation Plan. (Attached in the Documents section on page 183 is a list of attendees at this meeting). Outcome of this meeting resulted in all municipalities reviewing existing plans, updating and merging with Dare County.

The Town of Duck adopted a resolution on August 5, 2009 to be incorporated into the Dare County Hazard Mitigation Plan as part of a multi-jurisdictional hazard mitigation plan update for Dare County. (See Appendix H for their entire plan)

The Town of Nags Head adopted a Resolution to incorporate with the Dare County Hazard Mitigation Plan as part of the Multi-jurisdictional Plan on October 8, 2009. (See Appendix I for their plan)

On October 5, 2009 the Town of Kitty Hawk requested a resolution for Dare County to merge the Hazard Mitigation plan to include the Town of Kitty Hawk. (See Appendix J for their plan)

The Town of Kill Devil Hills Commissioners adopted a resolution on October 28, 2009 to merge with the Dare County Hazard Mitigation Plan. (See Appendix K for their complete plan and resolution)

On November 4, 2009, the Town of Southern Shores adopted a resolution to be incorporated into the Dare County Hazard Mitigation Plan. (See their complete plan in Appendix L)

**Incorporation with existing Plans**

Dare County intends to create a process by which the requirements of this hazard mitigation plan will be incorporated into other local plans. During the planning process for new and updated local planning documents (such as a comprehensive plan, CAMA land use plan, capital improvements plan, or emergency management plan, to name a few examples), the Director of Emergency Management will provide a copy of the hazard mitigation plan to each respective advisory committee member. The Director of Emergency Management will recommend that the advisory committee members ensure that all goals and actions of new and updated local planning documents are consistent with the hazard mitigation plan and will not contribute to increased hazards in the town's jurisdiction.

## B. Purpose of the Hazard Mitigation Plan

Dare County is required by 44 CFR 201.6(d)(3) and N.C. S.B. 300 to review and revise its Hazard Mitigation Plan, and resubmit it for approval within 5 years in order to continue to be eligible for mitigation project grant funding.

Therefore, the plan update shall continue to describe occurrences of hazards included in the previously approved plan, and discuss new occurrences of hazard events. As required under CFR 201.6(d) (3) the updated plan shall incorporate any new historical records since the previous plan was approved or hazard data related to profiling hazards.

Natural hazards are features of the earth's natural system. Although they are not predictable, they are inevitable. Natural hazards damage the earth's environment but the natural environment is amazingly recuperative from the

forces of wind, rain, fire and earthquakes and can regenerate with resiliency, restoring habitat and ecosystems in time for the next generation of plant and animal life to begin anew.

The built environment however is not as resilient and does not possess these recuperative capabilities. Natural disasters changes and losses occur when human activity in the form of buildings, infrastructure, agriculture and other land uses are located in the path of the destructive forces of nature. Communities impacted by natural hazards often recover over a long period of time and at great social and economic cost.

The impact of natural disasters, in recent years, has increased not because natural hazards occur more frequently but because more people are choosing to live and work in locations that put them and their property at risk. By the year 2010 the number of people residing in the most hurricane-prone counties throughout the nation will have doubled. Likewise, while floods have caused a greater loss of life and property and disrupted more families and communities than all other natural hazards combined, the rate of development in flood prone areas continues to escalate, putting more people and property in danger. This realization makes it imperative that coastal communities undertake floodplain management and hazard mitigation.

While natural hazards cannot be prevented, local communities can use means to reduce the vulnerability of people and property damage. Communities can reduce exposure to natural hazards by managing the location and characteristics of both the existing and future built environment. By utilizing local building codes and construction techniques, a community can mitigate negative impacts and reduce future damage to both human lives and property.

Man-made disasters have become more of a focus for emergency planners since the events of September 11, 2001. The unfortunate outcome of these events has been the subject of great concern in attempting to devise and plan for disaster occurrences. Emergency managers now focus on developing an all hazards approach when developing response plans understanding that similar problems occur in both natural and man-made disasters and that duplication of plans can lead to misunderstanding by public and elected officials. However, mitigating man-made disasters involves collaboration of many agencies and information on a continuous basis to successfully identify potential threats.

When prepared carefully a hazard mitigation plan can satisfy statutory requirements imposed on local government, such as those contained in the Stafford Act. In October 2000, the Disaster Mitigation Act of 2000 was signed into law to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. This new legislation reinforces the importance of pre-disaster mitigation planning and imposes new requirements for local plans. Also, the State of North Carolina, in S.B. 300 requires communities to adopt hazard mitigation plans in order to remain eligible for state disaster funding for state declared disasters.

The following is a partial list of benefits considered when developing this plan:

- Save lives and property – Dare County can save lives and reduce property damage from natural hazards through mitigation actions. The County will also reduce the risk to emergency workers who must rescue people and pets during a disaster.
- Reduce vulnerability to future hazards – By having a mitigation plan in place, Dare County is prepared to take steps that will permanently reduce the risk of future losses from disasters. This opportunity is often lost when we build communities without regard to natural hazards or when we rebuild them after a disaster without post-disaster measures to reduce vulnerability.
- Save money – Dare County will experience cost savings by reducing the level of emergency services, rescue operations or recovery measures to areas that are dangerous to people or property in the event of a hazard. Dare County will also avoid costly repairs or replacement of buildings and infrastructure that would have been damaged had preventative mitigation measures not been taken.
- Facilities post-disaster funding – By identifying and ranking projects before the next disaster, Dare County will be in a better position to obtain post-disaster funding because much of the background work necessary for applying for federal and state aid will already by completed.
- Speeds recovery – By developing a mitigation plan, the County can identify post-disaster mitigation opportunities in advance of a disaster. By having this strategy through-out in advance, Dare County can be ready to respond quickly after a disaster.

- Demonstrates commitment to community health, safety and well-being – A mitigation strategy demonstrates Dare County's commitment to safeguarding its citizens and protecting the economic, social and environmental well-being.

**C. Participants in the Planning Process**

Planning is one of the best ways to identify and correct problem areas associated with hazards in the community. The Dare County Hazard Mitigation Advisory Committee was established as the overall group to identify hazards in the county, analyze the potential vulnerability for each risk and provide measurable solutions for these risks. This committee included the following: Bobby Outten, County Attorney, Ray Sturza, Planning Director, Jim Meads, Floodplain Manager, Greta Skeen, Damage Assessment Officer, Edward Mann, Public Works Director, Jenny Gray Jones, Mitigation Recovery, N.H. Sanderson, Emergency Manager, and Mike Johnson, Dare County Commissioner.

Additionally the Dare County Support Group (see Annex 1, p. 204 for a complete list of participants), because of its multi-diverse make-up, was asked to review the plan and suggest improvements or additional areas of concern. A list of the Dare County Support group is provided, but includes representatives from local private non-profits, local, State and Federal agencies, private sector and general public.

The public was invited to attend three (3) public hearings concerning the review update process in the three geographic areas of Dare County, area south of Oregon Inlet, area north of Oregon Inlet and the area of Roanoke Island. Copies of the Pubic Hearing Notices are provided.

**II. Description of Planning Process**

As a community we recognize that natural hazards are a part of the natural environment in which we live and we cannot alter the inevitability of their occurrence. However, we must also acknowledge that while we cannot affect the hazards themselves, we can engage in activities and practices, both as individuals as a community, to mitigate the impacts of those natural hazards. As a community as individuals we propose to adhere to the following principles:

- The natural system contains many features that protect humans and the built environment from hazards, such as frontal dunes, wetlands, floodplains and other natural features. We will strive to develop our community in such a way as to leave those protective features intact and functioning naturally without substantial human intervention or alteration.
- We recognize that natural hazards result in disasters only when they intersect with the built environment. We will strive to develop our community in such a way that the built environment does not occur in the known or predictable pathway of a natural hazard. If this is unavoidable, we will strive to build our structures so that they are as resilient as possible to the impacts of natural hazards.
- We recognize that evacuation capacity is a critical element of a resilient community. We will strive to ensure that population growth does not exceed the capacity of the evacuation routes on which residents and visitors will depend to take them to safety in the event of a natural hazard.
- We recognize that infrastructure often attracts development in particular areas. We will strive to keep infrastructure out of our hazardous areas, thus not actively encouraging development to occur in unsafe locations.
- We recognize that property owners have a constitutional right to put their land to an economically viable use. We will honor this right while encouraging development that limits hazards to our emergency service responders. Public participation is an integral component to the mitigation planning process and will continue to be essential as the Dare County Hazard Mitigation Plan evolves over time. Significant changes or amendments to the Plan shall require the involvement of the general community as deemed appropriate prior to any formal adoption procedures.

Dare County will implement the following strategies to involve the general community in the plan maintenance, evaluation and revision process. These strategies may include:

- Advertising meetings of the Dare Hazards Mitigation Planning Committee with invitations for the public participation;
- Designating knowledgeable and willing members of the community to serve as official representatives of the Dare Hazards Mitigation Planning Committee;

- Utilizing local media to update the community of any maintenance and/or periodic review activities taking place;
- Utilizing the Dare County website to advertise any maintenance and/or periodic review activities taking place; and
- Maintain copies of the Plan in the local libraries.

**The following is a brief overview of the steps in the planning update process:**

**A. Identify the Hazards** (Appendix A – Hazard Descriptions and Intensity Scales)

This broadly identifies the natural/man-made hazards that affect Dare County and utilizes risk assessment that quantifies threat, vulnerability and consequences so that a consistent matrix can be utilized to compare the risk. Risk assessment is the systematic approach combining sector expertise, quantitative analysis and qualitative analysis. Through this analysis, the identification and reasonable understanding of the risk environment can be defined and conveyed to the appropriate stakeholders for a more encompassing risk reduction and risk management strategy. (See table 1 for a list of potential threats identified by the plan committee).

**B. Assess Vulnerability** (Appendix B – Assessment of Vulnerability)

This step will assess Dare County's vulnerability to the hazards identified in step one. Threats considered in this evaluation include natural, accidental and intentional. It is therefore necessary to distinguish intentional (terrorism) from "all others" (example: hurricane) as the matrices are uniquely different. Where applicable locations within Dare County where hazards are likely to occur, as well as the potential damage in identified areas will be mapped. A base map is developed to show local topography, flood prone areas, seismic zones, tsunami zones or wildfire areas. In this step hazardous areas are analyzed in terms of their existing development and potential future development to identify the extent of hazard exposure.

Maps showing locations of critical facilities, major highways, public buildings and other important assets are located in Appendix B.

**C. Assess Community Capability** (Appendix C – Community Capability Assessment)

This step assesses Dare County's current mitigation practices as well as its potential to engage in mitigation activities. It also identifies activities and practices that may unintentionally counter mitigation efforts or may be exacerbating the county's level of vulnerability.

**D. Form Interim Conclusions**

Are the hazard problems identified significant to warrant county time and resources for mitigation planning?

**E. Establish Values and Goals**

Goals are statements of desirable future actions that are implemented to reach a level beyond current conditions. They are broad in scope and assist in setting community priorities; they shape and determine all the mitigation policies and programs contained in this document.

**F. Formulate Mitigation Policies**

These policies put into action the goals established for reducing vulnerability. These policies consist of any combination of regulation, programs, projects and other activities to guide the decisions (including daily, long range and post disaster) made by the county to reduce vulnerability.

**G. Establish Procedures for Monitoring, Evaluation and Reporting Progress on the Plan**

To be effective, measures must be put in place to periodically monitor implementation, evaluation of effectiveness and report the progress of the plans proposed guidelines. This is an ongoing process of compiling information on the outcomes resulting from attempts to implement the hazard mitigation plan.

**H. Establish Procedures for Revision and Updates of the Plan**

This step calls for establishing procedures to see that the annual evaluation report results in revisions and updates of the plan, when warranted.

**I. Adoption**

The official adoption of the plan by the local governing body is critical to the plan's success. This step documents the process and includes an adoption or signature page(s). The Plan is adopted according to enabling legislation and established legal procedures.

**III. Hazard Assessment**

Dare County was formed in 1870 and encompasses approximately 800 square miles of land/water/ Its physical environment includes beaches, inlets, sounds, maritime forests, water ways and mainland marsh/low land areas. There are currently 33,903 residents with 21.4% under 18 years of age and 13.8% over 65. The County has grown 49.1% since 1990 with 26,671 housing units, 12,690 households and a population density of 88.4 per square mile.

The labor force consists of 22,460 persons, the median household income is $44,345.00, and the county poverty rate is 7.9%. Tourism, including retail, accommodations and food service are the largest economic sectors for the County. Retail trade has 445 establishments, with accommodations and food services having 289 establishments. (2000 census)

The Dare County Emergency Management Agency consists of a full-time professional that serves the community. The mission is to protect lives and property from threat of major emergencies and disasters through mitigation, preparedness, response and recovery.

Dare County is vulnerable to primarily natural hazards, and while man-made incidents have a potential for occurring, the focus of this study will be directed toward specific natural hazards with the following element:

- The type of natural hazard that threatens the County
- The likelihood of the occurrence of the hazard
- The location of the area that is most vulnerable
- The impact of the hazard
- The strength of the hazard, scored by a hazard index

The hazards identified by the Dare County Mitigation Planning Team where derived from past events and the probability of those events reoccurring. The consequences of these events, such as coastal erosion, high winds and infrastructure compromise are considered as part of the typical event, thus the relevance of these actions are quantified as part of the event rather than an event itself.

The elected officials of Dare County recognize the importance of identifying hazard areas and the benefits of addressing this important socio/political issue. To this end Dare County has a dedicated staff that strives to utilize hazard mitigation grant funds whenever available to neutralize damage threats and build a more resistant community. As an example Dare County has an excellent home elevation program that has, using hazard mitigation grant funds, elevated over 42 homes that are now at low risk for flood damage.

The table below represents the Hazard Identification and Analysis and corresponding Hazard index scores. In Bold print are the most threatening natural hazards to Dare County.

| | |
|---|---|
| **Hurricanes** | **Flooding** |
| **Nor'easters** | **Coastal Erosion** |

| Hazard Type | Likelihood of Occurance (Highly Likely, Likely, Possible unlikely) | Intensity Rating (Relative Terms) | Catastrophic (Critical, Limited Negligible) | Conclusion Rank |
|---|---|---|---|---|
| Earthquake | Unlikely | Low | Negligible | 2 |
| **Tidal Flooding** | Highly Likely | High | Critical | 5 |
| **Hurricanes** | Highly Likely | High | Catastrophic | 5 |
| Land Slides | Unlikely | Low | Negligible | 1 |
| **Nor'Easters** | Highly Likely | High | Critical | 4 |
| Thunderstorms | Highly Likely | Moderate | Negligible | 2 |
| Tornadoes | Possible | Moderate | Limited | 3 |
| Wildfires | Possible | Low | Limited | 2 |
| Winterstorms | Likely | Moderate | Limited | 3 |
| Tsunami | Unlikely | High | Critical | 1 |
| **Coastal Erosion** | Highly Likely | Moderate | Critical | 5 |
| Rip Currents | Highly Likely | High | Limited | 3 |
| Drought | Unlikely | Low | Negligible | 1 |
| Bridge Collapse | Possible | Moderate | Critical | 3 |
| Terrorism Event | Unlikely | Low | Negligible | 1 |
| Pademic Event | Unlikely | Moderate | Catastrophic | 1 |

Likelihood of Occurrence – estimates the likelihood of each type of hazard occurring in Dare County. Highly likely = near 100% probability in the next year. Likely = between 10 and 100% probability in the next year, or at least one chance in the next 100 years. Possible = between 1 and 10% probability in the next year, or at least one chance in the next 100 years. Less than 1% probability in the next year, or at least once chance in the next 100 years.

Intensity Rating – varying levels of potential intensity using relative terms

Impacts – a combination of the severity of the event, its magnitude, and the density of human activity in the affected area

Catastrophic = >50% magnitude, multiple deaths, complete shutdown of critical facilities for >30 days, >50% or property is severely damaged

Critical = 25% to 50% magnitude, multiple severe injuries, complete shutdown of critical facilities for >13 days, >25% of property is severely damaged.

Limited = 10% to 25% magnitude, some injuries, complete shutdown of critical facilities for >7 days, >10% of property is severely damaged.

Negligible = <10% magnitude, minor injuries, shutdown of critical facilities for <24 hours, <10% of property is severely damaged.

**IV. Summary and Final Plan**

## A. Mitigation Goals and Values

The Hazard Mitigation Plan Committee developed 9 goals to mitigate hazards in Dare County. These 12 goals were developed for the following four types of mitigation activities: 1) prevention; 2) property protection; 3) natural resource protection; 4) public information.

The Committee identified the following goals:

- Improve storm water drainage and land management preparation for flooding
- Assist property owners with safe and efficient clean up/debris removal after storm events
- Increase the number of properties that meet and exceed BFE
- Advocate the use of existing (2010) State and Federal regulatory programs for protecting and preserving coastal wetland area of environment concern
- Continue to support the U.S. Army Corps of Engineers permit program
- Develop emergency response plans for bridge/road loss due to storms
- Improve traffic flow on highway NC 12
- Advocate for protection of transportation routes with special emphasis on Hubert C. Bonner Bridge
- Advocate for beach replenishment
- Require realtors to disclose flood zones by providing update maps
- Enhance NFIP information through dissemination of brochures and public information releases
- Educate the public on other possible risk that the county may be vulnerable to

The Committee also evaluated the County's current programs and policies, along with potential programs and policies that could reduce Dare County's vulnerability to natural hazards.

Current and potential policies were examined by: 1) Effectiveness; and 2) Cost.

Effectiveness was determined by the perception of Hazard Mitigation Plan Committee as High, Medium and Low. Cost was determined by the Committee and rated as High, Medium or Low. The cost is the expense of implementation and administration to the community.

The overall goals described in the Dare County Plan gives a broad guide for implementation and are dependent on budget availability, grant and project funding, hazard frequency and damage occurrence. To this end Dare County will continue to pursue these goals in a proactive manner to best provide a level of service that will address our goals over the term of the plan and beyond.

## B. Prioritization and Cost Benefit Analysis

The Committee also conducted a cost benefit analysis of identified projects and prioritized those projects. A process for prioritization of identified hazard mitigation strategies was performed. The Committee used the following criteria for prioritization of hazard mitigation strategies:

- Cost benefit analysis
- Results of Hazard Identification and Analysis
- Results of Vulnerability assessment
- Results of Community Capability Assessment
- Effectiveness in meeting hazard mitigation goals and comprehensive plan goals

Cost benefit review was given special emphasis, in light of its possible use in environmental reviews for HMGP, FMA and other federal hazard mitigation projects.

## C. Participation of Other Interested Parties

The planning process included an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development, as well as businesses, academia and private and non-profit interests.

**D. Potential Funding Sources**

Dare County will continue to use the funding sources made available from the NC Division of Emergency Management, such as the Hazard Mitigation Grant Funds and Scattered Site Housing Block Grants administered by the NC Dept. of Commerce. Dare County will also review funding sources as indicated on the NC Division of Emergency Management Web Site, www.ncem.org/mitigation/additional_funding.htm.

**E. Final Plan**

The Hazard Mitigation Plan, after review from all parties, will be submitted to the NC Division of Emergency Management for review/approval, following to FEMA Region IV for review/approval and finally, to the Dare County Board of Commissioners for approval.

**1. Implementation and Monitoring**

Implementation of the activities recommended by this plan will be monitored so the deadlines will be met. The Floodplain Administrator will be responsible for tracking the activities outlined in this plan. Each person (department) assigned a responsibility in this plan shall report to the Floodplain Administrator once each year to update/advise on area of responsibility (May1).

**2. Evaluating and Reporting Progress**

Beyond checking whether the policies of the plan are being implemented on time, an evaluation of the plan's effectiveness should be undertaken each year. Evaluation includes gauging the effectiveness of individual policies, as well as evaluating the level of vulnerability of the community as a whole. The Floodplain Administrator will report to the Dare County Board of Commissioners each year, on the first meeting prior to the beginning of hurricane season (June1). The report should review the progress and recommend changes as needed.

**3. Revisions and Updates**

The Planning Committee held a series of meetings beginning on September 9, 2008 to beginning the revisions and updates for this plan. Workshops were held with the Community leaders to incorporate a multi-jurisdictional Hazard Mitigation Plan. At that time the Town of Manteo was already participating with Dare County and Duck adopted their resolution on August 5, 2009 to become part of the Dare County Hazard Mitigation Plan. On September 30, 2009, the towns of Nags Head, Kill Devil Hills, Kitty Hawk and Southern Shores were invited to a meeting to discuss incorporating their Hazard Mitigation Plans with the County of Dare. The town of Kitty Hawk adopted a resolution to merge with the Dare County HMP on October 5, 2009; along with the Town of Nags Head on October 7, 2009, Kill Devil Hills adopted a resolution on October 28, 2009, Southern Shores adopted a resolution on November 4, 2009.

The Hazard Mitigation Planning Committee will reconvene during the first week in May each year to receive a presentation from the Floodplain Administrator on the progress of the plan. The Hazard Mitigation Planning Committee will prepare an annual evaluation report that will be submitted, along with the Floodplain Administrator's report, to the Dare County Board of Commissioners. Revisions to the plan require a public hearing and adoption by the Dare County Board of Commissioners.

A table outlining areas of responsibility for recommended actions and goals is provided.

A table outlining Dare County's Hazard Mitigation Action Plan

| Goals / Actions | Hazard | Target Completion Date | Responsible Person | Funding Source | Deadline | | | | | Priority |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 10 | 11 | 12 | 13 | 14 | |
| **Preventive**<br>**Goals: 1. Improve stormwater drainage and land management preparation for flooding.**<br>**2. Assist property owners with safe and efficient clean up after storm events.** | | | | | | | | | | |
| 1a. Identify funding | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing | Planning Director | General Funds Grants | | X | | | | Medium |
| 1b. Identify problem areas | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Not Complete | Planning Director | General Funds | | X | | | | High |
| 1c. Prioritize and fund critical drainage projects | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing | Planning Director | General Funds Grants | | | X | | | High |
| 1d. Enforce ordiance preventing fill or structures without a drainage plan | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing / met | Planning Director | General Funds | | X | | | | High |
| 2a. Identify available resources | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing / met | Public Works | General Funds Grants | X | X | X | X | X | Medium |
| 2b. Public education | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing | Public Works | General funds | X | X | X | X | X | Medium |
| 2c. Fund and implement | Hurricanes, Nor'easters, Flooding, Thunderstorms, Tidal Flooding | Ongoing | Public Works | General Funds | | X | X | X | X | Medium |
| **Property Protection**<br>**Goals: 3. Increase the number of properties that meet and exceed BFE.** | | | | | | | | | | |
| 3a. Identify the most vulnerable structures within the county | Hurricanes, Nor'easters, Flooding, Thunderstorms, Coastal Erosion, Tidal Flooding, Tsunami | Ongoing | Floodplain Coordinator | Grants | X | X | | | | High |
| 3b. Develop Plan | Hurricanes, Nor'easters, Flooding, Thunderstorms, Coastal Erosion, Coastal Erosion, Tidal Flooding, Tsunami | Ongoing/being reviewed | Hurricane Recovery | General Funds | X | | | | | Low |
| 3c. Identify funding | Hurricanes, Nor'easters, Flooding, Thunderstorms, Coastal Erosion, Tidal Flooding, Tsunami | Ongoing | Hurricane Recovery | Grants | | X | X | | | Low |
| 3d. Prioritize funding | Hurricanes, Nor'easters, Flooding, Thunderstorms, Coastal Erosion, Tidal Flooding, Tsunami | Ongoing | Hurricane Recovery | Grants | X | X | X | X | X | High |
| 3e. Implement plan to reduce potential damage in future | Hurricanes, Nor'easters, Flooding, Thunderstorms, Coastal Erosion, Tidal Flooding, Tsunami | Ongoing/being reviewed | Planning Director<br>Hurricane Recovery | General Funds | | X | | | | Medium |
| **Natural Resource Protection**<br>**Goal: 4. Advocate the use of existing (2002) State and Federal regulatory programs for protecting and preserving coastal wetland areas of environmental concern. 5. Continue to support the U.S. Army Corps of Engineers permit program.** | | | | | | | | | | |
| 4a. Implementation and enforcement of CAMA use standards for coastal wetland AECs as identified under 15NCAC7H, Section .0205 and .0208. | Hurricanes, Nor'Easters, Tidal Flooding | Ongoing | Floodplain Coordinator | Grants | X | X | X | X | X | High |

| Goals / Actions | Hazard | | Responsible Person | | Deadline | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 10 | 11 | 12 | 13 | 14 | |
| 4b. Continue to administer the CAMA local permit enforcement program and maintain the staff necessary for this work | Tidal Flooding, Hurricanes, Nor'Easters, Flooding | Ongoing | Floodplain Coordinator | General Funds | X | X | X | X | X | Medium |
| 5a. Refer applicants to U.S. Army Corp of Engineers permit program, specifically section 404 | Flooding | Ongong | Floodplain Coordinator | General Funds | X | X | X | X | X | Medium |
| 5b. Facilitate implementation of permit program for wetland management | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Floodplain Coordinator | General Funds, Grants | X | X | X | X | X | Medium |
| **Structural Projects**<br>**Goal: 6. Improve traffic flow on NC 12**<br>**7. Protect transportation routes, including the Bonner Bridge** | | | | | | | | | | |
| 6a. Two lane highway NC 12 to improve traffic flow | Hurricanes, Nor'Easters, Tidal Flooding | Ongoing | N.C. Department of Transprotation | Grants | XX | | | | | High |
| 6b. Coordinate traffic lights to create efficient flow | Hurricanes | Ongoing | N.C. Department of Transprotation | Grants | | XX | | | | High |
| 7a. Replace the Bonner Bridge | Coastal Erosion | Ongoing | N.C. Department of Transprotation | Federal Funds | | | | | XX | High |
| **Public Information**<br>**Goals: 8. Require realtors to disclose flood zones.**<br>**9. Enhance NFIP information**<br>**10. Develop Emergency Response Plan for road/bridge loss**<br>**11. Advocate for Beach Replacement**<br>**12. Develop educational brochures on additional hazards that could possible occur within the county.** | | | | | | | | | | |
| 8a. Develop relations with real estate community | Tidal Flooding, Hurricanes, Nor'Easters, Flooding | Ongoing | Public Information Officer | General Funds | X | X | | | | Medium |
| 8b. Meet with realtors to coordinate public education activities | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Public Information Officer | General Funds | | X | X | X | | Medium |
| 8c. Develop floodplain map for public dissemination | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Met | Public Information Officer | General Funds | | X | X | X | | High |
| 8d. Lobby state legislators | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Public Information Officer | General Funds | X | | | | | Medium |
| 8e. Lobby local realtors board | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Public Information Officer | General Funds | X | | | | | Medium |
| 9a. Circulate brochure on NFIP | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Floodplain Coordinator | General Funds / Grants | X | X | X | | | Medium |
| 9b. Put flood maps on the County's website | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Met | GIS | General Funds | X | X | X | X | X | Medium |
| 9c. Continue to participate in CRS activities | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Floodplain Coordinator | General Funds | X | X | X | X | X | High |
| 9d. Update F.R.I.M. | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | GIS | General Funds | X | X | | | | Medium |
| 9e. Continue storm readiness | Flooding, Tidal Flooding, Nor'Easters, Hurricanes | Ongoing | Public Information Officer | General Funds | X | X | X | X | X | High |
| 10a. Develop Emergency Response Plan for road/bridge loss | Bridge Collapse | Ongoing | Emergency Management Director | General Funds | X | X | | | | High |
| 11a. Advocate for Beach Replacment | Coastal Erosion | Ongoing | Public Information Officer | Grants | | X | X | X | X | High |
| 12a. Circulate brocures on additional hazards identified in the risk assessment to educate the public on protective actions that they can prepare for in their disaster plans. | Earthquakes, Landslides, Tornadoes, Rip Currents, Terrorism Events, Pandemic Events | Ongoing | Public Information Officer | General Funds | | X | X | X | X | Low |

**Each action item is prioritized. The selection criteria used to analyze the action steps are: 1) Cost effective; 2) environmentally sound; 3) technically feasible. An item has to meet all three criteria, if it is given a High priority, it it meets 2 the item is given a Medium priority; and if it only meets one, it is given a Low Priority.**

# **APPENDIX A:** HAZARD DESCRIPTIONS AND INTENSITY SCALES

Before Dare County can determine how best to utilize time and resources on hazard mitigation, it is necessary to determine which specific hazards present the greatest potential for a natural disaster. Factors such as geography, topography, climate and natural features, must be considered.

This Appendix contains information regarding a number of the most serious natural hazards that can occur in North Carolina. A reader can refer to this information to get a general sense of the nature of the hazards, their causes, and their occurrences in the State. This Appendix is a starting point to gathering data that is more particular and specific to the community's hazard situation.

Much of the information contained here was adapted from FEMA Publication #386-2, *Understanding Your Risks: Identifying Hazards and Estimating Losses*, August 2001.

Dare County is more vulnerable to Hurricanes, nor'easters, tornadoes, floods, and wildfires than earthquakes, landslides, and sever winter weather. It is important that Dare County understand the hazards that it is most susceptible to so that it can direct its mitigation efforts and resources towards the hazards, which pose the greatest risk to the county residents and property.

It is also important that the policy makers understand the nature of each hazard and its likelihood of occurrence within their jurisdiction. In the following section, each natural hazard relevant to North Carolina will be described including discussion of its likelihood of occurrence and history of occurrence.

Dare County is located adjacent to the Pamlico, Albemarle, Roanoke, Croatan and Currituck Sounds and their tributaries. Similar to those portions of Dare County exposed to the Atlantic Ocean, these sound side areas are susceptible to flooding during hurricanes or other weather events where extended periods of gusty winds push the estuarine waters up their banks.

Dare County is vulnerable to multiple natural hazards. Those were identified and analyzed by specific hazard:

1. the type of natural hazard that threatens the County
2. the likelihood of the occurrence of the hazard
3. the location of the communities that are the most vulnerable
4. the impact of the hazard
5. the strength of the hazard, scored by a hazard index

**A. Tidal Flooding / Over wash**

A flood is a natural event for rivers, streams and coastal areas. Excess water from snowmelt, 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 North Carolina, and thousands of households are located within floodplains. Floods 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. Most property damage results from inundation by sediment-filled water, or by debris in floodwaters that acts as "battering rams."

Floods generally fall into two categories: flashfloods, the product of heavy localized precipitation in a short period over a given location, or caused by a dam break or levee failure; and general floods, which can occur in riverine, coastal and urban settings. There are also areas in North Carolina that are subject to long-term or permanent inundation.

<u>Flash Flooding:</u> Flash floods occur within a few minutes or hours of heavy amounts of rainfall, from a dam or levee failure, or from a sudden release of water held by an ice jam. In North Carolina, most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or by heavy rains from hurricanes and tropical

storms. Areas subject to rapid floodwater inundation pose special threats to life and property because there is insufficient time for warning, evacuation, emergency flood-proofing, or other protective measures. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides. Suddenness is a serious problem in the following areas:

- Steep rivers and streams in mountainous or hilly areas subject to sudden rainfall and rapid runoff;
- Areas with steep slopes and little or no vegetative ground cover;
- Areas behind dams or levees subject to failure or overtopping;
- Barrier islands and other areas along the coast which may be subject to relatively rapid hurricane storm surge; and
- Urban areas where much of the ground is covered by impervious surfaces, or where fixed drainage channels may be unable to contain the runoff that is generated by intense rainfall events.

Coastal Flooding: 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. Thousands of acres of crops and forestlands may be inundated by both saltwater and freshwater. Escape routes, particularly from barrier islands, may be cut off quickly, stranding residents in flooded areas and hampering rescue efforts.

Urban Flooding: Urban flooding occurs where there has been development within stream floodplains. This is partly a result of the use of waterways for transportation in earlier times. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities. Floodplains are also attractive for development since they provide flat areas for building. The price of the accessibility and convenience has been increased flooding of the ensuing urban areas. Urbanization increases the magnitude and frequency of floods by increasing impermeable surfaces, increasing the speed of drainage collection, reducing the carrying capability 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 storm water 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.

Steeply sloped watersheds: In hilly and mountainous areas, a flood may occur minutes after a heavy rain. These flash floods allow a little or no warning time, and are characterized by high velocities.

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 floodwaters' 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, increase 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 fuel from compromised tanks, farm and lawn chemicals, and animal waste. In addition, if a wastewater treatment plant was 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.

Soil saturation: Rainfall in areas already saturated with water will increase the runoff.

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 9greater than 5 feet per second) can erode steam 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 zone);
- Coastal inlets and over wash areas;
- Steep inland floodplain areas along smaller rivers and streams;
- Alluvial fans;
- Some riverine floodways, and in mudflow and high gradient sheet flow areas;
- Areas behind levees or dams where the protective structure suddenly fails or the design capacity is suddenly exceeded.

**Flood Frequency**

***100-Year Flood***

Floodplain mangers 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. Dare County lists flooding as a high hazard risk and can anticipate future flooding occurrences.

***Flood Insurance Rate Maps (FIRMs):***

Fortunately, most of the known floodplains in the United States have been mapped by FEMA, which administers the National Flood Insurance Program (NFIP). When a flood study is completed for the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). An (FIS) is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community and include causes of flooding.

The FIS report and associated maps delineate Special Flood Hazard Areas (SFHAs), designate flood risk zones, and establish base flood elevations (BFEs), based on the Flood that has a 1% chance of occurring annually, or the 100-year flood. The Study may have three components:

- The FIS – Flood Insurance Study text;
- The FIRM – Flood Insurance Rate Map; and

- A separate Flood Boundary and Floodway Map (FBFM) that was issued as a component of the FIS for each community studied prior to 1986. No BFE or flood zone names are shown on the floodway map and people often confuse the white floodway with the white area representing land that is free from flooding. FIS reports published since 1986 have corrected this problem by delineating the floodways as diagonally hatched areas on the FIRMs.

Table 2 provides a summary of the system FEMA uses on the Flood Insurance Rate Maps (FIRIMs) to categorize different floodplain areas.

**Table 2. Flood Insurance Rate Maps (FIRMs) used to categorize different floodplain areas.**

| **Flood Zones** | | |
|---|---|---|
| A Zone | The 100-yeart or base floodplain. There are six types of A zones: | |
| | A | The base floodplain mapped by approximate methods, i.e., BFEs are not determined. This is often called an unnumbered A zone or an approximate A zone. |
| | A1-30 | These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). |
| | AE | The base floodplain where the base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-A30 zones. |
| | AO | The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided. |
| | AH | Shallow flooding base floodplain. BFE are provided. |
| | A99 | Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined. |
| | AR | The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level or protection. |
| Zone V and VE | V | the coastal area subject to a velocity hazard (wave action) VE where BFEs are not determined on the FIRM. |
| | VE | The coastal area subject to a velocity hazard (wave action) where the BFEs are provided on the FIRM. |
| Zone B and Zone X | Area of moderated flood hazard, usually the area between the limits of the 100-year and 500-year floods. B zones are also used to designate base floodplains of lesser hazards, such areas protected by levees from the 100-year flood, or shallow flooding areas with average depths less than 1 foot or drainage areas less than 1 square mile. | |
| Zone C and Zone X | Area of minimal flood hazard, usually depicted on FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood. | |
| Zone D | Area of undetermined but possible flood hazards. | |

Flood hazard varies by location and type of flooding. Coastal areas are most at risk from flooding caused by hurricanes, tropical storms, and Nor' Easters. Low-laying coastal areas in close proximity to the shore, sounds, or estuaries are exposed to the threat of flooding from storm surge and wind-driven waves, as well as from intense rainfall. Areas bordering rivers may also be affected by large discharges caused by heavy rainfall over upstream areas.

**Flooding Depths**

Flood events in Dare County are divided into the storm surge elevations for the 10-, 50-, 1--, and 500-year intervals. The flood events, occurring in these intervals, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year.

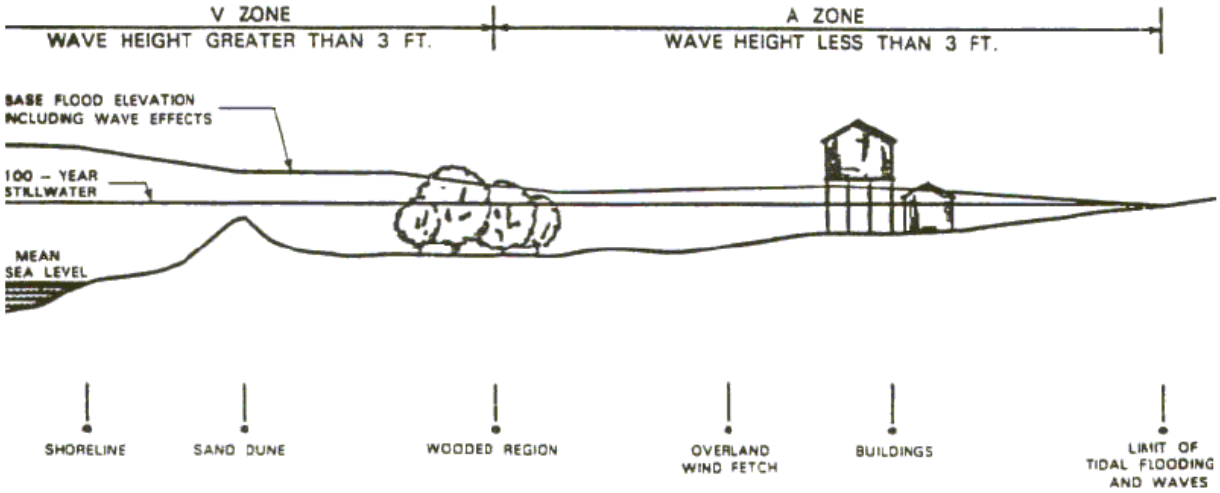
The analysis reported herein reflects the Stillwater elevations resulting from tidal and wind setup effects, but do not include the contributions from wave action effects.

**Table 5. Base Flood Elevation**

| **Flooding Source** | **Location** | **Stillwater Elevations (Feet NGVD)** 10-year | 50-year | 100-year | 500-year | **Zone** | **Base Flood Elevation (Feet NGVD)** |
|---|---|---|---|---|---|---|---|
| Atlantic Ocean | Northern Outer Banks | 5.8 | 7.2 | 10.4 | 9.6 | VE<br>AE | 12-16<br>7-11 |
| Atlantic Ocean | Southern Outer Banks | 5.4 | 6.6 | 8.8 | 8.4 | VE | 10-15<br>8-10 |
| Atlantic Ocean / Roanoke Sound | Roanoke Island | 7.4 | 8.9 | 9.2 | 10.8 | VE<br>AE | 11-12<br>9-11 |
| Atlantic Ocean / Pamlico Sound / Croatan Sound | Mainland | 4.8 | 6.8 | 7.3 | 8.2 | VE<br>AE | 10<br>7-9 |

Source: Dare County Flood Insurance Study, 1993.

Figure 1 represents a sample transect that illustrates the relationship between the Stillwater elevations, the wave crest elevation, the ground elevation profile and the location of VE/AE zone boundary.




Source: Dare County Flood Insurance Study, 1993.

**Historical Impact**

Dare County has approximately 850 buildings located in 10 flood prone areas located in the AE & VE zones, with a base flood elevations ranging from 6 to 8 feet MSL. Two of these areas are located adjacent to the Atlantic Ocean and 8 are on the sound side. The average ground elevation in this area range from 5 to 16 feet MSL. Historically during periods of flooding, there is a storm surge of 2 to 3 feet above normal tide level and standing floodwaters of 1 to 2 feet above ground elevation.
Flooding in Dare County can be attributed to elevated tide levels, wave wash, high winds, and erosion. All of these conditions are present during storm surges generated in the Atlantic Ocean by tropical storms and hurricanes. In addition the surge moves into the Pamlico, Albemarle, Croatan and Currituck Sounds where high winds associated with storm surge can be much more damaging than the high water levels. Not all storms, which pass close to these areas, produce extremely high surge. Similarly, storms that produce flooding conditions in one area may not necessarily produce flooding conditions in other parts of the area. Historical events would dictate that flooding is a high risk in Dare County and future occurrences can be expected. Flooding occurs as a part of other significant weather phenomenon and is evident when reviewing data as found in the Ash Wednesday Storm of 1962 and Hurricanes Emily (1993) and Isabel (2003) and Tropical Storm Dennis (1999). The probability of reoccurring damage due to flooding could affect as much as 50% of the county in terms of building damaged or destroyed.

Dare County will continue to enforce all flood insurance policies that have been required of us as a condition of federal financial assistance for insurable buildings in Dare County and located in the Special Flood Hazard area shown of our Flood Insurance Rate Map. (A copy of the Community Rating System Annual Recertification is located in Annex 6).

**B. Hurricanes**

***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 clam center called the eye, which can be 20-30 miles wide. When a hurricane nears land, it may bring torrential rains, high winds, storm surge, 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 from its center or eye. The hurricane season for the Atlantic Coast is June 1 to November 30, with a peak around mid-September.

***Measurement***
Hurricane intensity is measured using the Saffir-Simpson Scale, ranging from 1 (minimal) to 5 (catastrophic). Scale categorizes hurricane intensity linearly based upon the 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 2 and 3 below).

Some hurricanes are characterized primarily by water – a rainy or wet hurricane (such as Hurricane Floyd, which landed in North Carolina in 1999) – while others are primarily characterized by wind – a windy or dry hurricane (such as Hurricane Fran in 1996). Wet hurricanes can flood both coastal and inland areas, even as the storm dissipates in wind strength, while windy hurricanes primarily affect coastal areas with their high winds and storm surge. Inland communities will be most concerned with the flooding aspect of coastal storms. Torrential rains of even Category One hurricanes and tropical storms have been known to cause 500-year floods (which have a 0.2% chance of occurring each year) and greater flooding in inland communities. Coastal communities will need to determine how severe the high winds; storm surge and erosion could be from their storm surge inundation map.

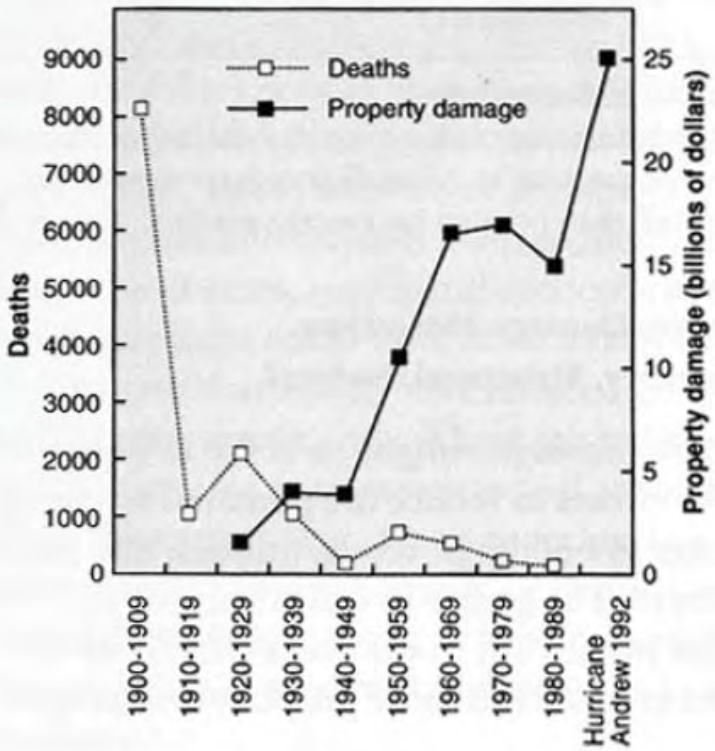
**Table 3. Saffir-Simpson Hurricane Scale**

| Saffir-Simpson Category | Maximum Sustained Wind Speed | | | Minimum Surface Pressure | | Storm Surge | |
|---|---|---|---|---|---|---|---|
| | MPH | Meters/ sec | Knots | Millibars (mb) | Inches | Feet | Meters |
| 1 | 74-96 | 33-42 | 64-83 | Greater than 980 | Greater than 28.94 | 3-5 | 1.0-1.7 |
| 2 | 97-111 | 43-49 | 84-96 | 979-965 | 28.50 – 28.91 | 6-8 | 1.8-2.6 |
| 3 | 112-131 | 50-58 | 97-113 | 964-945 | 27.91 – 28.47 | 9-12 | 2.7-3.8 |
| 4 | 132-155 | 59-69 | 114-135 | 944-920 | 27.17 – 27.88 | 13-18 | 3.9-5.6 |
| 5 | 156+ | 70+ | 136+ | Less than 920 | Less than 27.17 | 19+ | 5.7+ |

**Table 4. Hurricane Damage by Category**

| Category | Level | Description | Example |
|---|---|---|---|
| 1 | Minimal | Damage primarily to shrubbery, trees, foliage, and unanchored homes. No real damage to other structures. Some damage to poorly constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft torn from moorings | Hurricane Jerry (1989) |
| 2 | Moderate | Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to Roofing materials of buildings. Coast roads and low-lying escape routes inland cut b rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorage torn from moorings. Evacuation of some shoreline residence and low-lying areas required. | Hurricane Bob (1991) |
| 3 | Extensive | Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some wind and door damage. Some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before Hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required. | Hurricane Gloria (1985) |
| 4 | Extreme | Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. Flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before Hurricane center arrives. Major erosion of beaches. Massive Evacuation of all residences within 500 yards of shore possibly Required, and of single story residences within 2 miles of shore. | Hurricane Andrew (1992) |
| 5 | Catastrophic | Shrubs and trees blow down; considerable damage to roofs of Buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobiles homes. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required. | Hurricane Camille (1969) |

2.6 The historic record of the decrease in deaths and increase in property damage from hurricanes in the United States. A better storm warning system explains the former and denser development explains the latter (information from Williams, 1992).




North Carolina's geographic location on the Atlantic Ocean and its proximity to the Gulf Stream makes it prone to hurricanes. While occurring less frequently than winter storms, hurricanes strike the Outer Banks often enough to cause significant concern, between 1899 and 1980, North Carolina received 21 direct hurricane hits. Of these, eight were classified as major hurricanes (i.e., greater than 3 on the Saffir/Simpson Hurricane Scale). Among Atlantic Coast states only Florida received more direct hits than North Carolina. North Carolina's Outer Banks are particularly susceptible to the effects of hurricanes due to the projection of landmass into the Atlantic. Even in the absence of landfall, hurricanes deflected by inland high-pressure systems travel north along the coast and affect the barrier islands.

Maps indicate the areas of Dare County which are most susceptible to hurricane-generated storm surge. As discussed under flooding, storm surge from the Atlantic Ocean propagates in the Pamlico, Albemarle, Croatan and Currituck Sounds.

The topography of Dare County is relatively flat with elevations ranging from 3 to 138 feet National Geodetic Vertical Datum of 1929 (NGVD) above sea level. The dominant source of flooding for Dare County is storm surge generated in the Atlantic Ocean by tropical storms and hurricanes. In addition, this surge propagates into Albemarle Sound and further into the Alligator Rive, Croatan Sound, Currituck Sound, Davis Channel, East Lake, Old Hose Channel, Roanoke Sound, and South Lake where high winds associated with tropical storms can produce high waves. The wave action associate with tropical storms can be much more damaging than the higher water level.

Not all storms, which pass close to the study area, produce extremely high tides. Similarly, storms which produce flooding conditions in one area may not necessarily produce flooding conditions in other parts of the study area.

**Historical Impact**

North Carolina has had an extensive hurricane history dating back to colonial times. During the nineteenth century, storms occurred in 1837, 1846, 1856, 1879, 1883, and 1899. During the years 1960-1990, there was a decrease in land falling hurricanes, with the exception of Hurricane Donna in 1960. However, during the 1950's North Carolina was ravaged by several hurricanes including Hazel, Connie, Diane, and Ione. Recent history has included several hurricanes as well, with Hugo (1989), Emily (1993), Opal (1996), Fran (1996), Eduardo (1996), Bonnie (1998), Dennis (1999) and Floyd (1999) all leaving a mark on North Carolina. However these storms had varying impacts on Dare County.

Storms passing North Carolina in the vicinity of Dare County have produced severe floods as well as extensive structural damage. The following is a historic look at storms passed.

**A. <u>October 5 to 18, 1954 – Hurricane Hazel</u>**

Hurricane Hazel was the most destructive storm in the history of North Carolina. The storm crossed the coast just north of Myrtle Beach, South Carolina, as hurricane winds hit the Atlantic coast between the City of Georgetown, South Carolina, and Cape Lookout, North Carolina. Storm tides (i.e., hurricane surge0 devastated the immediate ocean from of this stretch of coast. Every fishing pier along 170 miles of coast, from Myrtle Beach, South Carolina, to Cedar Island, North Carolina, was destroyed. The waterfront between the South Carolina – North Carolina state line and Cape Fear was completely destroyed. Grass-covered dunes, some 20 feet high, along and behind which beach homes had been built in a continuous line five miles long, simply disappeared-dunes, houses, and all. From Cape Fear to Cape Lookout, the degree of devastation was not great, but ocean front property was damaged an average of 50-precent along this entire stretch. North or Cape Lookout, damage was relatively light.

Storm surge of 16.6 feet above the NGVD was observed at Holden Beach Bridge and the Town of Calabash, North Carolina. The lowest recorded barometric pressure of the storm was 938 millibars (mb), reported at Little River Inlet on the North Carolina – South Carolina border. Maximum wind speeds were 83 miles per hour (mph), with gusts recorded at 98 mph at the City of Wilmington, North Carolina; 106 mph at Myrtle Beach, South Carolina; and estimated 150 mph at Cape Fear. The storm continued inland through North Carolina causing widespread damage as a result of high winds and record rainfall. Nineteen people were killed and 200 injured during this storm.

**B. <u>August 3 to 14, 1955 – Hurricane Connie</u>**

Hurricane Connie entered North Carolina close to Cape Lookout at about 8:30 a.m. on August 12, 1955. The prolonged pounding of high waves against the coast caused tremendous beach erosion, probably worse than that caused by Hurricane Hazel in 1954. Storm tides along the coast from the City of Southport to the Town of Nags Head were reported to be about 7 feet NGVD (6.9 feet NGVD at Wrightsville Beach and 7.5 feet NGVD at Kure Beach). Water in sounds and near the mouths of rivers was five to eight feet above normal. At the City of Wilmington were reported at 72 mph, gusting to 83 mph. At Fort Macon, winds of 75 mph, gusts of 100 mph, and a barometric pressure of 962 mb were reported. The storm also brought torrential rains with the maximum rainfall; around 12 inches in 48 hours, occurring near the City of Morehead City. Total damage throughout the state was estimated at $50 million.

**C. <u>August 7 to 21, 1955 – Hurricane Diane</u>**

Five days after Hurricane Connie, and before the damage from that storm could be estimated, Hurricane Diane struck the coast near Carolina Beach about 6 a.m. on August 17, 1955. The highest wind speed reported during this storm was 74 mph at Wilmington Airport. Storm tides ranged from five to nine feet above mean low water on the beach (6.8 feet NGVD at Wrightsville Beach), and in some areas of sounds and rivers emptying into sounds, estimated water levels were five to nine feet above normal. Water was three feet above floor level in the business district of the Town of Belhaven and "waist deep" in parts of Washington and New Bern. Hurricane Diane caused severe beach erosion along the North Carolina coast. The total damage caused in North Carolina by Hurricane

Connie and Diane was estimated to be in excess of $90 million. No deaths or injuries in North Carolina were attributed to either of the storms.

**D. <u>September 10 to 23, 1955 – Hurricane Ione</u>**

Hurricane Ione moved up from the south and crossed the North Carolina coast near Salter Path, ten miles west of Morehead City, at about 5 a.m. on September 19, 1955. It then slowly curved to the northeast and went out to sea near the Virginia border early on September 20, 1955. When Hurricane Ione entered North Carolina, winds gusted to over 100 mph. Wind speeds of 75 mph with gusts to 107 mph were recorded at Cherry Point. The minimum barometric pressure recorded over North Carolina during this storm was 960 mb. Heavy rains also accompanied Hurricane Ione. At the same time, prolonged easterly winds drove tidal water onto beaches and into sounds and estuaries to heights of 3 to 10 feet above normal. The result was the largest inundation of eastern North Carolina ever known to have occurred. Hurricane Ione made landfall near Salter Path on Bogue Banks on September 19, 1955, killing seven people and causing $88 million in property damage.

**E. <u>September 21 to October 3, 1958 – Hurricane Helene</u>**

Hurricane Helene was one of the most powerful storms of recent history; fortunately for the people of North Carolina, the storm center was well out to sea as it moved north on September 26 and 27, 1958. Nevertheless, high winds were recorded at Wilmington, with the highest winds measured at 85 mph and peak gusts recorded at 135 mph, the lowest reported central pressure of the storm was 93 mb; this measurement was recorded south-southeast of Cape Fear early on the morning of September 27, 1958. There was some beach erosion, which resulted from seas and tides, but this erosion was minimized because the storm occurred at the time of low astronomical tides. High tides were estimated at 3 to 5 feet above normal; a high tide of 5.1 feet NGVD was reported at Wrightsville Beach. Tides were higher on the southern end of Pamlico Sound, where the wind shifts as the storm center passed brought the tides seven to eight feet above normal.

**F. <u>August 29 to September 13, 1960 – Hurricane Donna</u>**

Hurricane Donna crossed the North Carolina coast between Wilmington and Morehead City on September 11, 1960. The center of the storm passed a few miles east of Wrightsville Beach, although the City of Wilmington and Wrightsville Beach were each in the eye for about an hour. The lowest barometric pressure recorded during this storm was 962 mb at the City of Wilmington. High tides, six to eight feet above normal, and high winds caused severe damage at many points. Winds of hurricane force, up to 97 mph, were reported at the City of Wilmington.

During the night of September 11, 1960, the storm center moved northward, parallel and slightly east of a line drawn between Wilmington, North Carolina and Norfolk, Virginia. Wind gusts were in excess of 97 mph, and tides were 4 to 8 feet above normal. High tides of 10.3 and 8.3 feet NGVD were reported at Atlantic Beach and Wrightsville Beach, respectively. Coastal communities from the City of Wilmington to the Town of Nags Head suffered heavy structural damage and considerable beach erosion. Eight deaths and approximately 100 injuries were attributed to the storm. Damages were estimated at millions of dollars.

**G. <u>August 16 to 19, 1991 – Hurricane Bob</u>**

Dare County experienced minimal damage as a result of Hurricane Bob. Damage was concentrated in the villages on Hatteras Island. Typical damages included shingles blown off roofs, screen porches torn and blown out, water damage from leaking roofs, windows broken, holes in the roof from falling debris, minor flooding in garages and outbuildings, siding blown off or damaged, and commercial signs, canopies, fencing were blown down. Extensive damage was done to trees in random areas as a result of tornados and other high winds. Estimates obtained from Tax Administrator are as follows:

| | |
|---|---|
| Housing structural losses | $3,305.000.00 |
| Business structural losses | $4,446,560.00 |
| | |
| Total structural losses | $7,273,800.00 |

**H. <u>August 26 to 31, 1993 – Hurricane Emily</u>**

The first major hurricane of the 1993 season formed on August 22nd about 600 miles east-northeast of the Leeward Islands. It became a tropical storm on August 26th and strengthened to a hurricane the same day. Following a course that varied between west-northwest, Emily would eventually bring the western part of its eye wall over the Outer Banks. The National Hurricane Center upgraded Emily to a Category 3 hurricane. Hurricane Emily established a new benchmark for sound side flooding on Hatteras Island. Severe flooding occurred from Avon south to Hatteras Village, a distance of 17 miles. Sound water levels 10 ½ feet above normal were observed just north of Buxton and flooding exceeded that of Hurricane Gloria in 1985. In the villages of Frisco and Hatteras, water levels of 8 ½ feet above normal exceeded levels from storms dating back to 1899.
Storm surge on the ocean side was moderate. Hurricane force winds (e.g., 90 – 107 mph), strongest from the north then backing to the northwest, were experienced for an hour and a half as the eastern eye wall moved slowly north.

Estimates indicated that 160 homes were destroyed, 216 experienced major damage, and 144 received minor damage. Manufactured homes were particularly impacted by the hurricane. Approximately 85 percent of the destroyed homes were manufactured homes ravaged by the high winds and/or shifted off their piers by the storm surge. Older houses on Hatteras, those built before the elevation requirements of the NFIP, were also severely affected.

The damage assessment officer's estimate on file notes structural damage of $10,891,794.

**I. <u>November 1994 – Hurricane Gordon</u>**

Hurricane Gordon was a major weather factor along the North Carolina coast. The storm remained offshore, but caused significant flooding and strong winds all along the central and northern Carolina coast. The flooding began on Hatteras Island, with about 12 inches of over wash. Route 12 was closed due to over wash and debris. Wind measuring equipment recorded wind gusts of up to 75 miles per hour. Water overflowed the sandbags on Pea Island. By the morning of November 18th, Frisco Pier to Hatteras Village was less than 2.5 feet of over wash. Significant beach erosion occurred because of the length of time Gordon was in the area. Wrightsville Beach was particularly hard hit. Several beachfront cottages in Kitty Hawk sustained major damage or were completely destroyed. Damages in Dare County as a result of Gordon were minimal. Housing and business estimates indicate structural and flood damage was limited to the Town of Kitty Hawk and the Village of Rodanthe on Hatteras Island. Estimated costs of damages countywide were approximately $314,000.

**J. <u>August 16-1995 – Hurricane Felix</u>**

Damages in Dare County as a result of Hurricane Felix were minimal. Housing and business estimates indicate structural and flood damage resulted from ocean tides and over wash. Property damage was limited to Towns of Kitty Hawk, Kill Devil Hills and Nags Head and to the village of Rodanthe on Hatteras Island. Estimated costs of damages were approximately $93,000 to 25 residences and 6 businesses.

**K. <u>July 5 to 12, 1996 – Hurricane Bertha</u>**

Hurricane Bertha formed on July 5, 1996. As a Category One hurricane, Bertha moved across the northeastern Caribbean. The storm's highest sustained winds received 115-mph north of Puerto Rico. Bertha made landfall near Wilmington on July 12 as a Category Two hurricane, with estimated winds of 105 mph. Bertha claimed two lives in North Carolina and did substantial damage to agriculture crops and forestland. Storm surge flooding and beach erosion were severe along the coast. Damages throughout the state were estimated to exceed $60 million for homes and structures, and over $150 million in agriculture. Corn, tobacco, and other crops received server damage from the storm. Rainfall totals of over 5 inches were common in eastern North Carolina.

Dare County experienced minimal damage during this hurricane. Housing and business estimates indicated the majority of damage was from downed trees, wind and minor sound side flooding. The only areas with initial damage totaling over $5,000 are the village of Hatteras, on Hatteras Island; Wanchese, and the town of Nags Head. Other areas have minor damage to residences primarily due to loss of shingles, damage to decks, and damage due to

fallen trees. Very little flood damage to structures is apparent, however there was standing water of up to one foot in many sound side areas of the county, and on some secondary roads in those areas.

A total of four businesses located in Hatteras, Nags Head, and Wanchese sustained damage due to wind, fire (as a result of electrical problems), and possible water damage from exposed areas.

The initial estimated dollar loss to structures as a result of Hurricane Bertha is as follows:

**DAMAGE ESTIMATE COUNTYWIDE:**

| Numerous Residences | 4 Businesses |
|---|---|
| $25,000 | $24,000 |

**TOTAL INITIAL PROPERT Y DAMAGE ESTIMATE: $50,000**

**L. <u>August 19 to 30, 1998 – Hurricane Bonnie</u>**

Hurricane Bonnie originated as a tropical wave over Africa. It slowly increased speed and made its way across the Atlantic, near the Leeward Islands and then Hispania. It made landfall near Wilmington as a border Category 2/3 hurricane with approximately 115 mph winds and a diameter of 400 miles on August 27, 1998. Rainfall totals between 8 – 11 inches were recorded in portions of eastern North Carolina.

The property damages resulting from Hurricane Bonnie's journey through Dare County were primarily due to sound side flooding. Almost every one of the county's 22 districts had some flooding on roads. Downed trees and tree limbs were also reported throughout some districts, resulting in debris removal costs for the municipalities and the county, and a small number of the property damage incidents. In flood-prone areas, water levels rose just below first floor living areas on numerous properties.

The storm slowly moved off land on August 28, 1998. In its wake, the total damage was estimated in the $1 million range. There was an estimated $360 million in insured property damage, including $240 million in North Carolina alone. The insured losses do not include flooding and agricultural damages, which were due to the vast amount of rain and high winds. There were trees down, roofs torn off, structural damage, and widespread power outages. North Carolina Governor Jim Hunt asked that the areas be declared natural disaster areas. One 12-year-old girl died in Dare County as a result of a large tree falling on her home.

Preliminary estimates put countywide property damages at $1,349,500, and debris removal estimates* from the municipalities at $65,450. The majority of the property damage was noted as minor damage. Appraisers observed damage at 136 residences, including mobile homes; 46 businesses; and 5 government or public buildings. These estimates include secondary structure damage to docks, piers, and some bulk heading. The residential damages in Avon occurred as a result of sound side flooding in Avon Village, and the business damage there includes some wind-related destruction of canopies and windows. Structural damage at one condominium in Rodanthe was possibly the result of a tornado. The following table provides a breakdown of information by area for the counts unincorporated districts, and by municipalities:

**Table 10. Hurricane Bonnie damage estimates for all of Dare County**

| District or Area | Residences | Damage Estimate | Businesses | Damage Estimate | Gov't-Public | Damage Estimate | Debris Removal | Totals |
|---|---|---|---|---|---|---|---|---|
| Kitty Hawk | 0 | 0 | 0 | 0 | 0 | 0 | 7,500 | 7,500 |
| Kill Devil Hills | 2 | 5,500 | 2 | 15,500 | 0 | 0 | 0 | 21,000 |
| Southern Shores | 5 | 5,000 | 0 | 0 | 0 | 0 | 18,400 | 23,400 |
| Manteo | 2 | 5,000 | 22 | 46,000 | 2 | 11,000 | 20,000 | 82,000 |
| Nags Head | 44 | 310,000 | 9 | 170,000 | 2 | 5,000 | 20,000 | 505,000 |
| Mainland | 13 | 106,000 | 2 | 13,000 | 0 | 0 | * | 119,000 |
| Roanoke Island | 5 | 14,000 | 0 | 0 | 0 | 0 | * | 14,000 |
| Northern Beaches | 33 | 69,000 | 1 | 10,000 | 0 | 0 | * | 79,000 |
| Hatteras Island | 32 | 181,000 | 10 | 183,500 | 1 | 200,000 | * | 564,000 |
| **Totals** | **136** | **$695,500** | **46** | **$438,000** | **5** | **$216,000** | **$65,450** | **$1,414,950** |

***** Debris removal estimates for unincorporated areas are not included in this report.

Note: Mainland includes the districts of East Lake, Manns Harbor, Stumpy Point, and Mashoes. Northern beaches includes Colington, Kill Devil Hills outside, Duck, and Martins Point. Hatteras Island includes Rodanthe, Waves, Salvo, Avon, Buxton, Frisco and Hatteras.

**M. <u>August 24 to September 7, 1999 – Hurricane/Tropical Storm Dennis</u>**

Hurricane Dennis developed over the eastern Bahamas on August 26, 1999 and drifted parallel to the southeastern United States for the 25th to the 30th. The center of Dennis approached to within 60 miles off the Carolina coastline on August 30th as a strong Category 2 hurricane. Although, the storm never made landfall, rainfall amounts approached 10 inches in coastal southeastern North Carolina and beach erosion was substantial. Dennis made a return to Dare County on September 4, 1999 as a tropical storm, moving west-northwest through eastern and central North Carolina then lingering off the coast for several days.

Additional property damage as a result of this pass was relatively minor. Flooding of roads from heavy rains was widespread. The flooding resulted in $418,500 in water damage to ground floor enclosures, particularly in Duck and Colington, where 89 homes had minor damage and 9 had major damage. Most of the damage from Hurricane Dennis was a result of ocean over wash, erosion and wind. The rainfall of Hurricane Dennis saturated the ground and raised the water table. As a result, when Hurricane Floyd hit North Carolina, its impact was intensified.

Total estimated property damage from Tropical Storm and Hurricane Dennis was $12 million. This figure did not include costs for dune loss or debris removal.

**N. <u>September 7 to 18, 1999 – Hurricane Floyd</u>**

Hurricane Floyd brought flooding rains, high winds, and rough seas to a good portion of the United States coastline from September 14th through the 18th. Although Hurricane Floyd reached Category 4 intensity in the Bahamas, it weakened to a Category 2 hurricane by the time it made landfall in North Carolina. Due to Floyd's large size, heavy rainfall covered a large area and lasted longer than a tropical Category 2 storm. Flooding caused major problems across the region resulting in at least 77 deaths and damages estimated in the billions. In North Carolina alone, 7,000 homes were uninhabitable, and 56,000 homes were damaged. In Dare County most of the damage was a result of sound side flooding, and downed trees due to high winds. Sound side flooding occurred several hours after the period of hurricane force winds. The area hardest hit were the Mainland, particularly Stumpy Point and Manns Harbor; Roanoke Island and the areas north or Oregon Inlet. Unlike Hurricane Dennis, which primarily affected oceanfront and Oceanside properties, Floyd's impact was in the sound side areas. Initial dollar estimates of damage total $4,000,000 in property damage. At least 17 structures were uninhabitable or have been destroyed, 39 having major damage and roughly 950 with minor damage.

**O. <u>October 13 to 18, 1999 – Hurricane Irene</u>**

Hurricane Irene formed from a broad area of low pressure in the southwest Caribbean on October 13th. It became a tropical storm on the same day and moved northward across western Cuba on the 14th with 70 mph winds. It became a 75-mph hurricane on the 15ht and moved northeastward across south Florida. Irene dumped 10 to 20 inches of rain along its path resulting in a considerable freshwater flooding. The damage assessment surveys for Hurricane Irene reported were no structural losses; there was standing water on many roads as a result of rain and in isolated areas from sound side flooding.

**P. <u>September 18, 2003 – Hurricane Isabel</u>**

Hurricane Isabel was the costliest and deadliest hurricane of the 2003 Atlantic Hurricane season. Isabel formed from a tropical wave on September 6 in the tropical Atlantic Ocean and moved northwestward steadily gaining strength reaching peak winds of 165 MPH on September 11. After fluctuating in intensity for four days, Isabel gradually weakened and made landfall on the Outer Banks of North Carolina with winds of 105 MPH on September 18. In North Carolina, the storm surge from Isabel washed out a portion of Hatteras Island to form what was unofficially known as Isabel Inlet. Damage was greatest along the Outer Banks, where thousands of homes were destroyed or damaged with a total damage estimate of $450M in Dare County.

**Q. <u>August 4, 2004 – Hurricane Alex</u>**

Hurricane Alex was the first storm of the 2004 hurricane season. The hurricane reached Category 2 intensity as it tracked between just offshore from Cape Lookout and Cape Hatteras, North Carolina. Alex reached hurricane intensity at 0200 a.m. on Tuesday, August 3, while centered about 75 miles south-southeast of Wilmington, NC. The hurricane quickly intensified Tuesday with the center of the storm remaining just offshore. The western fringe of the eye wall skirted the Outer Banks from Cape Lookout to Cape Hatteras. Peak wind gusts of 102 MPH were observed at Hatteras Village.

**R. <u>September 14, 2005 – Hurricane Ophelia</u>**

Hurricane Ophelia was the fifteenth named tropical cyclone and the eighth hurricane of the 2005 Atlantic hurricane season. It was a long lived storm that was most remembered for its very erratic and extremely slow track off the East Coast of the United States, alternating between tropical storm and hurricane intensity. Ophelia caused some damage and beach erosion along the United States coastline from Florida to North Carolina with its closest approach occurring on September 14/15 with its western eye wall crossing land and the eye remaining just offshore as a Category 1. Damage was heaviest in Salter Path, NC and along the Outer Banks near that community where many buildings suffered significant damage as a result of the storm surge which was described as worse than Hurricane Isabel in 2003.

***Other Technical Resources***

Dare County uses the latest damage assessment loss estimation models (Hazus-MH) developed by the Federal Emergency Management Agency and the National Institute of building Sciences to project damage potential from hurricanes that could affect the area. The primary purpose of Hazus-MH is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery. Examples from Gloria, Floyd and Isabel are provided.

Dare County also utilizes the post landfall models provided by the Army Corp of Engineers during an actual hurricane threat to determine projected outcomes for needs in the area of commodities, debris totals, housing needs and affected areas.

**Table 11. Twentieth century storm events, and cost.**

| Storm Data | Storm Name | Property Damage / Cost |
|---|---|---|
| 1962 | Ash Wednesday Storm | |
| August 1986 | Hurricane Charlie | 250,000 |
| March 1989 | Nor'Easter | 600,000 |
| August 1991 | Hurricane Bob | 1 Million |
| October 1991 | Halloween Storm | 7.5 Million |
| March 1993 | Storm of the Century | 5 Million |
| August 1993 | Hurricane Emily | 15 Million |
| November 1994 | Hurricane Gordon | 0.5 Million |
| August 1995 | Hurricane Felix | 100,000 |
| July 1996 | Hurricane Bertha | 100,000 |
| August 1996 | Hurricane Eduardo | 0 |
| September 1996 | Hurricane Fran | 0 |
| August 1998 | Hurricane Bonnie | 1.5 Million |
| September 1999 | Hurricane Dennis | 12 Million |
| September 1999 | Hurricane Floyd | 4 Million |
| October 1999 | Hurricane Irene | 0 |
| September 2003 | Hurricane Isabel | 400 Million |
| August 2004 | Hurricane Alex | 2.4 Million |
| September 2005 | Hurricane Ophelia | 20,000 |

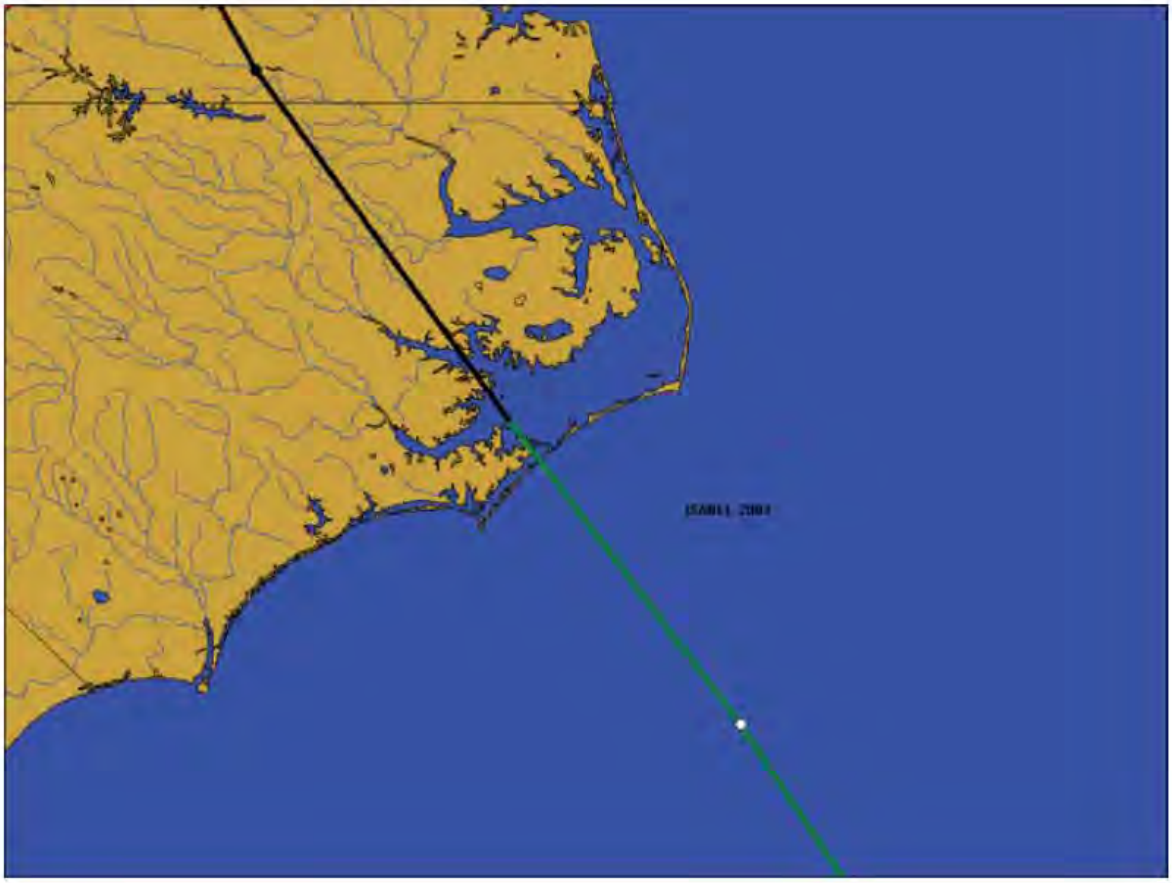
Dare County is well aware of the risks that hurricanes present to the population and overall economic stability of the area. Dare County has invested in a full-time Emergency Management Director to prepare for and respond to all weather emergencies with particular interest in hurricane warnings. Dare County was one of the first counties in the state to acquire the National Weather Service "Storm Ready" designation and continues to review and update hurricane plans and procedures in conjunction with state and Federal agencies.

# HAZUS-MH: Hurricane Event Report

**Region Name:** Hurricane Isabell

**Hurricane Scenario:** ISABEL_2003_stm_1505PM

**Print Date:** Friday, January 16, 2009



*Disclaimer:*
*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.*

## General Description of the Region

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

– North Carolina

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 386.60 square miles and contains 6 census tracts. There are over 12 thousand households in the region and has a total population of 29,967 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 25 thousand buildings in the region with a total building replacement value (excluding contents) of 3,523 million dollars (2002 dollars). Approximately 98% of the buildings (and 81% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 25,123 buildings in the region which have an aggregate total replacement value of 3,523 million (2002 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

**Table 1: Building Exposure by Occupancy Type**

| Occupancy | Exposure ($1000) | Percent of Tot |
|---|---|---|
| Residential | 2,859,419 | 81.2% |
| Commercial | 492,947 | 14.0 |
| Industrial | 82,253 | 2.3% |
| Agricultural | 8,647 | 0.2% |
| Religious | 40,100 | 1.1% |
| Government | 26,306 | 0.7% |
| Education | 13,007 | 0.4% |
| Total | 3,522,679 | 100.0% |

### Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 10 schools, 17 fire stations, 9 police stations and 1 emergency operation facilities.

## Hurricane Scenario

HAZUS used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

**Scenario Name: ISABEL_2003_stm_1505PM**
**Type:** Forcast/Advisory
**Maximum Peak Gust in Study Region:** mph

### User Defined Storm Track Input Data

| Point | Latitude | Longitude | Time Step (hour) | Transla-tion Speed (mph) | Radius to Max Wind Speeds (miles) | Max. Sustained Wind Speed (miles) | Central Pressure (mBar) | Profile Parameter | Radius to Hurricane Force Winds (miles) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 14.00 | -34.00 | 0.00 | -- | -- | 40.00 | 1,005.00 | | 0.00 |
| 2 | 13.60 | -34.50 | 2.00 | -- | -- | 40.00 | 1,005.00 | | 0.00 |
| 3 | 13.40 | -35.40 | 8.00 | -- | -- | 46.58 | 1,000 | | 0.00 |
| 4 | 13.40 | -36.10 | 41.00 | -- | -- | 51.72 | 997.00 | | 0.00 |
| 5 | 13.70 | -37.10 | 20.00 | -- | -- | 56.93 | 994.00 | | 0.00 |
| 6 | 14.50 | -37.70 | 26.00 | -- | -- | 67.28 | 987.00 | | 0.00 |
| 7 | 15.20 | -39.10 | 32.00 | -- | -- | 72.45 | 984.00 | | 0.00 |
| 8 | 16.10 | -40.20 | 38.00 | -- | -- | 82.80 | 979.00 | | 21.56 |
| 9 | 16.90 | -41.40 | 44.00 | -- | -- | 93.15 | 970.00 | | 26.18 |
| 10 | 17.20 | -42.60 | 50.00 | -- | -- | 103.50 | 962.00 | | 26.18 |
| 11 | 17.90 | -43.70 | 56.00 | -- | -- | 113.85 | 952.00 | | 26.18 |
| 12 | 18.50 | -44.50 | 62.00 | -- | -- | 119.03 | 948.00 | | 26.18 |
| 13 | 19.10 | -45.70 | 68.00 | -- | -- | 119.03 | 948.00 | | 35.42 |
| 14 | 19.60 | -46.90 | 74.00 | -- | -- | 119.03 | 948.00 | | 35.42 |
| 15 | 20.30 | -47.80 | 80.00 | -- | -- | 119.03 | 948.00 | | 35.42 |
| 16 | 20.60 | -48.80 | 86.00 | -- | -- | 119.03 | 948.00 | | 35.42 |
| 17 | 20.90 | -50.20 | 92.00 | -- | -- | 119.03 | 948.00 | | 35.42 |
| 18 | 21.30 | -50.90 | 98.00 | -- | -- | 119.03 | 948.00 | | 43.89 |
| 19 | 21.20 | -51.90 | 104.00 | -- | -- | 124.20 | 942.00 | | 43.89 |
| 20 | 21.10 | -52.80 | 110.00 | -- | -- | 129.38 | 935.00 | | 43.89 |
| 21 | 21.30 | -53.70 | 116.00 | -- | -- | 129.38 | 936.00 | | 43.89 |
| 22 | 21.40 | -54.50 | 122.00 | -- | -- | 134.55 | 930.00 | | 43.89 |
| 23 | 21.60 | -55.30 | 128.00 | -- | -- | 144.90 | 921.00 | | 43.89 |
| 24 | 21.60 | -56.10 | 134.00 | -- | -- | 144.90 | 924.00 | | 43.89 |
| 25 | 21.70 | -57.00 | 140.00 | -- | -- | 144.90 | 921.00 | | 43.89 |
| 26 | 21.60 | -57.80 | 146.00 | -- | -- | 144.90 | 924.00 | | 53.13 |
| 27 | 21.80 | -58.60 | 152.00 | -- | -- | 144.90 | 920.00 | | 66.22 |
| 28 | 21.80 | -59.50 | 158.00 | -- | -- | 144.90 | 923.00 | | 66.22 |
| 29 | 22.00 | -60.40 | 164.00 | -- | -- | 134.55 | 935.00 | | 66.22 |
| 30 | 22.20 | -61.50 | 170.00 | -- | -- | 134.55 | 935.00 | | 66.22 |
| 31 | 22.60 | -62.60 | 176.00 | -- | -- | 144.90 | 932.00 | | 70.84 |
| 32 | 23.00 | -63.70 | 182.00 | -- | -- | 144.90 | 932.00 | | 66.22 |
| 33 | 23.30 | -65.20 | 188.00 | -- | -- | 144.90 | 938.00 | | 66.22 |

| Point | Latitude | Longitude | Time Step (hour) | Transla-tion Speed (mph) | Radius to Max Wind Speeds (miles) | Max. Sustained Wind Speed (miles) | Central Pressure (mBar) | Profile Parameter | Radius to Hurricane Force Winds (miles) |
|---|---|---|---|---|---|---|---|---|---|
| 34 | 23.70 | -66.30 | 194.00 | -- | -- | 139.73 | 939.00 | | 66.22 |
| 35 | 24.10 | -67.40 | 200.00 | -- | -- | 139.73 | 933.00 | | 74.69 |
| 36 | 24.50 | -68.30 | 206.00 | -- | -- | 139.73 | 933.00 | | 88.55 |
| 37 | 24.80 | -69.00 | 212.00 | -- | -- | 134.55 | 940.00 | | 88.55 |
| 38 | 25.20 | -69.40 | 218.00 | -- | -- | 124.20 | 945.50 | | 88.55 |
| 39 | 25.60 | -70.00 | 224.00 | -- | -- | 113.85 | 949.00 | | 79.31 |
| 40 | 26.10 | -70.20 | 230.00 | -- | -- | 108.68 | 949.00 | | 79.31 |
| 41 | 26.60 | -70.70 | 236.00 | -- | -- | 103.50 | 956.00 | | 92.40 |
| 42 | 27.40 | -71.20 | 242.00 | -- | -- | 93.15 | 959.00 | | 92.40 |
| 43 | 27.50 | -71.30 | 245.00 | -- | -- | 94.18 | 959.00 | | 92.40 |
| 44 | 27.80 | -71.40 | 248.00 | -- | -- | 93.15 | 959.00 | | 123.97 |
| 45 | 28.20 | -71.50 | 251.00 | -- | -- | 94.18 | 956.00 | | 123.97 |
| 46 | 28.50 | -71.70 | 254.00 | -- | -- | 98.33 | 957.00 | | 110.11 |
| 47 | 29.00 | -72.00 | 257.00 | -- | -- | 99.36 | 957.00 | | 110.11 |
| 48 | 29.40 | -72.20 | 260.00 | -- | -- | 98.33 | 958.00 | | 110.11 |
| 49 | 29.70 | 72.40 | 263.00 | -- | -- | 99.36 | 957.00 | | 110.11 |
| 50 | 30.00 | -72.60 | 266.00 | -- | -- | 98.33 | 957.00 | | 88.55 |
| 51 | 30.60 | -73.00 | 269.00 | -- | -- | 94.18 | 956.00 | | 88.55 |
| 52 | 31.10 | -73.30 | 272.00 | -- | -- | 93.15 | 955.00 | | 88.55 |
| 53 | 31.50 | -73.60 | 275.00 | -- | -- | 94.18 | 955.00 | | 88.55 |
| 54 | 31.90 | -73.90 | 278.00 | -- | -- | 93.15 | 956.00 | | 88.55 |
| 55 | 32.500 | -74.30 | 281.00 | -- | -- | 94.18 | 957.00 | | 88.55 |
| 56 | 33.10 | -74.70 | 284.00 | -- | -- | 93.15 | 957.00 | | 88.55 |
| 57 | 33.70 | -75.20 | 287.00 | -- | -- | 90.04 | 957.00 | | 88.55 |
| 58 | 34.40 | -75.70 | 290.00 | -- | -- | 87.98 | 956.00 | | 88.55 |
| 59 | 34.90 | -76.10 | 292.00 | -- | -- | 90.04 | 957.00 | | 88.55 |
| 60 | 35.40 | -76.60 | 294.00 | -- | -- | 85.91 | 959.00 | | 88.55 |
| 61 | 36.20 | -77.10 | 296.00 | -- | -- | 82.80 | 960.00 | | 74.69 |
| 62 | 36.60 | -77.50 | 298.00 | -- | -- | 72.45 | 965.00 | | 0.00 |
| 63 | 37.00 | -77.90 | 300.00 | -- | -- | 63.14 | 968.00 | | 0.00 |
| 64 | 37.70 | -78.00 | 302.00 | -- | -- | 56.93 | 972.00 | | 0.00 |
| 65 | 38.30 | 78.40 | 305.00 | -- | -- | 53.82 | 978.00 | | 0.00 |
| 66 | 39.20 | -78.70 | 308.00 | -- | -- | 46.58 | 987.00 | | 0.00 |
| 67 | 40.30 | -79.50 | 311.00 | -- | -- | 40.00 | 996.00 | | 0.00 |

## Building Damage

### General Building Stock Damage

HAZUS estimates that there are 25,123 buildings in the region which have an aggregate total replacement value of 3,523 million (2002 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

**Table 2: Expected Building Damage by Occupancy**

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Occupancy | Count | % | Count | % | Count | % | Count | % | Count | % |
| Agriculture | 6 | 91.78 | 0 | 6.40 | 0 | 1.29 | 0 | 0.50 | 0 | 0.03 |
| Commercial | 323 | 92.21 | 22 | 6.31 | 5 | 1.40 | 0 | 0.08 | 0 | 0.00 |
| Education | 7 | 93.05 | 0 | 6.10 | 0 | 0.82 | 0 | 0.03 | 0 | 0.00 |
| Government | 28 | 92.64 | 2 | 6.37 | 0 | 0.94 | 0 | 0.04 | 0 | 0.00 |
| Industrial | 50 | 92.99 | 3 | 5.91 | 1 | 0.94 | 0 | 0.15 | 0 | 0.01 |
| Religion | 23 | 93.28 | 2 | 6.08 | 0 | 0.62 | 0 | 0.02 | 0 | 0.00 |
| Residential | 22,401 | 90.88 | 2,068 | 8.39 | 176 | 0.71 | 3 | 0.01 | 2 | 0.01 |
| Total | 22,838 | | 2,097 | | 182 | | 3 | | 0 | |

**Table 3: Expected Building Damage by Building Type**

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Building Type | Count | % | Count | % | Count | % | Count | % | Count | % |
| Concrete | 54 | 90.74 | 5 | 7.74 | 1 | 1.50 | 0 | 0.02 | 0 | 0.00 |
| Masonry | 1,836 | 91.14 | 146 | 7.23 | 32 | 1.57 | 1 | 0.05 | 0 | 0.00 |
| MH | 2,098 | 98.63 | 22 | 1.04 | 6 | 0.27 | 0 | 0.00 | 1 | 0.06 |
| Steel | 219 | 92.13 | 15 | 6.17 | 4 | 1.60 | 0 | 0.010 | 0 | 0.00 |
| Wood | 18,733 | 90.61 | 1,814 | 8.78 | 122 | 0.59 | 3 | 0.01 | 2 | 0.01 |

### Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

**Table 4: Expected Damage to Essential Facilities**

| Classification | Total | Probability of at Least Moderate Damage > 50% | Probability of Complete Damage > 50% | Expected Loss of Use < 1 Day |
|---|---|---|---|---|
| EOCs | 1 | 0 | 0 | 0 |
| Fire Stations | 17 | 0 | 0 | 8 |
| Hospitals | 1 | 0 | 0 | 0 |
| Police Stations | 9 | 0 | 0 | 6 |
| Schools | 10 | 0 | 0 | 5 |

## Induced Hurricane Damage

### Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into three general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, and c) Trees. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 194,993 tons of debris will be generated. Of the total amount, Brick/Wood comprises 3% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 206 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 12 households to be displaced due to the hurricane. Of these, 2 people (out of a total population of 29,967) will seek temporary shelter in public shelters.

### Economic Loss

The total economic loss estimated for the hurricane is 26.0 million dollars, which represents 0.74 % of the total replacement value of the region's buildings.

### Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 26 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 89% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

**Table 5: Building-Related Economic Loss Estimates**
(Thousands of dollars)

| Category | Area | Residential | Commercial | Industrial | Others | Total |
|---|---|---|---|---|---|---|
| Property Damage | | | | | | |
| | Building | 20,229.93 | 1,141.14 | 144.70 | 125.14 | 21,640.91 |
| | Content | 805.22 | 267.19 | 76.04 | 28.32 | 1,176.77 |
| | Inventory | 0.00 | 8.05 | 18.29 | 1.52 | 27.87 |
| | Subtotal | 21,035.15 | 1,416.38 | 239.03 | 154.99 | 22,845.54 |
| | Income | 0.00 | 309.71 | 2.29 | 5.13 | 317.12 |
| | Relocation | 1,104.63 | 256.87 | 12.91 | 22.13 | 1,396.54 |
| | Rental | 939.46 | 138.58 | 1.68 | 2.30 | 1,082.03 |
| | Wage | 0.00 | 201.92 | 3.81 | 180.50 | 314.22 |
| | Subtotal | 2,044.09 | 907.08 | 20.69 | 138.06 | 3,109.92 |
| | Total | 23,079.24 | 2,323.45 | 259.73 | 293.04 | 25,955.46 |

## Appendix A: County Listing for the Region

North Carolina
- Dare

## Appendix B: Regional Population and Building Value Data

**Building Value (thousands of dollars)**

| | Population | Residential | Non-Residential | Total |
|---|---|---|---|---|
| North Carolina | | | | |
| Dare | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Study Region Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |

# HAZUS-MH: Hurricane Event Report

**Region Name** Hurricane Floyd

**Hurricane Scenario:** FLOYD_1999_stm_1322PM

**Print Date:** Friday, January 16, 2009

*Disclaimer:*
*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.*

## General Description of the Region

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- North Carolina

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 386.60 square miles and contains 6 census tracts. There are over 12 thousand households in the region and has a total population of 29,967 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 25 thousand buildings in the region with a total building replacement value (excluding contents) of 3,523 million dollars (2002 dollars). Approximately 98% of the buildings (and 81% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 25,123 buildings in the region which have an aggregate total replacement value of 3,523 million (2002 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

**Table 1: Building Exposure by Occupancy Type**

| Occupancy | Exposure ($1000) | Percent of Tot |
|---|---|---|
| Residential | 2,859,419 | 81.2% |
| Commercial | 492,947 | 14.0 |
| Industrial | 82,253 | 2.3% |
| Agricultural | 8,647 | 0.2% |
| Religious | 40,100 | 1.1% |
| Government | 26,306 | 0.7% |
| Education | 13,007 | 0.4% |
| Total | 3,522,679 | 100.0% |

### Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 10 schools, 17 fire stations, 9 police stations and 1 emergency operation facilities.

## Hurricane Scenario

HAZUS used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

**Scenario Name:** FLOYD_1999_stm_1322PM
**Type:** Forcast/Advisory
**Maximum Peak Gust in Study Region:** mph

### User Defined Storm Track Input Data

| Point | Latitude | Longitude | Time Step (hour) | Transla-tion Speed (mph) | Radius to Max Wind Speeds (miles) | Max. Sustained Wind Speed (miles) | Central Pressure (mBar) | Profile Parameter | Radius to Hurricane Force Winds (miles) |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 15.60 | -49.10 | 12.00 | -- | -- | 40.00 | 1,005.00 | -- | 0.00 |
| 4 | 15.80 | -50.00 | 18.00 | -- | -- | 41.40 | 1,003.00 | -- | 0.00 |
| 5 | 16.60 | -51.70 | 24.00 | -- | -- | 46.58 | 1,000.00 | -- | 0.00 |
| 6 | 16.70 | -53.60 | 30.00 | -- | -- | 51.75 | 1,000.00 | -- | 0.00 |
| 7 | 17.30 | -54.60 | 36.00 | -- | -- | 51.75 | 1,003.00 | -- | 0.00 |
| 8 | 17.20 | -55.50 | 42.00 | -- | -- | 51.75 | 1,003.00 | -- | 0.00 |
| 9 | 18.20 | -56.90 | 48.00 | -- | -- | 62.10 | 996.00 | -- | 0.00 |
| 10 | 18.30 | -57.70 | 54.00 | -- | -- | 62.10 | 995.00 | -- | 0.00 |
| 11 | 18.90 | -58.70 | 60.00 | -- | -- | 62.10 | 985.00 | -- | 0.00 |
| 12 | 19.30 | -59.20 | 66.00 | -- | -- | 72.45 | 989.00 | -- | 0.00 |
| 13 | 20.20 | -60.00 | 72.00 | -- | -- | 72.45 | 975.00 | -- | 0.00 |
| 14 | 21.10 | -60.80 | 78.00 | -- | -- | 82.80 | 971.00 | -- | 53.13 |
| 15 | 21.70 | -61.60 | 84.00 | -- | -- | 93.15 | 963.00 | -- | 56.98 |
| 16 | 22.20 | -62.40 | 90.00 | -- | -- | 98.33 | 962.00 | -- | 56.98 |
| 17 | 22.70 | -63.50 | 96.00 | -- | -- | 98.33 | 966.00 | -- | 79.31 |
| 18 | 22.70 | -64.50 | 102.00 | -- | -- | 98.33 | 967.00 | -- | 79.31 |
| 19 | 22.80 | -65.90 | 108.00 | -- | --- | 98.33 | 960.00 | -- | 66.22 |
| 20 | 23.00 | -66.60 | 114.00 | -- | -- | 108.68 | 955.00 | -- | 88.55 |
| 21 | 23.40 | -68.20 | 120.00 | -- | -- | 113.85 | 940.00 | -- | 88.55 |
| 22 | 23.60 | -69.30 | 126.00 | -- | -- | 129.38 | 931.00 | -- | 79.31 |
| 23 | 23.70 | -70.60 | 132.00 | -- | -- | 139.73 | 922.00 | -- | 79.31 |
| 24 | 24.10 | -72.10 | 138.00 | -- | -- | 139.73 | 921.00 | -- | 79.31 |
| 25 | 24.20 | -73.70 | 144.00 | -- | -- | 139.73 | 923.00 | -- | 97.02 |
| 26 | 24.50 | -74.70 | 150.00 | -- | -- | 139.73 | 924.00 | -- | 97.02 |
| 27 | 25.10 | -75.90 | 156.00 | -- | -- | 139.73 | 927.00 | -- | 97.02 |
| 28 | 25.70 | -76.80 | 162.00 | -- | -- | 129.38 | 932.00 | -- | 97.02 |
| 29 | 26.50 | -77.40 | 168.00 | -- | -- | 124.20 | 929.00 | -- | 97.02 |
| 30 | 27.70 | -77.90 | 174.00 | -- | -- | 124.20 | 933.00 | -- | 97.02 |
| 31 | 28.80 | -78.80 | 180.00 | -- | -- | 124.20 | 938.00 | -- | 97.02 |
| 32 | 29.90 | -79.00 | 186.00 | -- | -- | 113.85 | 943.00 | -- | 106.26 |

| Point | Latitude | Longitude | Time Step (hour) | Translation Speed (mph) | Radius to Max Wind Speeds (miles) | Max. Sustained Wind Speed (miles) | Central Pressure (mBar) | Profile Parameter | Radius to Hurricane Force Winds (miles) |
|---|---|---|---|---|---|---|---|---|---|
| 33 | 31.30 | -79.00 | 192.00 | -- | -- | 103.50 | 949.00 | -- | 106.26 |
| 34 | 32.90 | -78.30 | 198.00 | -- | -- | 103.50 | 952.00 | -- | 88.55 |
| 35 | 34.50 | -77.60 | 204.00 | -- | -- | 103.50 | 956.00 | -- | 88.55 |
| 36 | 36.80 | -76.00 | 210.00 | -- | -- | 83.32 | 967.00 | -- | 0.00 |
| 37 | 39.30 | -74.60 | 216.00 | -- | -- | 65.46 | 974.00 | -- | 0.00 |
| 38 | 41.70 | -72.20 | 222.00 | -- | -- | 59.51 | 980.00 | -- | 0.00 |
| 39 | 43.50 | -70.80 | 228.00 | -- | -- | 59.51 | 984.00 | -- | 0.00 |
| 40 | 46.00 | -67.00 | 237.00 | -- | -- | 59.51 | 984.00 | -- | 0.00 |
| 41 | 48.50 | -61.50 | 249.00 | -- | -- | 51.75 | 984.00 | -- | 0.00 |
| 42 | 50.00 | -51.00 | 261.00 | -- | -- | 51.75 | 984.00 | -- | 0.00 |
| 43 | 50.00 | -43.50 | 273.00 | -- | -- | 51.75 | 984.00 | -- | 0.00 |
| 44 | 49.00 | -31.00 | 297.00 | -- | -- | 51.75 | 984.00 | -- | 0.00 |

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 73 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

**Table 2: Expected Building Damage by Occupancy**

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Occupancy | Count | % | Count | % | Count | % | Count | % | Count | % |
| Agriculture | 7 | 95.44 | 0 | 3.75 | 0 | 0.59 | 0 | 0.21 | 0 | 0.01 |
| Commercial | 336 | 95.88 | 12 | 3.53 | 2 | 0.57 | 0 | 0.02 | 0 | 0.00 |
| Education | 7 | 96.73 | 0 | 3.09 | 0 | 0.18 | 0 | 0.00 | 0 | 0.00 |
| Government | 29 | 96.66 | 1 | 3.16 | 0 | 0.19 | 0 | 0.00 | 0 | 0.00 |
| Industrial | 52 | 96.27 | 2 | 3.40 | 0 | 0.28 | 0 | 0.04 | 0 | 0.00 |
| Religion | 24 | 96.44 | 1 | 3.38 | 0 | 0.18 | 0 | 0.00 | 0 | 0.00 |
| Residential | 23,432 | 95.06 | 1,147 | 4.65 | 69 | 0.28 | 1 | 0.00 | 0 | 0.00 |
| Total | 23,886 | | 1,164 | | 72 | | 1 | | 0 | |

**Table 3: Expected Building Damage by Building Type**

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Building Type | Count | % | Count | % | Count | % | Count | % | Count | % |
| Concrete | 56 | 95.02 | 3 | 4.32 | 0 | 0.47 | 0 | 0.00 | 0 | 0.00 |
| Masonry | 1,914 | 95.04 | 85 | 4.20 | 15 | 0.74 | 0 | 0.02 | 0 | 0.00 |
| MH | 2,119 | 99.63 | 6 | 0.29 | 1 | 0.07 | 0 | 0.00 | 0 | 0.01 |
| Steel | 228 | 95.80 | 8 | 3.54 | 2 | 0.64 | 0 | 0.03 | 0 | 0.00 |
| Wood | 19,622 | 94.91 | 1,006 | 4.86 | 45 | 0.22 | 1 | 0.00 | 0 | 0.00 |

### Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

**Table 4: Expected Damage to Essential Facilities**

| Classification | Total | Probability of at Least Moderate Damage > 50% | Probability of Complete Damage > 50% | Expected Loss of Use < 1 Day |
|---|---|---|---|---|
| EOCs | 1 | 0 | 0 | 1 |
| Fire Stations | 17 | 0 | 0 | 17 |
| Hospitals | 1 | 0 | 0 | 1 |
| Police Stations | 9 | 0 | 0 | 9 |
| Schools | 10 | 0 | 0 | 10 |

## Induced Hurricane Damage

### Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into three general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, and c) Trees. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 155,327 tons of debris will be generated. Of the total amount, Brick/Wood comprises 2% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 120 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 5 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 29,967) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 16.8 million dollars, which represents 0.48 % of the total replacement value of the region's buildings.

## Building-Related Losses

The total property damage losses were 17 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 92% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

**Table 5: Building-Related Economic Loss Estimates**
(Thousands of dollars)

| Category | Area | Residential | Commercial | Industrial | Others | Total |
|---|---|---|---|---|---|---|
| Property Damage | | | | | | |
| | Building | 13,804.92 | 591.22 | 66.46 | 57.66 | 14,520.15 |
| | Content | 285.13 | 104.43 | 31.43 | 8.14 | 429.13 |
| | Inventory | 0.00 | 2.38 | 6.55 | 0.59 | 9.52 |
| | Subtotal | 14,090.05 | 698.03 | 104.44 | 66.29 | 14,958.81 |
| | Income | 0.00 | 171.45 | 0.26 | 0.00 | 171.71 |
| | Relocation | 794.12 | 111.61 | 3.25 | 3.82 | 912.80 |
| | Rental | 564.87 | 62.73 | 0.26 | 0.07 | 67.92 |
| | Wage | 0.00 | 97.49 | 0.43 | 0.00 | 97.92 |
| | Subtotal | 1,358.99 | 443.27 | 4.19 | 3.89 | 1,810.34 |
| | Total | 15,449.04 | 1,141.30 | 108.64 | 70.18 | 16,769.15 |

## Appendix A: County Listing for the Region

North Carolina
- Dare

## Appendix B: Regional Population and Building Value Data

**Building Value (thousands of dollars)**

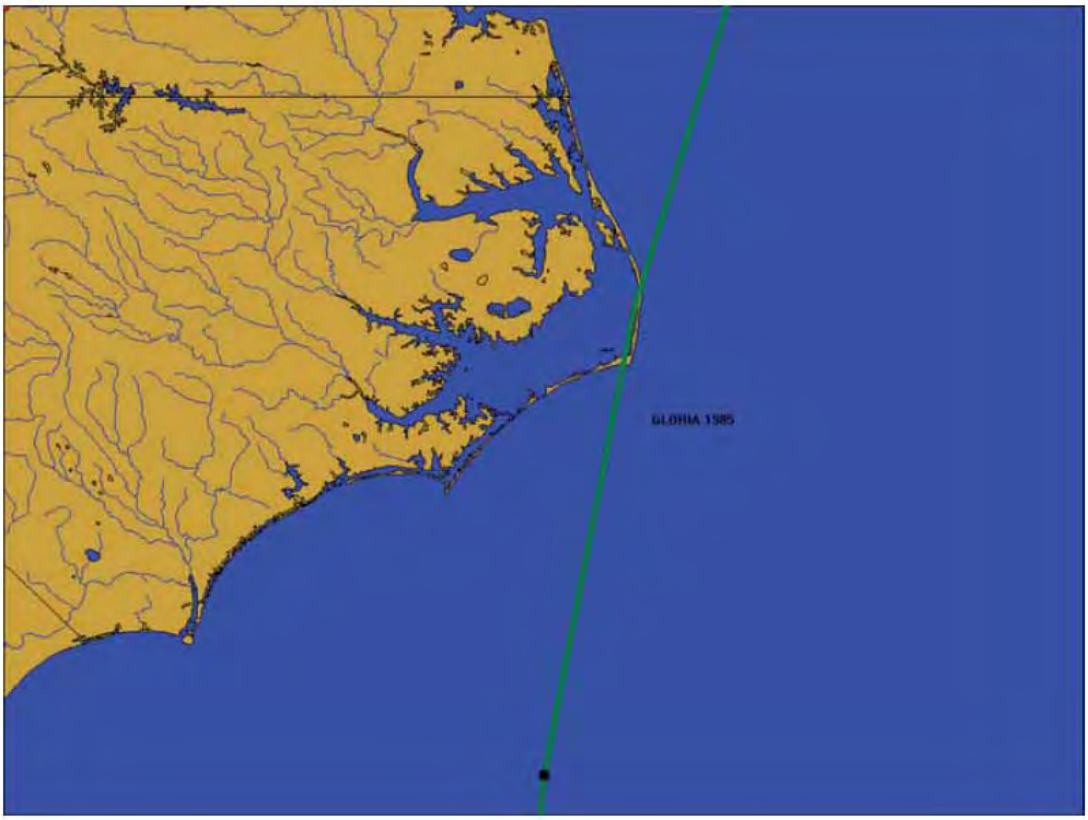
| | Population | Residential | Non-Residential | Total |
|---|---|---|---|---|
| North Carolina | | | | |
| Dare | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Study Region Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |

# HAZUS-MH: Hurricane Event Report

**Region Name** Hurricane Gloria

**Hurricane Scenario:** Hurricane Gloria

**Print Date:** Friday, January 16, 2009




*Disclaimer:*
*Totals only reflect data for those census tracts/blocks included in the user's study region.*

*The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.*

## General Description of the Region

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- North Carolina

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 386.60 square miles and contains 6 census tracts. There are over 12 thousand households in the region and has a total population of 29,967 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 25 thousand buildings in the region with a total building replacement value (excluding contents) of 3,523 million dollars (2002 dollars). Approximately 98% of the buildings (and 81% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 25,123 buildings in the region which have an aggregate total replacement value of 3,523 million (2002 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

**Table 1: Building Exposure by Occupancy Type**

| Occupancy | Exposure ($1000) | Percent of Tot |
|---|---|---|
| Residential | 2,859,419 | 81.2% |
| Commercial | 492,947 | 14.0 |
| Industrial | 82,253 | 2.3% |
| Agricultural | 8,647 | 0.2% |
| Religious | 40,100 | 1.1% |
| Government | 26,306 | 0.7% |
| Education | 13,007 | 0.4% |
| Total | 3,522,679 | 100.0% |

### Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 19 beds. There are 10 schools, 17 fire stations, 9 police stations and 1 emergency operation facilities.

## Hurricane Scenario

HAZUS used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

**Scenario Name:** Hurricane Gloria
**Type:** Deterministic
**Maximum Peak Gust in Study Region:** mph

### User Defined Storm Track Input Data

| Point | Latitude | Longitude | Time Step (hour) | Translation Speed (mph) | Radius to Max Wind Speeds (miles) | Max. Sustained Wind Speed (miles) | Central Pressure (mBar) | Profile Parameter | Radius to Hurricane Force Winds (miles) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 31.40 | -76.20 | -- | 15.00 | 55.00 | 85.00 | 944.00 | -- | -- |
| 2 | 33.20 | -76.00 | -- | 18.00 | 65.00 | 90.00 | 942.00 | -- | -- |
| 3 | 35.50 | -75.50 | -- | 23.00 | 65.00 | 90.00 | 942.00 | -- | -- |
| 4 | 38.40 | -74.50 | -- | 30.00 | 65.00 | 85.00 | 951.00 | -- | -- |
| 5 | 41.90 | -572.80 | -- | 37.00 | 55.00 | 75.00 | 964.00 | -- | -- |

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 38 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

### Table 2: Expected Building Damage by Occupancy

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Occupancy | Count | % | Count | % | Count | % | Count | % | Count | % |
| Agriculture | 7 | 97.13 | 0 | 2.45 | 0 | 0.31 | 0 | 0.10 | 0 | 0.00 |
| Commercial | 340 | 97.01 | 9 | 2.66 | 1 | 0.33 | 0 | 0.01 | 0 | 0.00 |
| Education | 7 | 97.46 | 0 | 2.43 | 0 | 0.11 | 0 | 0.00 | 0 | 0.00 |
| Government | 29 | 97.50 | 1 | 2.39 | 0 | 0.11 | 0 | 0.00 | 0 | 0.00 |
| Industrial | 53 | 97.45 | 1 | 2.39 | 0 | 0.15 | 0 | 0.02 | 0 | 0.00 |
| Religion | 24 | 97.90 | 1 | 2.03 | 0 | 0.08 | 0 | 0.00 | 0 | 0.00 |
| Residential | 23,894 | 96.93 | 719 | 2.92 | 37 | 0.15 | 0 | 0.00 | 0 | 0.00 |
| Total | 24,354 | | 731 | | 38 | | 0 | | 0 | |

**Table 3: Expected Building Damage by Building Type**

| | None | | Minor | | Moderate | | Severe | | Destruction | |
|---|---|---|---|---|---|---|---|---|---|---|
| Building Type | Count | % | Count | % | Count | % | Count | % | Count | % |
| Concrete | 57 | 96.29 | 2 | 3.43 | 0 | 0.28 | 0 | 0.00 | 0 | 0.00 |
| Masonry | 1,946 | 96.63 | 58 | 2.90 | 9 | 0.46 | 0 | 0.01 | 0 | 0.00 |
| MH | 2,124 | 99.85 | 3 | 0.12 | 1 | 0.03 | 0 | 0.00 | 0 | 0.00 |
| Steel | 231 | 96.88 | 7 | 2.74 | 1 | 0.36 | 0 | 0.01 | 0 | 0.00 |
| Wood | 20,026 | 96.87 | 626 | 3.03 | 21 | 0.10 | 0 | 0.00 | 0 | 0.00 |

### Essential Facility Damage

Before the hurricane, the region had 19 hospital beds available for use. On the day of the hurricane, the model estimates that 19 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational.

**Table 4: Expected Damage to Essential Facilities**

| Classification | Total | Probability of at Least Moderate Damage > 50% | Probability of Complete Damage > 50% | Expected Loss of Use < 1 Day |
|---|---|---|---|---|
| EOCs | 2 | 0 | 0 | 2 |
| Fire Stations | 17 | 0 | 0 | 17 |
| Hospitals | 7 | 0 | 0 | 6 |
| Police Stations | 9 | 0 | 0 | 9 |
| Schools | 11 | 0 | 0 | 11 |

## Induced Hurricane Damage

### Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into three general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, and c) Trees. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 79,134 tons of debris will be generated. Of the total amount, Brick/Wood comprises 3% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 84 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 29,967) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 13.0 million dollars, which represents 0.37 % of the total replacement value of the region's buildings.

## Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 13 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 93% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

**Table 5: Building-Related Economic Loss Estimates**
(Thousands of dollars)

| Category | Area | Residential | Commercial | Industrial | Others | Total |
|---|---|---|---|---|---|---|
| Property Damage | | | | | | |
| | Building | 10,746.67 | 409.37 | 43.13 | 37.56 | 11,236.72 |
| | Content | 167.05 | 67.46 | 20.94 | 3.50 | 258.95 |
| | Inventory | 0.00 | 4.00 | 6.55 | 0.32 | 5.49 |
| | Subtotal | 10,913.72 | 68.06 | 104.44 | 41.38 | 11,501.16 |
| | Income | 0.00 | 0.00 | 0.26 | 0.00 | 104.27 |
| | Relocation | 718.15 | .99 | 3.25 | 1.28 | 783.44 |
| | Rental | 522.30 | 0.00 | 0.26 | 0.00 | 555.17 |
| | Wage | 0.00 | 0.00 | 0.43 | 0.00 | 71.01 |
| | Subtotal | 1,240.45 | 0.99 | 4.19 | 1.28 | 1,513.89 |
| | Total | 12,154.17 | 69.05 | 108.64 | 42.66 | 13,015.05 |

## Appendix A: County Listing for the Region

North Carolina
- Dare

## Appendix B: Regional Population and Building Value Data

**Building Value (thousands of dollars)**

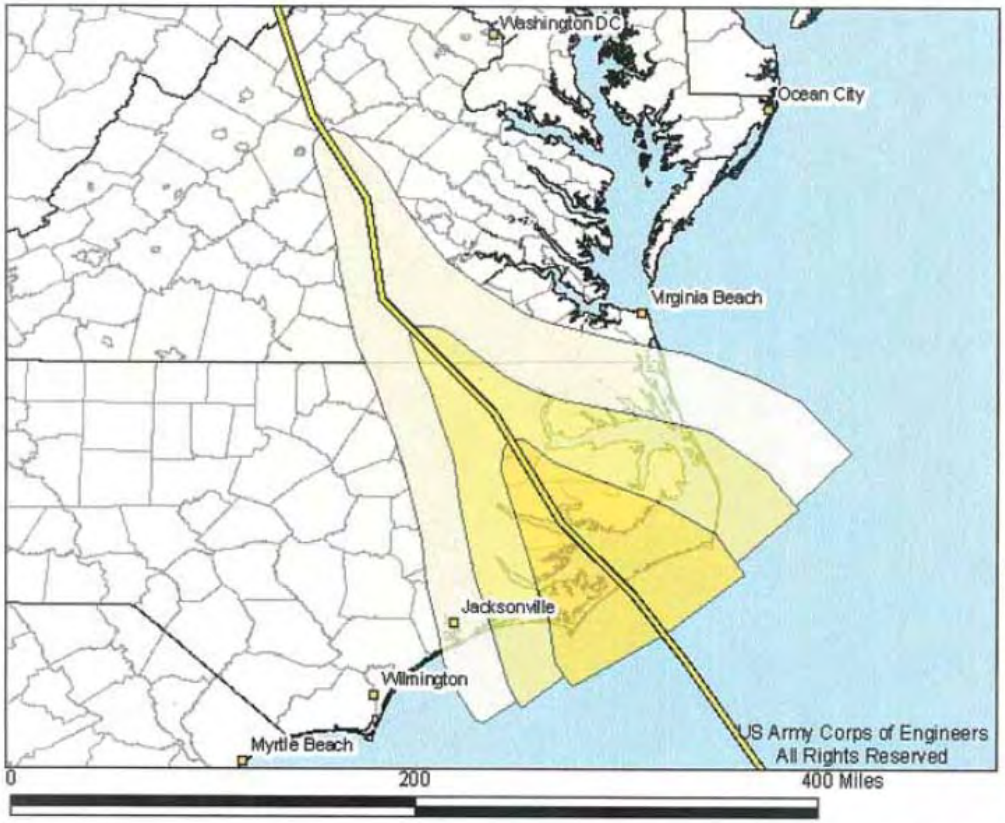
| | Population | Residential | Non-Residential | Total |
|---|---|---|---|---|
| North Carolina | | | | |
| Dare | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |
| Study Region Total | 29,967 | 2,859,419 | 663,260 | 3,522,679 |

US Army Corps of Engineers

# Hurricane Isabel Projected Damage Areas

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Post Landfall Projected Damage Areas***

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Projected Damage Areas**

- CAT 0-type damage
- CAT 1-type damage
- CAT 2-type damage
- CAT 3-type damage
- CAT 4-type damage
- CAT 5-type damage

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Projected Damage Areas | |
|---|---|
| **Generated By:** Siemsen, LRL 0000 EDT 10/22/2008 | |
| **Sources:** HURREVAC LRL-DEBRIS | Page 1 of 43 |

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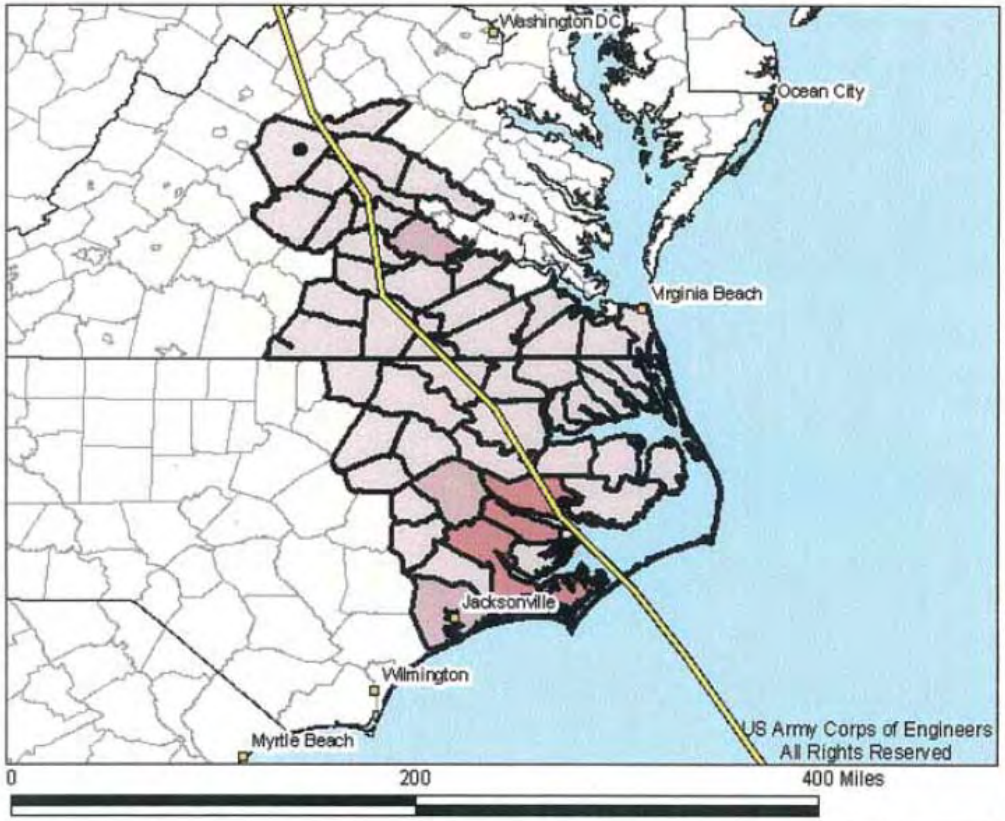
# Hurricane Isabel Debris Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




### *Post Landfall Debris Model Results*

North Carolina - 2,327,000 Yards
Virginia - 659,000 Yards

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Debris**

- < 100,000 cubic yards
- 100,000 - 249,999 cubic yards
- 250,000 - 499,999 cubic yards
- 500,000 - 999,999 cubic yards
- >1,000,000 cubic yards

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast. The amount of debris forecasted is possible total volume, not necessarily the volume that may need to be removed with Federal funds, but does not include volume that may be covered by private insurance. Debris volume may include storm surge generated debris.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Debris Model | |
|---|---|
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| **Sources:** HURREVAC LRL-DEBRIS | Page 2 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Debris Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| State | Yards per State | County | Yards per County |
|---|---|---|---|
| North Carolina | | Beaufort | 295,000 |
| | | Bertie | 95,000 |
| | | Camden | 14,000 |
| | | Carteret | 293,000 |
| | | Chowan | 34,000 |
| | | Craven | 280,000 |
| | | Currituck | 31,000 |
| | | Dare | 91,000 |
| | | Edgecombe | 58,000 |
| | | Gates | 18,000 |
| | | Greene | 8,000 |
| | | Halifax | 87,000 |
| | | Hertford | 63,000 |
| | | Hyde | 73,000 |
| | | Jones | 24,000 |
| | | Lenoir | 38,000 |
| | | Martin | 90,000 |
| | | Nash | 12,000 |
| | | Northampton | 56,000 |
| | | Onslow | 147,000 |
| | | Pamlico | 98,000 |
| | | Pasquotank | 53,000 |
| | | Perquimans | 32,000 |
| | | Pitt | 229,000 |
| | | Tyrrell | 21,000 |
| | | Warren | 3,000 |
| | | Washington | 84,000 |
| | | Wilson | < 1,000 |
| North Carolina | 2,327,000 | | |
| Virginia | | Albemarle | 8,000 |

| State | Yards per State | County | Yards per County |
|---|---|---|---|
| Virginia (continued) | | Amelia | 18,000 |
| | | Brunswick | 30,000 |
| | | Buckingham | < 1,000 |
| | | Chesapeake city | 57,000 |
| | | Chesterfield | 138,000 |
| | | Colonial Heights city | 7,000 |
| | | Cumberland | 7,000 |
| | | Dinwiddie | 38,000 |
| | | Emporia City | 16,000 |
| | | Fluvanna | 27,000 |
| | | Franklin City | 12,000 |
| | | Goochland | 20,000 |
| | | Greensville | 22,000 |
| | | Hanover | < 1,000 |
| | | Isle Of Wight | 9,000 |
| | | Louisa | 21,000 |
| | | Lunenburg | 7,000 |
| | | Mecklenburg | 4,000 |
| | | Nottoway | 19,000 |
| | | Orange | 3,000 |
| | | Petersburg city | 44,000 |
| | | Powhatan | 31,000 |
| | | Prince George | 11,000 |
| | | Southampton | 28,000 |
| | | Suffolk City | 64,000 |
| | | Sussex | 14,000 |
| | | Virginia Beach city | 4,000 |
| Virginia | 659,000 | | |

The amount of debris forecasted is possible total volume, not necessarily the volume that may need to be removed with Federal funds, but does not include volume that may be covered by private insurance. Debris volume may include storm surge generated debris.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

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**Hurricane Isabel Debris Model**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

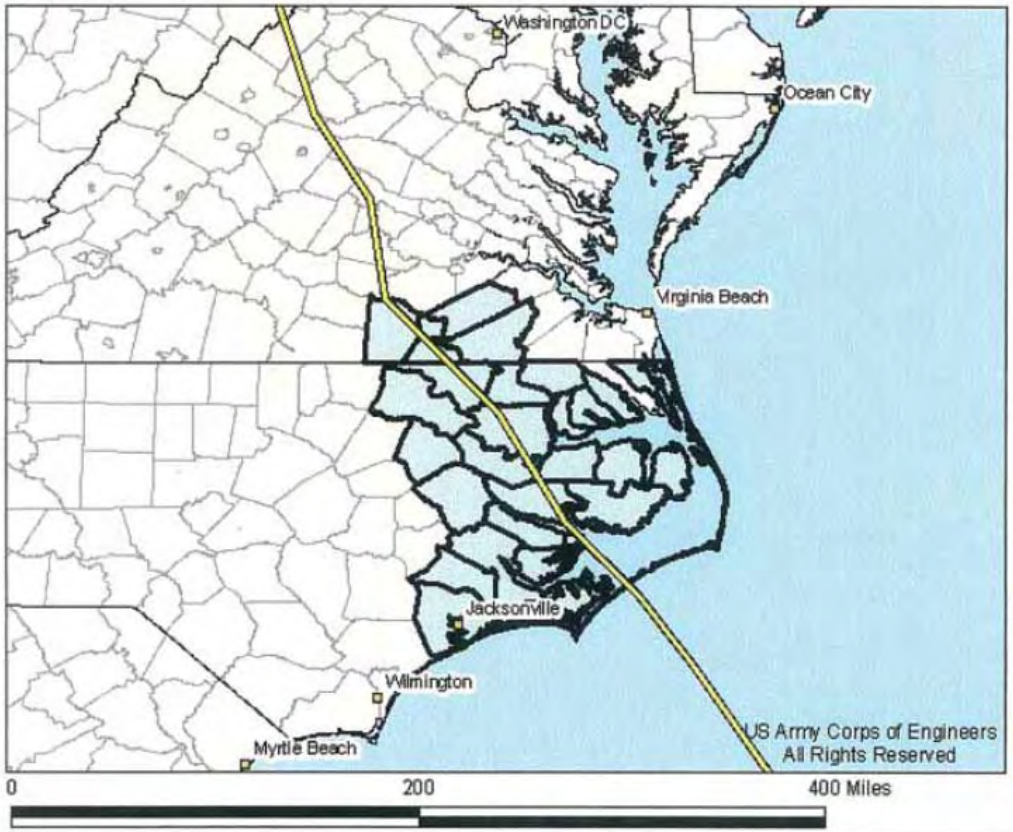
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Commodities Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




### *Post Landfall Water Model Results*

**Day One / Day Two / Day Three**
North Carolina – 8/15/30 Truckloads
Virginia – 2/3/5 Truckloads

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Commodities**

- < 5 Trucks Each
- 5 - 10 Trucks Each
- 11 - 20 Trucks Each
- 21 - 40 Trucks Each
- > 40 Trucks Each

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC ***(0000 EDT 10/22/2008)*** forecast. The amount of commodities forecasted is based on Mission Guide Book requirements and SME input. The graphic represents single day needs with full distribution system in place and operating.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Commodities Model | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 4 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Commodities Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| State | Truckloads per State | County | Truckloads per County |
|---|---|---|---|
| North Carolina | | Beaufort | 2 |
| | | Bertie | 1 |
| | | Carteret | 3 |
| | | Chowan | 1 |
| | | Craven | 4 |
| | | Currituck | 1 |
| | | Dare | 2 |
| | | Edgecombe | 1 |
| | | Gates | 1 |
| | | Halifax | 1 |
| | | Hertford | 1 |
| | | Hyde | 1 |
| | | Jones | 1 |
| | | Martin | 1 |
| | | Northampton | 1 |
| | | Onslow | 1 |
| | | Pamlico | 1 |
| | | Pasquotank | 1 |
| | | Perquimans | 1 |
| | | Pitt | 2 |
| | | Tyrrell | 1 |
| | | Washington | 1 |
| North Carolina | 30 | | |
| Virginia | | Brunswick | 1 |
| | | Emporia City | 1 |
| | | Greensville | 1 |
| | | Southampton | 1 |
| | | Sussex | 1 |
| Virginia | 5 | | |

The amount of commodities forecasted is based on Mission Guide Book requirements and SME input and the above table indicates suggested needs based on phased deployment of a commodities distribution system.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

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**Hurricane Isabel Commodities Model**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

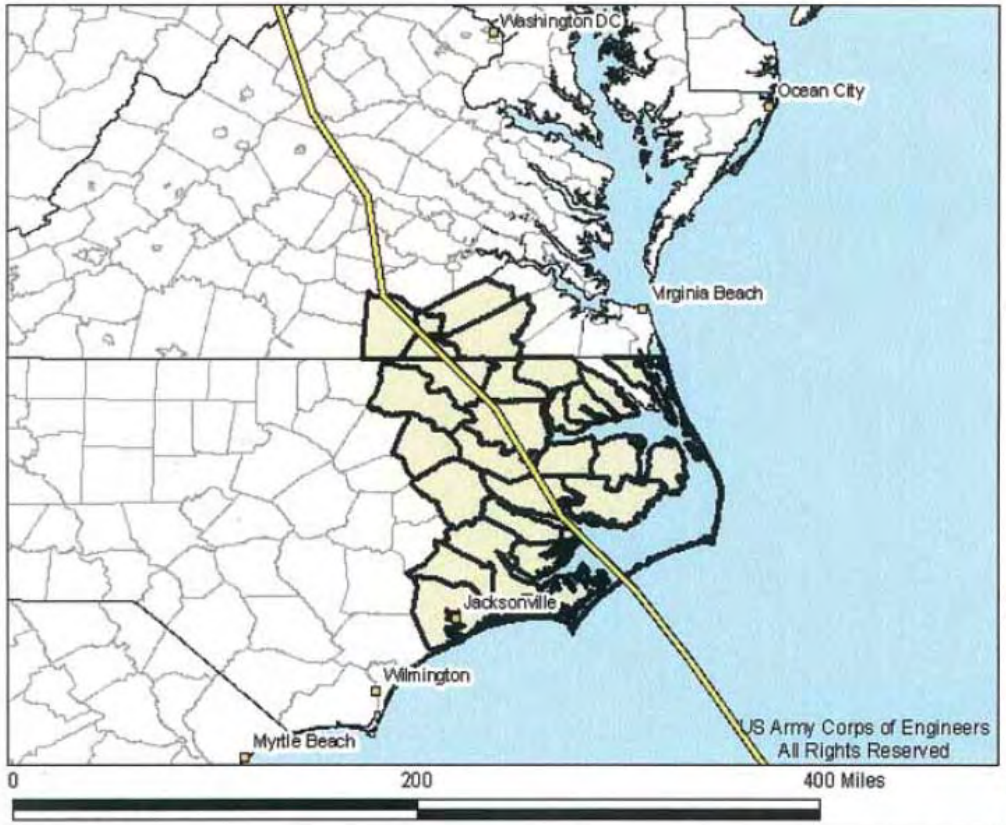
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Temporary Roofing Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




### *Post Landfall Temporary Roofing Model Results*

North Carolina - 2,700
Virginia – less than 400

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Temporary Roofing**

- < 2,000 units
- 2,000 - 3,999 units
- 4,000 - 5,999 units
- 6,000 - 9,999 units
- > 10,000 units

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast. Temporary roofing is based on 1% in CAT 1 and 4% in CAT 2.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Roofing Model | |
|---|---|
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| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 6 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Temporary Roofing Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| State | House Units per State | County | House Units per County |
|---|---|---|---|
| North Carolina | | Beaufort | 500 |
| | | Bertie | 200 |
| | | Carteret | 600 |
| | | Chowan | < 100 |
| | | Craven | 400 |
| | | Currituck | < 100 |
| | | Dare | 200 |
| | | Edgecombe | < 100 |
| | | Gates | < 100 |
| | | Halifax | < 100 |
| | | Hertford | < 100 |
| | | Hyde | < 100 |
| | | Jones | < 100 |
| | | Martin | 200 |
| | | Northampton | < 100 |
| | | Onslow | < 100 |
| | | Pamlico | 200 |
| | | Pasquotank | < 100 |
| | | Perquimans | < 100 |
| | | Pitt | 200 |
| | | Tyrrell | < 100 |
| | | Washington | 200 |
| North Carolina | 2,700 | | |
| Virginia | | Brunswick | < 100 |
| | | Emporia City | < 100 |
| | | Greensville | < 100 |
| | | Southampton | < 100 |
| | | Sussex | < 100 |
| Virginia | | | |

Temporary roofing is based on 1% in CAT 1 and 4% in CAT 2.

Details about this model may be obtained at http://www.englink.usace.army.mil
or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

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**Hurricane Isabel Roofing Model**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

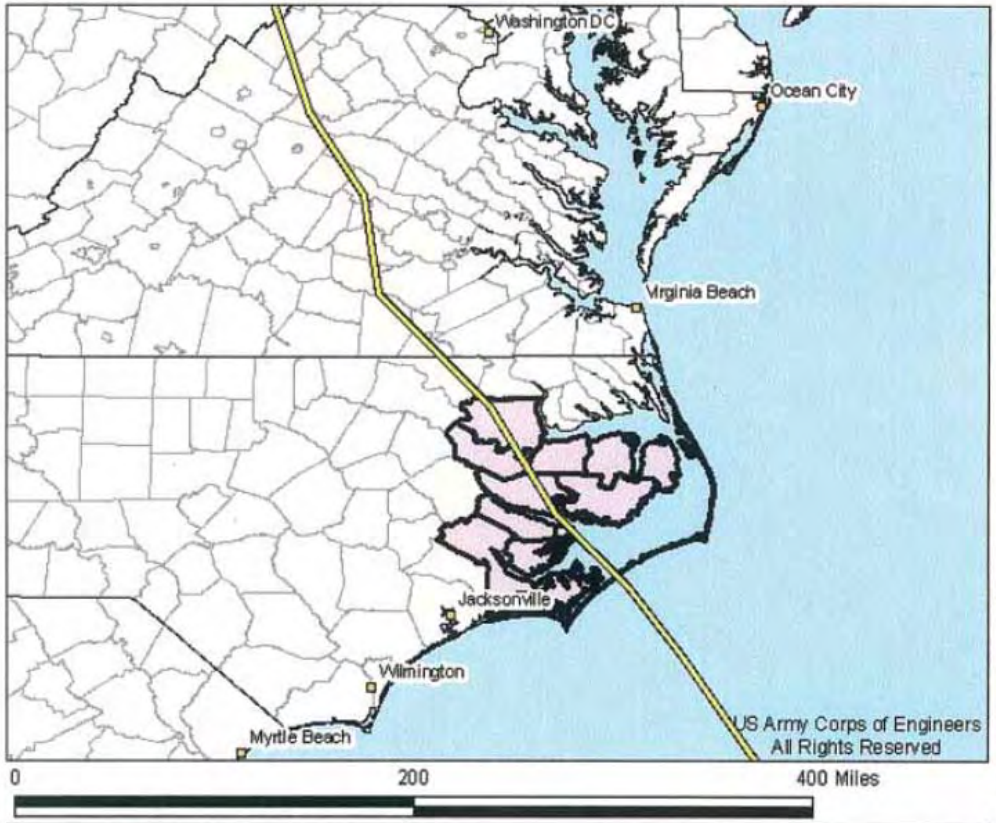
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Temporary Housing Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




### *Post Landfall Temporary Housing Model Results*

Less than 500 units

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Temporary Housing**

- < 2,000 units
- 2,000 - 3,999 units
- 4,000 - 5,999 units
- 6,000 - 9,999 units
- > 10,000 units

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast. Temporary housing is based on 1% in CAT 2.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Housing Model | |
|---|---|
| **Generated By:** Siemsen, LRL 0000 EDT 10/22/2008 | |
| **Sources:** HURREVAC LRL-DEBRIS | Page 8 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Temporary Housing Model

## Landfall Plus About 24 Hours

For Planning Purposes Only!

| State | House Units per State | County | House Units per County |
|---|---|---|---|
| North Carolina | | Beaufort | < 100 |
| | | Bertie | < 100 |
| | | Carteret | < 100 |
| | | Craven | < 100 |
| | | Dare | < 100 |
| | | Hyde | < 100 |
| | | Martin | < 100 |
| | | Pamlico | < 100 |
| | | Tyrrell | < 100 |
| | | Washington | < 100 |
| North Carolina | | | |

Temporary housing is based on 1% in CAT 2.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel Housing Model**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

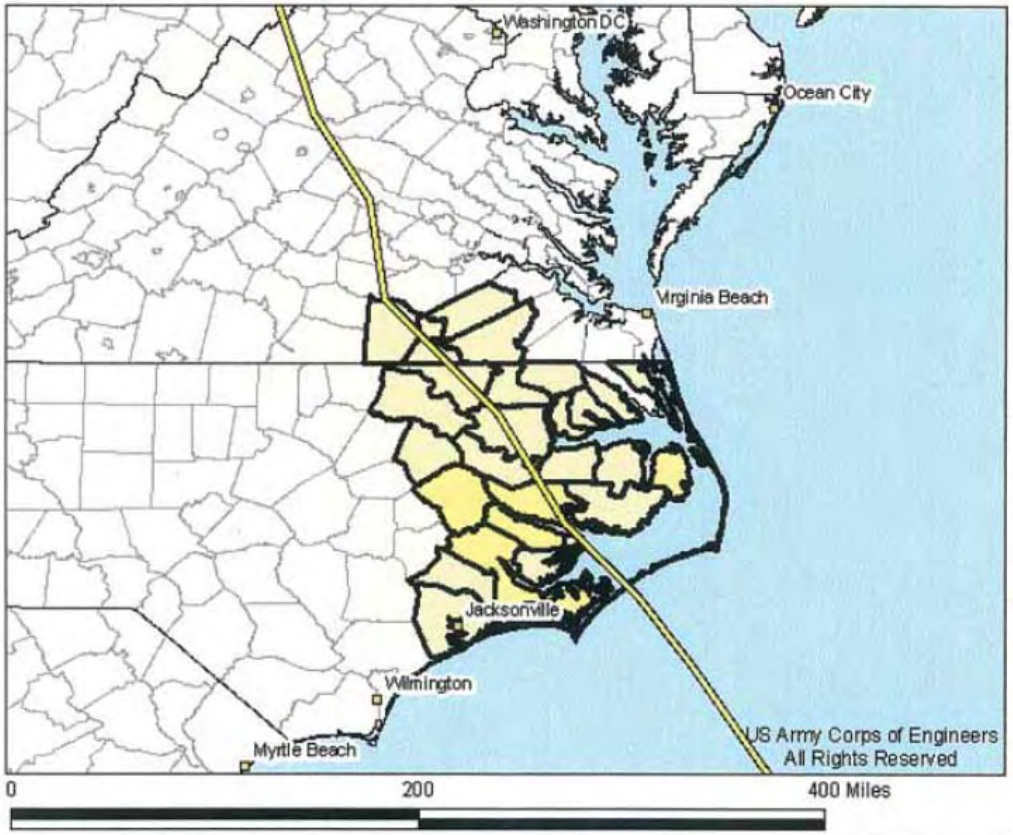
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Population Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Post Landfall Results – Resident Population Within Hurricane Force Winds***

North Carolina - 425,000
Virginia - 17,000

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Population**

- < 25,000 persons
- 25,000 - 99,999 persons
- 100,000 - 174,999 persons
- 175,000 - 249,999 persons
- > 250,000 persons

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast. The numbers of persons included in this model output are those that would be included within estimated hurricane force winds (Census 2000 values adjusted to July 2007 values).

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Population Model | |
|---|---|
| **Generated By:** Siemsen, LRL 0000 EDT 10/22/2008 | |
| **Sources:** HURREVAC LRL-DEBRIS | Page 10 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Population Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| State | Population per State | County | Population per County |
|---|---|---|---|
| North Carolina | | Beaufort | 46,000 |
| | | Bertie | 19,000 |
| | | Carteret | 64,000 |
| | | Chowan | 14,000 |
| | | Craven | 92,000 |
| | | Currituck | < 1,000 |
| | | Dare | 31,000 |
| | | Edgecombe | < 1,000 |
| | | Gates | < 1,000 |
| | | Halifax | 7,000 |
| | | Hertford | 20,000 |
| | | Hyde | 6,000 |
| | | Jones | 3,000 |
| | | Martin | 24,000 |
| | | Northampton | 16,000 |
| | | Onslow | < 1,000 |
| | | Pamlico | 13,000 |
| | | Pasquotank | 5,000 |
| | | Perquimans | 10,000 |
| | | Pitt | 37,000 |
| | | Tyrrell | 5,000 |
| | | Washington | 13,000 |
| North Carolina | 425,000 | | |
| Virginia | | Brunswick | < 1,000 |
| | | Emporia City | 6,000 |
| | | Greensville | 9,000 |
| | | Southampton | 2,000 |
| | | Sussex | < 1,000 |
| Virginia | 17,000 | | |

The number of persons estimated to be within the hurricane force winds comes from Census 2000 values adjusted to July 2007 values.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel Population Model**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

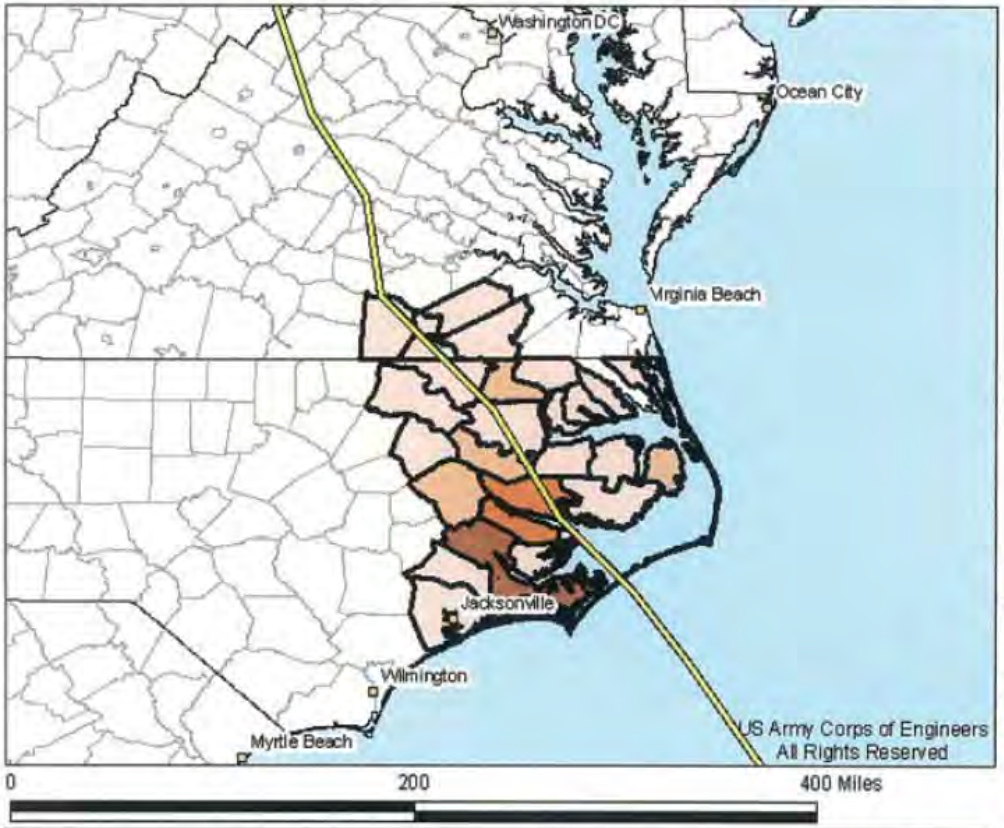
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Households Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Post Landfall Results – Resident Households Within Hurricane Force Winds***

North Carolina - 176,000
Virginia - 6,000

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Historic Track

**Households**

- <7,500 households
- 7,500 - 14,999 households
- 15,000 - 24,999 households
- 25,000 - 49,999 households
- >50000 households

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast. The numbers of households included in this model output are those that would be included within estimated hurricane force winds (Census 2000 values adjusted to July 2007 values).

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Households Model | |
|---|---|
| **Generated By:** Siemsen, LRL 0000 EDT 10/22/2008 | |
| **Sources:** HURREVAC LRL-DEBRIS | Page 12 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Households Model

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| State | Households per State | County | Households per County |
|---|---|---|---|
| North Carolina | | Beaufort | 19,000 |
| | | Bertie | 8,000 |
| | | Carteret | 27,000 |
| | | Chowan | 6,000 |
| | | Craven | 35,000 |
| | | Currituck | < 1,000 |
| | | Dare | 14,000 |
| | | Edgecombe | < 1,000 |
| | | Gates | < 1,000 |
| | | Halifax | 3,000 |
| | | Hertford | 8,000 |
| | | Hyde | 2,000 |
| | | Jones | 2,000 |
| | | Martin | 10,000 |
| | | Northampton | 7,000 |
| | | Onslow | < 1,000 |
| | | Pamlico | 6,000 |
| | | Pasquotank | 2,000 |
| | | Perquimans | 4,000 |
| | | Pitt | 15,000 |
| | | Tyrrell | 2,000 |
| | | Washington | 6,000 |
| North Carolina | 176,000 | | |
| Virginia | | Brunswick | < 1,000 |
| | | Emporia City | 3,000 |
| | | Greensville | 3,000 |
| | | Southampton | < 1,000 |
| | | Sussex | < 1,000 |
| Virginia | 6,000 | | |

The number of households estimated to be within the hurricane force winds comes from Census 2000 values adjusted to July 2007 values.

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel Households Model**

**Generated By:** Siemsen, LRL 0000 EDT 10/22/2008

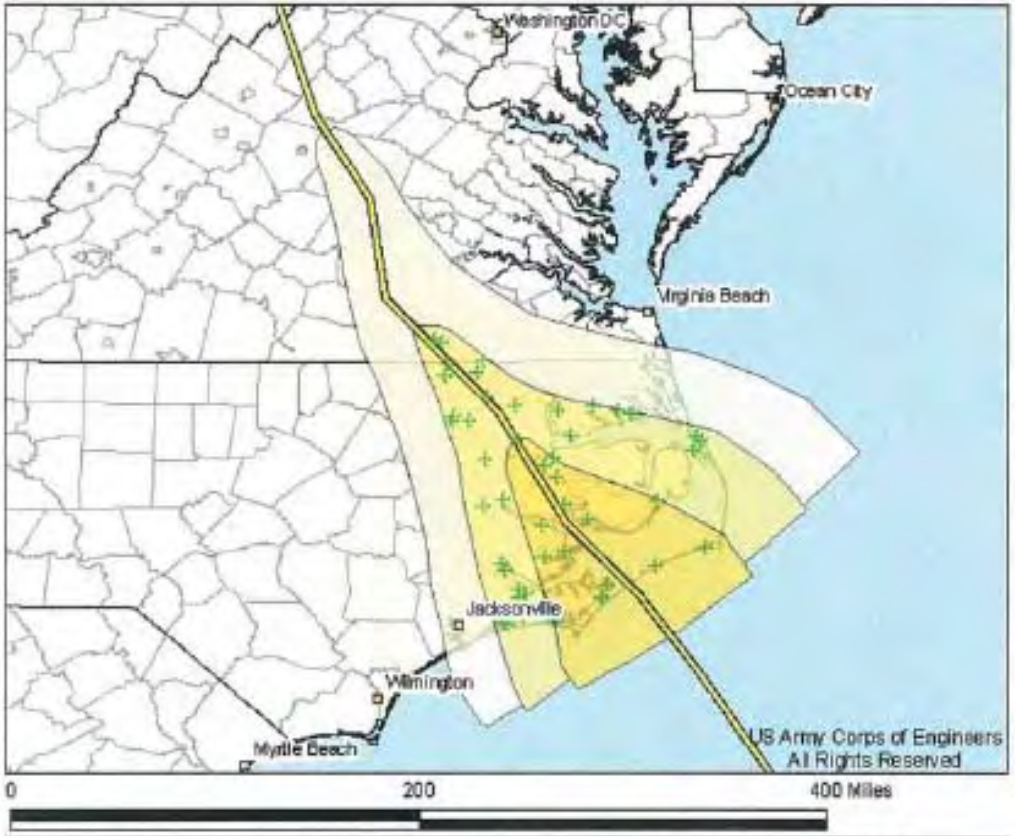
**Sources:** HURREVAC LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Airports

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Airports Inside Hurricane Force Winds***

North Carolina - 45
Virginia - 3

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Airports
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2006) forecast.

The number of airports included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

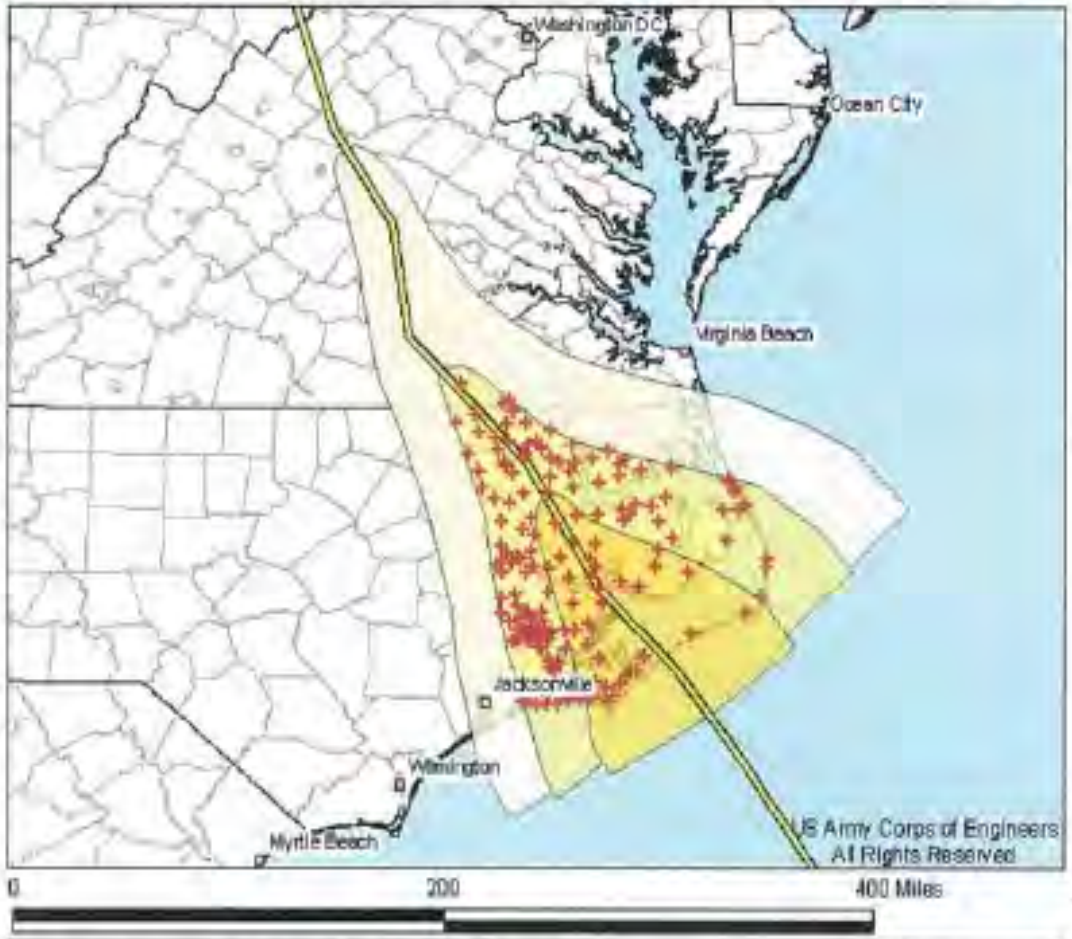
| Hurricane Isabel Airports | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2006 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 14 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Fire Stations

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Fire Stations Inside Hurricane Force Winds***

North Carolina - 166
Virginia - 3

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

+ Fire Stations
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast.

The number of fire stations included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

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| Hurricane Isabel Fire Stations | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 15 of 43 |

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 2
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| ATLANTIC FD INC | 967 SEASHORE DR | ATLANTIC | NC |
| AURORA VOLUNTEER FD | 99 STATE HWY 33 E | AURORA | NC |
| BATH VOL. FD INC | 430 CARTERET ST | BATH | NC |
| BEAUFORT FD | 900 CEDAR ST | BEAUFORT | NC |
| BELHAVEN VOL FIRE & RESCUE | 245 HASLIN ST | BELHAVEN | NC |
| BUNYAN VOLUNTEER FD INC | 8264 BROAD CREEK RD | WASHINGTON | NC |
| CEDAR ISLAND COMM CTR VFD-RESCUE INC | 2208 CEDAR ISLAND RD | CEDAR ISLAND | NC |
| DAVIS VOLUNTEER FD INC | 595 US HWY 70 | DAVIS | NC |
| ENGELHARD VFD INC | 34545 US HWY 264 | ENGELHARD | NC |
| FAIRFIELD VFD | 6680 STATE HIGHWAY 94 | FAIRFIELD | NC |
| FLORENCE-WHORTONSVILLE VFD INC - STATION 25 | 5208 FLORENCE RD | MERRITT | NC |
| FRISCO VFD | 52470 STATE HIGHWAY 12 | BUXTON | NC |
| GOOSE CREEK ISLAND VFD - STATION 23 | 5212 LOWLAND RD | LOWLAND | NC |
| HARKERS ISLAND FD | 1219 ISLAND RD | HARKERS ISLAND | NC |
| JAMESVILLE VFD INC | 1100 WASHINGTON ST | JAMESVILLE | NC |
| KILKENNY STATION | 63 KILKENNY ROAD | FAIRFIELD | NC |
| LONG ACRE VOLUNTEER FD INC | 23177 STATE RTE 32 N | PLYMOUTH | NC |
| MARSHALLBERG VOLUNTARY FD INC | 109 GOOSE POND RD | MARSHALLBERG | NC |
| NORTH RIVER & LAUREL ROAD VFD INC | 893 MERRIMON RD | BEAUFORT | NC |
| OCRACOKE FD | 215 BACK RD | OCRACOKE | NC |
| OTWAY VOL FIRE & RESCUE DEPT INC | 509 HWY 70 EAST OTWAY | BEAUFORT | NC |
| PAMLICO BEACH FIRE & RESCUE SQUAD | 382 OLD PAMLICO BEACH RD W | BELHAVEN | NC |
| PANTEGO FD | 25673 US HIGHWAY 264 E | PANTEGO | NC |
| PINETOWN VOL. FIREMEN'S ASSN- INC. | 7241 N BOYD RD | PINETOWN | NC |
| PLYMOUTH FD | 308 GOLF RD | PLYMOUTH | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

Details about this model may be obtained at http://www.englink.usace.army.mil
or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 2
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| PUNGO RIVER VOL. FD INC | 40 PIKE RD | PANTEGO | NC |
| SCRANTON VFD | 5224 SLADESVILLE CREDLE RD | SCRANTON | NC |
| SEA LEVEL FD- RESCUE SQUAD & COMM INC | 647 US HWY 70 SEALEVEL | SEALEVEL | NC |
| SIDNEY VOL FD INC | 6755 N SAVANNAH RD | BELHAVEN | NC |
| SOUTH RIVER-MERRIMON FIRE & EMS INC | 1329 S RIVER RD | BEAUFORT | NC |
| SOUTHEAST PAMLICO VFD INC | 6389 STRAIGHT RD | ORIENTAL | NC |
| STACY VFD INC | 1442 US HWY 70 STACY | STACY | NC |
| SWAN QUARTER VFD INC | 25 OYSTERCREEK RD | SWANQUARTER | NC |
| TRIANGLE VFD INC | 202 4TH ST | BAYBORO | NC |
| VANDEMERE FD INC (NEW STATION) | PENNSYLVANIA AVE | VANDEMERE | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel**
**Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| AHOSKIE FD | 301 MAIN ST | AHOSKIE | NC |
| AHOSKIE RURAL VFD | 609 MAIN ST W | AHOSKIE | NC |
| ALLIGATOR STATION | 9720 SOUND SIDE ROAD | COLUMBIA | NC |
| ARAPAHOE VFD INC | 8233 STATE HIGHWAY 306 S | ARAPAHOE | NC |
| ASKEWVILLE VFD INC ST 41 | 105 ASKEWVILLE S RAILROAD ST | WINDSOR | NC |
| ATLANTIC BEACH FD | 125 W FORT MACON RD | ATLANTIC BEACH | NC |
| AULANDER FD ST 61 | 124 W MAIN ST | AULANDER | NC |
| AVON FD | 40159 HARBOR RD | AVON | NC |
| BEAR GRASS FIRE RESCUE INC | 6005 BEAR GRASS RD | WILLIAMSTON | NC |
| BETHEL COMM. FIRE PROTECTION ASSOC. INC | 462 SNUG HARBOR RD | HERTFORD | NC |
| BLACK JACK VFD INC | 3728 MILLS RD | GREENVILLE | NC |
| BLOUNTS CREEK VOL FD INC | 13965 STATE RTE 33 E | BLOUNTS CREEK | NC |
| BLUE JAY VOL FIRE COMPANY INC ST 44 | 1709 INDIAN WOODS RD | WINDSOR | NC |
| BOGUE BANKS FIRE/RESCUE | 1410 SALTER PATH RD | INDIAN BEACH | NC |
| BOYKINS VFD | 18127 S RAILROAD AVE | BOYKINS | VA |
| BRANCHVILLE VFD | 15310 BROAD ST | BRANCHVILLE | VA |
| BROAD & GALES CREEK COMM. ASSOC.- INC | 3010 STATE HWY 24 | NEWPORT | NC |
| CAROLINA TOWNSHIP VFD INC | 2025 WHICHARD-CHERRY LN | STOKES | NC |
| CENTER HILL-CROSSROADS FIRE DISTRICT | 105 CENTER HILL RD | TYNER | NC |
| CHERRY POINT FD | 4TH AND F | CHERRY POINT | NC |
| CHERRY POINT FD ST 2 | BUILD 192 ROOSEVELT BLVD | MCAS CHERRY POINT | NC |
| CHERRY POINT FD ST 3 | JACKSON DR | MCAS CHERRY POINT | NC |
| CHICAMACOMICO FD | 24333 NC--12 | RODANTHE | NC |
| CHOCOWINITY TOWNSHIP VFD INC | 512 STATE HWY 33 E | CHOCOWINITY | NC |
| CLARKS NECK FD | 5440 CLARKS NECK RD | WASHINGTON | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| CLARKS NECK VFD INC | 1049 N GRIMESLAND BRIDGE RD | WASHINGTON | NC |
| COLERIAN FD ST 51 | 105 E RIVER ST | COLERAIN | NC |
| COLINGTON VFD INC | 108 SCHOOLHOUSE RD | KILL DEVIL HILLS | NC |
| COLUMBIA STATION | 618 N ROAD ST | COLUMBIA | NC |
| CONWAY VFD INC | 113 WHITE ST | CONWAY | NC |
| DURANTS NECK VFD | 2087 NEW HOPE RD | HERTFORD | NC |
| EASTERN PINES FIRE-RESCUE & EMS INC | 5467 EASTERN PINES RD | GREENVILLE | NC |
| EDENTON FD | 704 N BROAD ST | EDENTON | NC |
| EMERALD ISLE FD | 7516 EMERALD DR | EMERALD ISLE | NC |
| EMERALD ISLE FD ST 2 | 2810 EMERALD DR | EMERALD ISLE | NC |
| EMPORIA VFD | 209 HALIFAX ST | EMPORIA | VA |
| FRYING PAN STATION | 33 FRYING PAN ROAD | COLUMBIA | NC |
| GARYSBURG FD | 501 OLD GARYSBURG HIGHWAY | GARYSBURG | NC |
| GRANTSBORO-SILVERHILL VFD INC - STATION 11 | 35 STATE HIGHWAY 306 SOUTH | GRANTSBORO | NC |
| GRIFFINS TOWNSHIP FD INC | 5217 FIRE DEPARTMENT RD | WILLIAMSTON | NC |
| GRIMESLAND VFD INC | 4669 1ST STREET | GRIMESLAND | NC |
| GUM NECK STATION | 2950 N GUM NECK RD | COLUMBIA | NC |
| HAMILTON DIST. VOL. FIRE & EMS DEPT INC | 408 SOUTH FRONT STREET | HAMILTON | NC |
| HARLOW FD | 3930 STATE HWY 101 | HAVELOCK | NC |
| HARRELLSVILLE VFD INC | 227 E MAIN ST | HARRELLSVILLE | NC |
| HAVELOCK FIRE & RESCUE DEPARTMENT | 2 HATTERAS AVE | HAVELOCK | NC |
| HERTFORD FD | 324 W GRUBB ST | HERTFORD | NC |
| HOBGOOD VFD INC | 108 W COMMERCE ST | HOBGOOD | NC |
| INDUSTRIAL PARK | 280 INDUSTRIAL DR | NEW BERN | NC |
| JACKSON FD | 102 DEPOT ST | JACKSON | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| KELFORD VOLUNTEER FIRE/RESCUE INC ST 62 | 106 N MAIN ST | KELFORD | NC |
| KILL DEVIL HILLS FD | 1634 N CROATAN HWY | KILL DEVIL HILLS | NC |
| KITTY HAWK VFD INC | 965 W KITTY HAWK RD | KITTY HAWK | NC |
| LAKE PHELPS FD | 11550 NEWLAND RD | CRESWELL | NC |
| LASKER FD | 203 W CHURCH ST | LASKER | NC |
| LEWISTON-WOODVILLE F/R DEPT INC ST 63 | 103 W CHURCH ST | LEWISTON | NC |
| LITTLE SWIFT CREEK VFD - ANTIOCH STATION | 775 ANTIOCH RD | NEW BERN | NC |
| LITTLE SWIFT CREEK VFD - CATON STATION | 2580 AURORA RD | ERNUL | NC |
| LITTLE SWIFT CREEK VFD - ERNUL STATION | 309 MACEDONIA CHURCH RD | ERNUL | NC |
| LITTLE SWIFT CREEK VFD - ERNUL STATION | 4580 US HWY 17 N | ERNUL | NC |
| LITTLE SWIFT CREEK VFD - MAIN STATION | 115 AURORA RD | ERNUL | NC |
| MANNS HARBOR VFD INC | 6657 US HIGHWAY 64 | MANNS HARBOR | NC |
| MERRY-HILL MIDWAY VFD INC ST 42 | 109 STATE RTE 45 N | MERRY HILL | NC |
| MID-COUNTY VFD INC | 20600 US HIGHWAY 64 | CRESWELL | NC |
| MILL CREEK FIRE ASSOCIATION INC | 2370 MILL CREEK RD | NEWPORT | NC |
| MILLENNIUM FD INC | 216 MILLENNIUM RD | AULANDER | NC |
| MOREHEAD FD STATION 1 | 801 EVANS ST | MOREHEAD CITY | NC |
| MOREHEAD FD STATION 2 | 3308 ARENDELL ST | MOREHEAD CITY | NC |
| MURFREESBORO FD | 200 SYCAMORE ST | MURFREESBORO | NC |
| NAGS HEAD FIRE & RESCUE DEPARTMENT | 5314 S CROATAN HWY | NAGS HEAD | NC |
| NEW BERN FD - ELIZABETH AVE. | 3101 ELIZABETH AVE | NEW BERN | NC |
| NEW BERN FD - NATIONAL AVE. | 1700 NATIONAL AVE | NEW BERN | NC |
| NEW BERN FD - TABERNA STATION | 800 W THURMAN RD | NEW BERN | NC |
| NEW BERN FD -MAIN STATION | 420 BROAD ST | NEW BERN | NC |
| NEWPORT FD | 125 HOWARD BLVD | NEWPORT | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| NEWPORT FD ST 2 | 485 LAKE RD | NEWPORT | NC |
| NO 7 TWP FD - BRICES CREEK STATION | 1815 BRICES CREEK RD | NEW BERN | NC |
| NO 9 TOWNSHIP FIRE DEPT - MAIN | 3783 STATE HWY 55 W | NEW BERN | NC |
| NO 9 TOWNSHIP VFD - SUBSTATION | 2431 ASBURY RD | COVE CITY | NC |
| NO. 7 TWSHP FD - MAIN STATION | 1705 OLD CHERRY POINT RD | NEW BERN | NC |
| NO. 7 TWSHP FD - RIVERDALE STATION | 4530 OLD CHERRY POINT RD | NEW BERN | NC |
| OAK CITY FIRE RESCUE | 100 E COMMERCE ST | OAK CITY | NC |
| OLD FORD VOLUNTEER FD INC | 6050 US HIGHWAY 17 N | WASHINGTON | NC |
| OLYMPIA VFD | 394 OLYMPIA RD | NEW BERN | NC |
| PACTOLUS FIRE & RESCUE DEPARTMENT INC | 5858 US HIGHWAY 264 E | GREENVILLE | NC |
| PERRYTOWN FD INC ST 53 | 825 PERRYTOWN RD | COLERAIN | NC |
| PINE KNOLL SHORES FD | 100 MUNICIPAL CIR | PINE KNOLL SHORES | NC |
| POWELLSVILLE VOL FD INC ST 52 | 106 CURTIS ST | POWELLSVILLE | NC |
| REELSBORO FD INC | 105 HOLLAND DR | NEW BERN | NC |
| RHEMS VFD INC - MAIN STATION | 5860 US HWY 17 S | NEW BERN | NC |
| RHEMS VFD INC - RIVERBEND | 25 SHORELINE DR | NEW BERN | NC |
| RICH SQUARE FD | 300 E JACKSON ST | RICH SQUARE | NC |
| ROANOKE ISLAND VFD INC | 917 US HWY 64 | MANTEO | NC |
| ROBERSONVILLE FD | 119 MILL ST | ROBERSONVILLE | NC |
| ROPER FD INC | OLD US HWY 64 | ROPER | NC |
| ROXOBEL FD ST 64 | 200 S MAIN ST | ROXOBEL | NC |
| SALVO VFD | 27209 ROTH RD | SALVO | NC |
| SCOTLAND NECK FD | 1410 MAIN ST | SCOTLAND NECK | NC |
| SCUPPERNONG STATION | 3575 ALBEMARLE CHURCH RD | COLUMBIA | NC |
| SEABOARD FD | 107 CLAY ST | SEABOARD | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| SEVERN FD | STATE HWY 35 N | SEVERN | NC |
| SIMPSON RURAL FD INC | 1253 BLACKJACK SIMPSON RD | GREENVILLE | NC |
| SOUTHERN SHORES VFD INC | 15 S DOGWOOD TRL | KITTY HAWK | NC |
| ST. JOHN FD INC | 1127 STATE HWY 561 W | AULANDER | NC |
| STELLA VFD | 314 MORRISTOWN RD | STELLA | NC |
| STUMPY POINT FD | 149 BAYVIEW DR | STUMPY POINT | NC |
| SWANSBORO FD | 502 CHURCH ST | SWANSBORO | NC |
| THE BELVIDERE-CHAPPEL HILL VFD INC | 143 DRINKING HOLE RD | BELVIDERE | NC |
| THE CRESWELL VFD INC | 109 MAIN ST | CRESWELL | NC |
| TILLERY VFD INC | 6607 STATE HWY 561 | TILLERY | NC |
| TOWNSHIP SIX FD - CAROLINA PINES | 109 CAROLINA PINES BLVD | NEW BERN | NC |
| TOWNSHIP SIX FD - MAIN STATION | 313 US HWY 70 W | HAVELOCK | NC |
| TRAP VOL FD INC ST 54 | 1404 MEADOW RD | COLERAIN | NC |
| TRI COMMUNITY VOL FD - BRIDGETON VFD | 408 BRIDGE ST | NEW BERN | NC |
| TRI-COMMUNITY VFD - FAIRFIELD STATION | 589 BROAD CREEK RD | NEW BERN | NC |
| TRI-COMMUNITY VFD - TRUITT STATION | 651 TRUITT RD | NEW BERN | NC |
| TRI-COMMUNITY VOL - MAIN STATION | 187 ST DELIGHTS CHURCH RD | NEW BERN | NC |
| UNION RURAL FD OF HERTFORD COUNTY INC | 103 UNION RD | AHOSKIE | NC |
| VANCEBORO RURAL VFD - MAIN STATION | 102 1ST AVE | VANCEBORO | NC |
| VANCEBORO VFD - CHIPS STATION | 3475 RIVER RD | VANCEBORO | NC |
| VANCEBORO VFD - EPWORTH STATION | 4080 STATE HWY 118 | VANCEBORO | NC |
| VANCEBORO VFD - OAK GROVE STATION | 201 OAK GROVE RD | VANCEBORO | NC |
| WASHINGTON FIRE & RESCUE DEPARTMENT | 410 N MARKET ST | WASHINGTON | NC |
| WASHINGTON FORKS ST 3 | 108 WANDA AVE | NEW BERN | NC |
| WEEKSVILLE VFD SUB STN | SOUNDNECK RD | ELIZABETH CITY | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

Details about this model may be obtained at http://www.englink.usace.army.mil
or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Fire Stations Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| WEEKSVILLE VFD SUB STN | 1422 SOUNDNECK RD | ELIZABETH CITY | NC |
| WEST OF NEW BERN VFD- MAIN STATION | 900 CHELSEA RD | TRENT WOODS | NC |
| WESTERN CARTERET FIRE & RESCUE | 140 SHERWOOD AVE | CEDAR POINT | NC |
| WILDWOOD FIRE & RESCUE INC | 5291 US HWY 70 W | MOREHEAD CITY | NC |
| WILLIAMSTON FD | 901 WASHINGTON ST | WILLIAMSTON | NC |
| WINDSOR FD ST 43 | 501 N KING ST | WINDSOR | NC |
| WINFALL FD | 341 WIGGINS RD | WINFALL | NC |
| WINTON FD | 501 N MAIN ST | WINTON | NC |
| WOODLAND FD | 103 OAK ST | WOODLAND | NC |

The number of fire stations included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Fire Stations**

**Generated By:** Siemsen, LRL 0000 EDT 10/22/2008

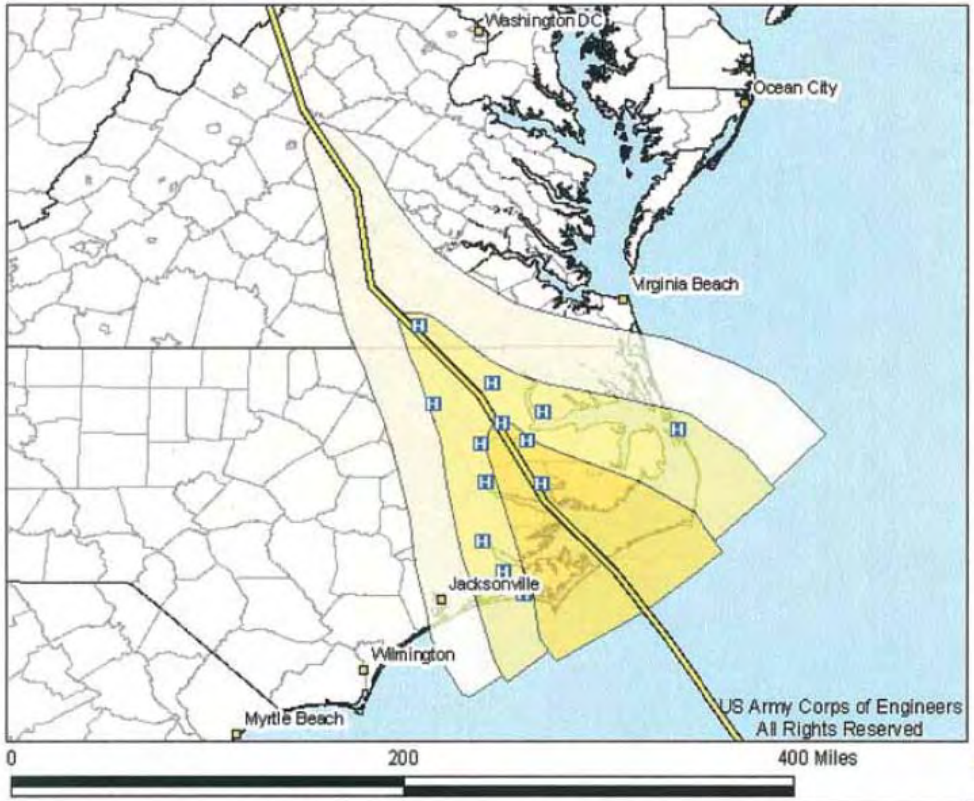
**Sources:** HURREVAC LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Hospitals

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Hospitals Inside Hurricane Force Winds***

North Carolina - 12
Virginia - 1

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Hospitals
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008).forecast.
The number of hospitals included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

Details about this model may be obtained at http://www.englink.usace.army.mil
or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Hospitals | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 24 of 43 |

US Army Corps of Engineers

# Hurricane Isabel
# Hospitals Within CAT 2
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| BERTIE MEMORIAL HOSPITAL | 1403 S KING ST | WINDSOR | NC |
| PUNGO DISTRICT HOSPITAL | 202 E WATER ST | BELHAVEN | NC |
| WASHINGTON COUNTY HOSPITAL | 958 US HWY 64E | PLYMOUTH | NC |

The number of hospitals included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Hospitals**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Hospitals Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| BEAUFORT COUNTY HOSPITAL | 628 E 12TH ST | WASHINGTON | NC |
| CARTERET GENERAL HOSPITAL | 3500 ARENDELL ST | MOREHEAD CITY | NC |
| CHOWAN HOSPITAL | 211 VIRGINIA RD | EDENTON | NC |
| CRAVEN REGIONAL MED CTR | 2000 NEUSE BLVD | NEW BERN | NC |
| MARTIN GENERAL HOSPITAL | 310 S MCCASKEY RD | WILLIAMSTON | NC |
| NAVAL HOSPITAL CHERRY POINT | BLDG 4889 BEAUFORT RD | CHERRY POINT | NC |
| OUR COMMUNITY HOSPITAL | 921 JR HIGH SCHOOL RD | SCOTLAND NECK | NC |
| ROANOKE-CHOWAN HOSPITAL | 500 ACADEMY ST S | AHOSKIE | NC |
| SOUTHERN VIRGINIA REGIONAL MEDICAL CENT | 727 N MAIN ST | EMPORIA | VA |
| THE OUTER BANKS HOSPITAL | 4800 S CROATAN HWY | NAGS HEAD | NC |

The number of hospitals included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Hospitals**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

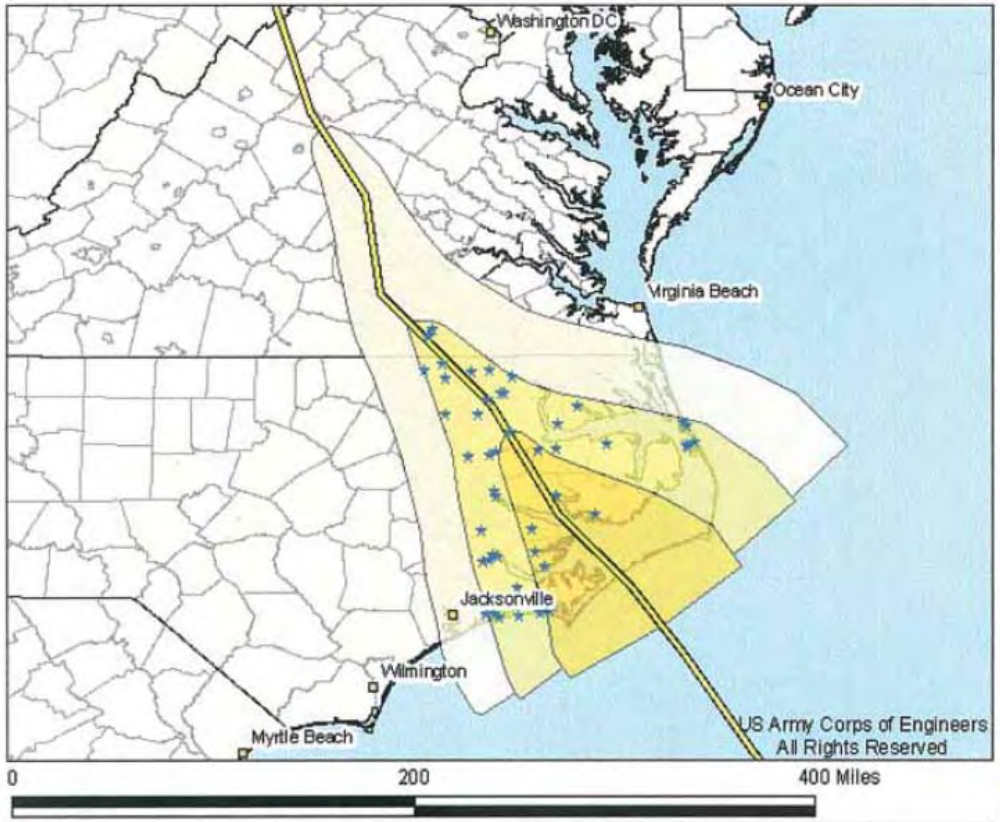
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Law Enforcement

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Law Enforcement Inside Hurricane Force Winds***

North Carolina - 56
Virginia - 4

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

★ Law Enforcement
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast.

The number of law enforcement included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

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| Hurricane Isabel Law Enforcement | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 27 of 43 |

US Army Corps of Engineers

# Hurricane Isabel
# Law Enforcement Within CAT 2
## Landfall Plus About 24 Hours

For Planning Purposes Only!

| Name | Address | City | State |
|---|---|---|---|
| AURORA POLICE DEPT HEADQUARTERS | 460 4TH ST | AURORA | NC |
| BEAUFORT POLICE DEPT HEADQUARTERS | 610 BROAD ST | BEAUFORT | NC |
| BELHAVEN POLICE DEPT HEADQUARTERS | 215 E MAIN ST | BELHAVEN | NC |
| BERTIE COUNTY SHERIFF'S DEPT. HEADQUARTERS | 104 DUNDEE ST | WINDSOR | NC |
| CARTERET COUNTY SHERIFF'S DEPT. HEADQUARTERS | 415 BROAD ST | BEAUFORT | NC |
| HYDE COUNTY SHERIFF'S DEPT. HEADQUARTERS | 50 OYSTER CREEK ST | SWAN QUARTER | NC |
| ORIENTAL TOWN POLICE DEPT HEADQUARTERS | 507 CHURCH ST | ORIENTAL | NC |
| PAMLICO COUNTY SHERIFF'S DEPT. HEADQUARTERS | 202 MAIN ST | BAYBORO | NC |
| PLYMOUTH POLICE DEPT HEADQUARTERS | 132 E WATER ST | PLYMOUTH | NC |
| WASHINGTON COUNTY SHERIFF'S DEPT HEADQUARTERS | 120 ADAMS ST | PLYMOUTH | NC |
| WINDSOR POLICE DEPT HEADQUARTERS | 128 S KING ST | WINDSOR | NC |

The number of law enforcement included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel**
**Law Enforcement**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Law Enforcement Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| AHOSKIE POLICE DEPT HEADQUARTERS | 301 MAIN ST W | AHOSKIE | NC |
| ATLANTIC BEACH POLICE DEPT HEADQUARTERS | 125 FORT MACON RD W | ATLANTIC BEACH | NC |
| AULANDER POLICE DEPT HEADQUARTERS | 124 W MAIN ST | AULANDER | NC |
| BEAUFORT COUNTY SHERIFF'S DEPT. HEADQUARTERS | 210 N MARKET ST | WASHINGTON | NC |
| CAPE CARTERET POLICE DEPT HEADQUARTERS | 204 W B MCLEAN BLVD | SWANSBORO | NC |
| CHOWAN COUNTY SHERIFF'S DEPT. HEADQUARTERS | 100 COURT ST | EDENTON | NC |
| CONWAY POLICE DEPT HEADQUARTERS | 221 W MAIN ST | CONWAY | NC |
| CRAVEN COUNTY SHERIFF'S DEPT. HEADQUARTERS | 411 CRAVEN ST | NEW BERN | NC |
| DARE COUNTY SHERIFF'S DEPT. HEADQUARTERS | 962 US HIGHWAY 64 AND 264 | MANTEO | NC |
| EDENTON POLICE DEPT HEADQUARTERS | 504 S BROAD ST | EDENTON | NC |
| EMERALD ISLE POLICE DEPT HEADQUARTERS | 7500 EMERALD DR | EMERALD ISLE | NC |
| EMPORIA CITY SHERIFF'S DEPT. HEADQUARTERS | 201 S MAIN ST | EMPORIA | VA |
| EMPORIA POLICE DEPT HEADQUARTERS | 310 BUDD ST | EMPORIA | VA |
| GARYSBURG POLICE DEPT HEADQUARTERS | 501 OLD HIGHWAY RD | GARYSBURG | NC |
| GREENSVILLE COUNTY SHERIFF'S DEPT. HEADQUARTERS | 174 URIAH BRANCH WAY | EMPORIA | VA |
| HAVELOCK POLICE DEPT HEADQUARTERS | 2 HATTERAS AVE | HAVELOCK | NC |
| HERTFORD COUNTY SHERIFF'S DEPT. HEADQUARTERS | 701 N TAYLOR ST | WINTON | NC |
| HERTFORD POLICE DEPT HEADQUARTERS | 114 W GRUBB ST | HERTFORD | NC |
| INDIAN BEACH POLICE DEPT HEADQUARTERS | 1400 SALTER PATH RD | INDIAN BEACH | NC |
| KITTY HAWK POLICE DEPT HEADQUARTERS | 722 W KITTY HAWK RD | KITTY HAWK | NC |
| LEWISTON WOODVILLE POLICE DEPT HEADQUARTERS | 103 W CHURCH ST | LEWISTON WOODVILLE | NC |
| MANTEO POLICE DEPT HEADQUARTERS | 410 ANANIAS DARE ST | MANTEO | NC |
| MARTIN COUNTY SHERIFF'S DEPT. HEADQUARTERS | 305 E MAIN ST | WILLIAMSTON | NC |
| MOREHEAD CITY POLICE HEADQUARTERS | 202 S 8TH ST | MOREHEAD CITY | NC |
| MURFREESBORO POLICE DEPT HEADQUARTERS | 115 E BROAD ST | MURFREESBORO | NC |

The number of law enforcement included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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Source: US Army Corps of Engineers, All Rights Reserved

**Hurricane Isabel**
**Law Enforcement**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Law Enforcement Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| NAGS HEAD POLICE DEPT HEADQUARTERS | 5401 S CROATAN HWY | NAGS HEAD | NC |
| NEW BERN POLICE DEPT HEADQUARTERS | 601 GEORGE ST. | NEW BERN | NC |
| NEWPORT POLICE DEPT HEADQUARTERS | 53 CHATHAM ST | NEWPORT | NC |
| NORTH CAROLINA STATE HIGHWAY PATROL TROOP A COMMUNICATIONS | 4003 W MAIN ST | WILLIAMSTON | NC |
| NORTH CAROLINA STATE HIGHWAY PATROL TROOP A, DIST. 2 | 242 STATE HWY 42 W | AHOSKIE | NC |
| NORTH CAROLINA STATE HIGHWAY PATROL TROOP A, DIST. 4 | 1821 CAROLINA AVE | WASHINGTON | NC |
| NORTH CAROLINA STATE HIGHWAY PATROL TROOP A, DIST. 6 | 2106 NEUSE BLVD | NEW BERN | NC |
| NORTH CAROLINA STATE HIGHWAY PATROL TROOP A, DIST. 9 | 2601 N CROATAN HWY | KILL DEVIL HILLS | NC |
| NORTHHAMPTON COUNTY SHERIFF'S DEPT. HEADQUARTERS | 105 E JEFFERSON ST | JACKSON | NC |
| PERQUIMANS COUNTY SHERIFF'S DEPT. HEADQUARTERS | 110 N CHURCH ST | HERTFORD | NC |
| RIVER BEND POLICE DEPT HEADQUARTERS | 115 WILDWOOD DR | NEW BERN | NC |
| ROBERSONVILLE POLICE DEPT. HEADQUARTERS | 119 S MAIN ST | ROBERSONVILLE | NC |
| ROPER POLICE DEPT. HEADQUARTERS | 301 W BUNCOMBE ST | ROPER | NC |
| SCOTLAND NECK POLICE HEADQUARTERS | 101 E 11TH ST | SCOTLAND NECK | NC |
| SEABOARD TOWN POLICE DEPT HEADQUARTERS | 102 CLAY ST | SEABOARD | NC |
| SWANSBORO POLICE DEPT HEADQUARTERS | 502 CHURCH ST | SWANSBORO | NC |
| TRENT WOODS POLICE DEPT HEADQUARTERS | 912 COUNTRY CLUB DR | TRENT WOODS | NC |
| TYRRELL COUNTY SHERIFF'S DEPT. HEADQUARTERS | 405 MAIN ST. | COLUMBIA | NC |
| U.S. CUSTOMS AND BORDER PROTECTION PORT OF ENTRY MOREHEAD CITY/BEAUFORT | 113 ARENDELL ST. | MOREHEAD CITY | NC |
| VANCEBORO POLICE DEPT HEADQUARTERS | 7905 MAIN ST | VANCEBORO | NC |
| VIRGINIA STATE HIGHWAY PATROL DIV. 5 / AREA 35 | 2361 SUSSEX DR | EMPORIA | VA |
| WASHINGTON POLICE DEPT HEADQUARTERS | 201 W 3RD ST | WASHINGTON | NC |
| WILLIAMSTON POLICE DEPT HEADQUARTERS | 106 E MAIN ST | WILLIAMSTON | NC |
| WINTON POLICE DEPT HEADQUARTERS | 405 N MAIN ST | WINTON | NC |

The number of law enforcement included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel**
**Law Enforcement**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

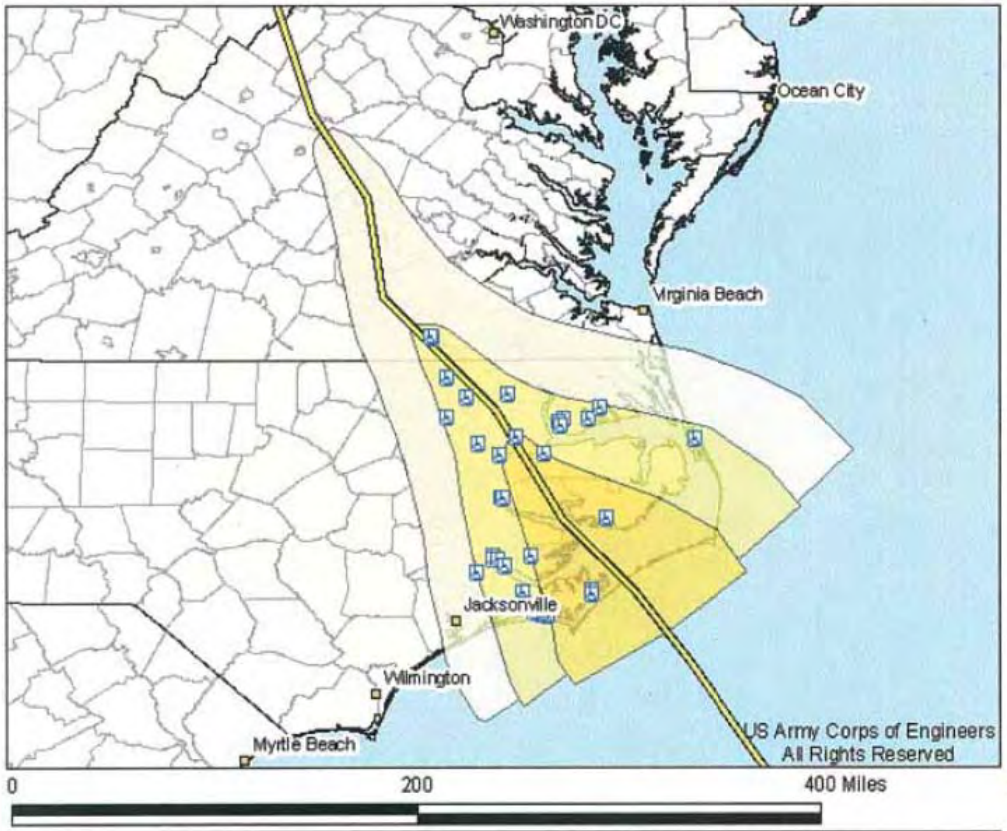
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Nursing Homes

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Nursing Homes Inside Hurricane Force Winds***

North Carolina - 37
Virginia - 3

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Nursing Homes
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast.

The number of nursing homes included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Nursing Homes | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 31 of 43 |

US Army Corps of Engineers

# Hurricane Isabel
# Nursing Homes Within CAT 2
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| BRIAN CT HEALTH & REHAB | | WINDSOR | NC |
| BRITTHAVEN OF PAMLICO NRSG HOME | | GRANTSBORO | NC |
| CROSS CREEK HEALTH CARE INC | | SWANQUARTER | NC |
| PLUMBEE NURSING CENTER | | PLYMOUTH | NC |
| SNUG HARBOR NRSG CTR | | SEALEVEL | NC |
| TAYLOR EXTENDED CARE | | SEALEVEL | NC |
| THREE RIVERS | | WINDSOR | NC |

The number of nursing homes included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Nursing Homes**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Nursing Homes Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| ALTERRA STERLING HSE NEW BERN | | NEW BERN | NC |
| AUTUMN CARE OF ROANOKE VALLEY | | RICH SQUARE | NC |
| AVIS B ADAMS CHRISTIAN CONV CTR | | EMPORIA | VA |
| BAYVIEW NURSING & REHAB CENTER | | NEW BERN | NC |
| BERNE VILLAGE | | NEW BERN | NC |
| BLOOM RETIREMENT CENTER | | EMPORIA | VA |
| BRIAN CENTER HEALTH & REHAB | | HERTFORD | NC |
| BRITTHAVEN NURSING HOME | | NAGS HEAD | NC |
| BRITTHAVEN OF HAVELOCK | | HAVELOCK | NC |
| BRITTHAVEN OF NEWPORT | | NEWPORT | NC |
| BRITTHAVEN-EDENTON NURSING HOME | | EDENTON | NC |
| BRITTHAVEN-NEW BERN NURSING HME | | NEW BERN | NC |
| BRITTHAVEN-WASHINGTN NRSG HOME | | WASHINGTON | NC |
| CAROLINA HOUSE OF MOREHEAD CITY | | MOREHEAD CITY | NC |
| CENTRY CARE OF CRYSTAL COAST | | MOREHEAD CITY | NC |
| CHOWAN HOSPITAL-SNF | | EDENTON | NC |
| EKKLESIA | | MOREHEAD CITY | NC |
| GRNSVIL MEM NURS HM-LNG TRM CR UNT | | EMPORIA | VA |
| GUARDIAN CARE | | SCOTLAND NECK | NC |
| GUARDIAN CARE OF AHOSKIE | | AHOSKIE | NC |
| HAMILTON BAPTIST HOME | | HAMILTON | NC |
| HAMPTON WOODS HLTH & REHAB CTR | | JACKSON | NC |
| HARBORVIEW HEALTH CARE CENTER | | MOREHEAD CITY | NC |
| IHS OF WILLIAMSTON | | WILLIAMSTON | NC |
| NEW BERN HEALTH CARE CENTER | | NEW BERN | NC |

The number of nursing homes included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Nursing Homes**

**Generated By:** Siemsen, LRL 0000 EDT 10/22/2008

**Sources:** HURREVAC LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Nursing Homes Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| OUR COMMUNITY HOSPITAL-SNF | | SCOTLAND NECK | NC |
| PRIME TIME SR ESTATES ASSTD LVNG | | EDENTON | NC |
| RIDGEWOOD MANOR | | WASHINGTON | NC |
| ROANOKE CHOWAN HOSP-SUBACUTE | | AHOSKIE | NC |
| SOMERSET COURT OF NEWPORT | | NEWPORT | NC |
| SOUTH HAVEN MANOR | | HERTFORD | NC |
| TRENT VILLAGE NURSING HOME | | POLLOCKSVILLE | NC |
| TWO RIVERS HEALTH CARE | | NEW BERN | NC |

The number of nursing homes included in this output are those that would included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program). They are broken out by interpolated wind damage areas for easier review of assets and facilities.

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**Hurricane Isabel Nursing Homes**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

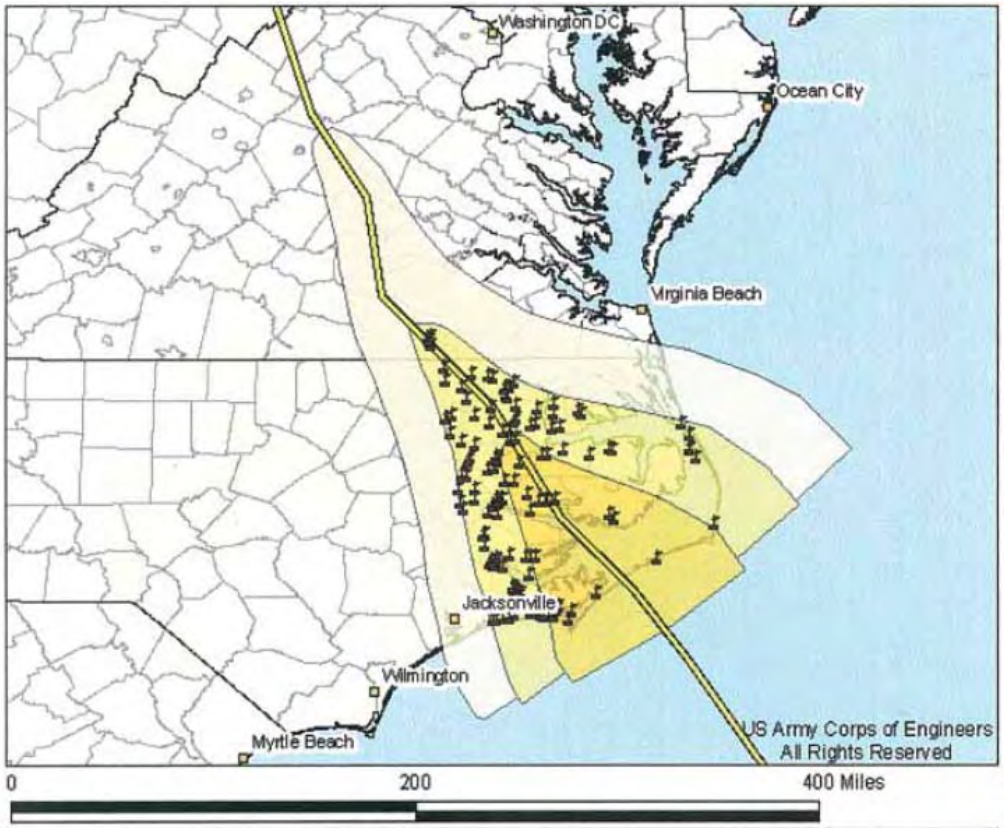
**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Schools

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**




***Most Probable Landfall Schools Inside Hurricane Force Winds***

North Carolina - 157
Virginia - 6

*Model results per County on following page*

This model is based on a Category 2 storm making landfall on coastal NC.

Schools
Historic Track

Information provided on this page displays a Category 2 storm making landfall on coastal NC. These projections are based on information from the NHC (0000 EDT 10/22/2008) forecast.

The number of schools included in this output are those that would be included within estimated hurricane force winds (data source: Homeland Security Infrastructure Program).

Details about this model may be obtained at http://www.englink.usace.army.mil or contact Louisville District staff at DLL-CELRL-GIS@usace.army.mil

| Hurricane Isabel Schools | |
|---|---|
| **Generated By:** Siemsen, LRL<br>0000 EDT 10/22/2008 | |
| **Sources:**<br>HURREVAC<br>LRL-DEBRIS | Page 35 of 43 |

US Army Corps of Engineers

# Hurricane Isabel Schools Within CAT 2

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| ATLANTIC ELEM SCHOOL | | ATLANTIC | NC |
| BATH ELEM SCHOOL | | BATH | NC |
| BEAUFORT CHRIST ACADEMY | | BEAUFORT | NC |
| BEAUFORT ELEM SCHOOL | | BEAUFORT | NC |
| BEAUFORT MIDDLE SCHOOL | | BEAUFORT | NC |
| E CARTERET SR HIGH SCH | | BEAUFORT | NC |
| FRED A ANDERSON ELEM SCHOOL | | BAYBORO | NC |
| HARKERS IS ELEM SCHOOL | | HARKERS ISLAND | NC |
| HOPE MENNONITE SCHOOL | | PANTEGO | NC |
| JAMESVILLE ELEM SCHOOL | | JAMESVILLE | NC |
| JAMESVILLE HIGH SCHOOL | | JAMESVILLE | NC |
| MATTAMUSKEET ELEM SCHOOL | | SWANQUARTER | NC |
| MATTAMUSKEET HIGH SCHOOL | | SWANQUARTER | NC |
| MATTAMUSKEET MIDDLE SCHOOL | | SWANQUARTER | NC |
| NORTHEAST ELEMENTARY SCHOOL | | PINETOWN | NC |
| NORTHSIDE HIGH SCHOOL | | PINETOWN | NC |
| NORTHWOODS COLLEGIATE SCH | | WILLIAMSTON | NC |
| OCRACOKE SCHOOL | | OCRACOKE | NC |
| PAMLICO CO MIDDLE SCHOOL | | BAYBORO | NC |
| PAMLICO CO PRIMARY SCHOOL | | BAYBORO | NC |
| PAMLICO CO SR HIGH SCHOOL | | BAYBORO | NC |
| PLYMOUTH HIGH SCHOOL | | PLYMOUTH | NC |
| PUNGO CHRISTIAN ACADEMY | | BELHAVEN | NC |
| SERENDIPITY ALTERNATIVE SCHOOL | | WINDSOR | NC |
| SMYRANA ELEM SCHOOL | | SMYRNA | NC |

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**Hurricane Isabel Schools**

**Generated By:** Siemsen, LRL
0000 EDT 10/22/2008

**Sources:**
HURREVAC
LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel Schools Within CAT 2

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| TERRA CEIA CHRISTIAN SCH | | PANTEGO | NC |
| TILLER SCHOOL | | BEAUFORT | NC |
| WINDSOR ELEM SCHOOL | | WINDSOR | NC |

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**Hurricane Isabel Schools**

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**Sources:** HURREVAC LRL-DEBRIS

US Army Corps of Engineers

# Hurricane Isabel
# Schools Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| A H BANGERT ELEM SCHOOL | | TRENT WOODS | NC |
| AHOSKIE CHRISTIAN SCH | | AHOSKIE | NC |
| AHOSKIE ELEM SCHOOL | | AHOSKIE | NC |
| ANNUNCIATION CATHOLIC EL SCH | | HAVELOCK | NC |
| ARAPAHOE CHARTER SCHOOL | | ARAPAHOE | NC |
| ARTHUR W EDWARDS ELEM SCHOOL | | HAVELOCK | NC |
| ASKEWVILLE ELEM SCHOOL | | WINDSOR | NC |
| AULANDER ELEM SCHOOL | | AULANDER | NC |
| BAKERS ELEM SCHOOL | | SCOTLAND NECK | NC |
| BEACON ACADEMY | | HERTFORD | NC |
| BEAR GRASS HIGH SCH | | WILLIAMSTON | NC |
| BEARFIELD PRIMARY SCHOOL | | AHOSKIE | NC |
| BEAUFORT ED TECH CENTER | | WASHINGTON | NC |
| BELFIELD ELEM SCHOOL | | EMPORIA | VA |
| BEN D QUINN ELEM SCHOOL | | NEW BERN | NC |
| BERTIE SR HIGH SCHOOL | | WINDSOR | NC |
| BETHEL ASSEM CHR ACAD | | WINDSOR | NC |
| BOGUE SOUND ELEM SCHOOL | | NEWPORT | NC |
| BRAWLEY MIDDLE SCHOOL | | SCOTLAND NECK | NC |
| BRIDGETON ELEM SCHOOL | | BRIDGETON | NC |
| BRINSON MEM ELEM SCHOOL | | NEW BERN | NC |
| BROAD CREEK MIDDLE SCHOOL | | NEWPORT | NC |
| C G WHITE MIDDLE SCHOOL | | COLERAIN | NC |
| CALVARY BAPT CHURCH SCH | | NEW BERN | NC |
| CAPE HATTERAS ELEM SCHOOL | | BUXTON | NC |

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US Army Corps of Engineers

# Hurricane Isabel
# Schools Within CAT 1
## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| CAPE HATTERAS SEC SCHOOL | | BUXTON | NC |
| CAPE LOOKOUT MRNE SCNCE HI SCH | | MOREHEAD CITY | NC |
| CARTERET ACADEMY | | MOREHEAD CITY | NC |
| CHICOD ELEM SCHOOL | | GREENVILLE | NC |
| CHOCOWINITY MIDDLE SCHOOL | | CHOCOWINITY | NC |
| CHOCOWINITY PRIMARY SCHOOL | | CHOCOWINITY | NC |
| CHOWAN MIDDLE SCHOOL | | TYNER | NC |
| COLERAIN ELEM SCHOOL | | COLERAIN | NC |
| COLUMBIA HIGH SCHOOL | | COLUMBIA | NC |
| COLUMBIA MIDDLE SCHOOL | | COLUMBIA | NC |
| COMMUNITY CHRISTIAN ACAD | | GREENVILLE | NC |
| COUNTRYSIDE SCHOOL | | EDENTON | NC |
| CRESWELL ELEM SCHOOL | | CRESWELL | NC |
| CRESWELL HIGH SCHOOL | | CRESWELL | NC |
| CROATAN HIGH SCHOOL | | NEWPORT | NC |
| D F WALKER ELEM SCHOOL | | EDENTON | NC |
| D H CONLEY HIGH SCHOOL | | GREENVILLE | NC |
| DARE CO ALTERNATIVE SCHOOL | | MANTEO | NC |
| E J HAYES ELEM SCHOOL | | WILLIAMSTON | NC |
| EAST END ELEM SCHOOL | | ROBERSONVILLE | NC |
| EASTERN ELEM SCHOOL | | WASHINGTON | NC |
| EDNA ANDREWS ELEM SCHOOL | | HAMILTON | NC |
| EDWARD WYATT JR HIGH SCHOOL | | EMPORIA | VA |
| EMMANUEL CHR SCH | | WASHINGTON | NC |
| FAITH CHRISTIAN SCHOOL | | EMPORIA | VA |

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# Hurricane Isabel Schools Within CAT 1

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| FIRST FLIGHT ELEM SCHOOL | | KILL DEVIL HILLS | NC |
| FIRST FLIGHT MIDDLE SCHOOL | | KILL DEVIL HILLS | NC |
| G R WHITFIELD ELEM SCHOOL | | GRIMESLAND | NC |
| GRACE CHRIST SCHOOL | | NEWPORT | NC |
| GRAHAM BARDEN ELEM SCHOOL | | HAVELOCK | NC |
| GRAMERCY CHRISTIAN SCHOOL | | NEWPORT | NC |
| GREENSVILLE CO HIGH SCHOOL | | EMPORIA | VA |
| GREENVILLE ELEM SCHOOL | | EMPORIA | VA |
| GROVER C FIELDS MIDDLE SCH | | NEW BERN | NC |
| H J MACDONALD MIDDLE SCHOOL | | NEW BERN | NC |
| HAVELOCK ELEM SCHOOL | | HAVELOCK | NC |
| HAVELOCK HIGH SCH | | HAVELOCK | NC |
| HAVELOCK MIDDLE SCHOOL | | HAVELOCK | NC |
| HERTFORD CO HIGH SCHOOL | | AHOSKIE | NC |
| HERTFORD CO MIDDLE SCHOOL | | MURFREESBORO | NC |
| HERTFORD GRAMMER SCHOOL | | HERTFORD | NC |
| HERTFORD MULTI PURPOSE SCH | | WINTON | NC |
| HOBGOOD ACADEMY | | HOBGOOD | NC |
| HORIZONS ACADEMY/DAY SCHOOL | | NEW BERN | NC |
| J C TAYLOE ELEM SCHOOL | | WASHINGTON | NC |
| J T BARBER ELEM SCHOOL | | NEW BERN | NC |
| JOHN A HOLMES HIGH SCHOOL | | EDENTON | NC |
| JOHN P LAW ELEM SCHOOL | | MERRY HILL | NC |
| JOHN SMALL ELEM SCHOOL | | WASHINGTON | NC |
| KITTY HAWK ELEM SCHOOL | | KITTY HAWK | NC |

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# Hurricane Isabel Schools Within CAT 1

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| LAWRENCE ACADEMY | | MERRY HILL | NC |
| LIBERTY CHRIST SCHOOL | | HAVELOCK | NC |
| LIFEGATE CHRIST SCHOOL | | GREENVILLE | NC |
| MANTEO ELEM SCHOOL | | MANTEO | NC |
| MANTEO HIGH SCHOOL | | MANTEO | NC |
| MOREHEAD CITY MIDDLE SCHOOL | | MOREHEAD CITY | NC |
| MOREHEAD ELEM SCHOOL | | MOREHEAD CITY | NC |
| MOREHEAD PRIMARY SCHOOL | | MOREHEAD CITY | NC |
| NEW BERN HIGH SCHOOL | | NEW BERN | NC |
| NEWPORT ELEM SCHOOL | | NEWPORT | NC |
| NEWPORT MIDDLE SCHOOL | | NEWPORT | NC |
| NORTH PITT HIGH SCHOOL | | BETHEL | NC |
| NORTHAMPTON CO HIGH SCH EAST | | CONWAY | NC |
| NORTHAMPTON LEARNING CENTER | | JACKSON | NC |
| NORTHEAST ACADEMY | | LASKER | NC |
| OAKS RD ELEM SCHOOL | | NEW BERN | NC |
| P S JONES MIDDLE SCHOOL | | WASHINGTON | NC |
| PACTOLUS ELEM SCHOOL | | GREENVILLE | NC |
| PERQUIMANS COUNTY HIGH SCHOOL | | HERTFORD | NC |
| PINES ELEM SCHOOL | | PLYMOUTH | NC |
| RICH SQUARE CREECY ELEM SCH | | RICH SQUARE | NC |
| RIDGECROFT SCH | | AHOSKIE | NC |
| RIVERVIEW ELEM SCHOOL | | MURFREESBORO | NC |
| ROANOKE HIGH SCHOOL | | ROBERSONVILLE | NC |
| ROANOKE MIDDLE SCHOOL | | ROBERSONVILLE | NC |

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# Hurricane Isabel Schools Within CAT 1

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| ROANOKE-CHOWAN CHR ACAD | | AHOSKIE | NC |
| RODGERS ELEM SCHOOL | | WILLIAMSTON | NC |
| ROGER R BELL ELEM SCHOOL | | HAVELOCK | NC |
| RUTHS CHAPEL CHRIST SCH | | NEW BERN | NC |
| SCOTLAND NECK PRIMARY SCHOOL | | SCOTLAND NECK | NC |
| SEABOARD COATES ELEM SCHOOL | | SEABOARD | NC |
| SERENDIPITY SCHOOL | | WINDSOR | NC |
| SOUTHSIDE HIGH SCHOOL | | CHOCOWINITY | NC |
| SOUTHWESTERN MIDDLE SCHOOL | | WINDSOR | NC |
| ST EGBERT GRADE SCHOOL | | MOREHEAD CITY | NC |
| ST PAULS SCHOOL | | NEW BERN | NC |
| STANDARD CHRISTIAN ACADEMY | | GRANTSBORO | NC |
| STOKES ELEM SCHOOL | | STOKES | NC |
| SWANSBORO ELEM SCHOOL | | SWANSBORO | NC |
| TRENT PARK ELEM SCHOOL | | NEW BERN | NC |
| TUCKER CREEK MIDDLE SCHOOL | | HAVELOCK | NC |
| TYRRELL ELEM SCHOOL | | COLUMBIA | NC |
| VANCEBORO FARM LIFE SCHOOL | | VANCEBORO | NC |
| W BERTIE ELEM SCHOOL | | LEWISTON | NC |
| W CARTERET HIGH SCHOOL | | MOREHEAD CITY | NC |
| W JESSE GURGANUS ELEM SCHOOL | | HAVELOCK | NC |
| W MARTIN ALTERNATIVE SCHOOL | | OAK CITY | NC |
| WANCHESE CHRIST ACAD | | WANCHESE | NC |
| WASHINGTON CO UNION SCHOOL | | ROPER | NC |
| WASHINGTON HIGH SCHOOL | | WASHINGTON | NC |

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# Hurricane Isabel Schools Within CAT 1

## Landfall Plus About 24 Hours

**For Planning Purposes Only!**

| Name | Address | City | State |
|---|---|---|---|
| WASHINGTON MONT CHARTER SCH | | WASHINGTON | NC |
| WEST CRAVEN HIGH SCHOOL | | VANCEBORO | NC |
| WEST CRAVEN MIDDLE SCHOOL | | NEW BERN | NC |
| WHITE OAK CHRIST ACAD | | NEWPORT | NC |
| WHITE OAK ELEM SCHOOL | | CAPE CARTERET | NC |
| WHITE OAK ELEM SCHOOL | | EDENTON | NC |
| WILLIAMSTON HIGH SCHOOL | | WILLIAMSTON | NC |
| WILLIAMSTON MIDDLE SCHOOL | | WILLIAMSTON | NC |
| WILLIAMSTON PRIMARY SCHOOL | | WILLIAMSTON | NC |
| ZION SCHOOL | | EMPORIA | VA |

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**Hurricane Isabel Schools**

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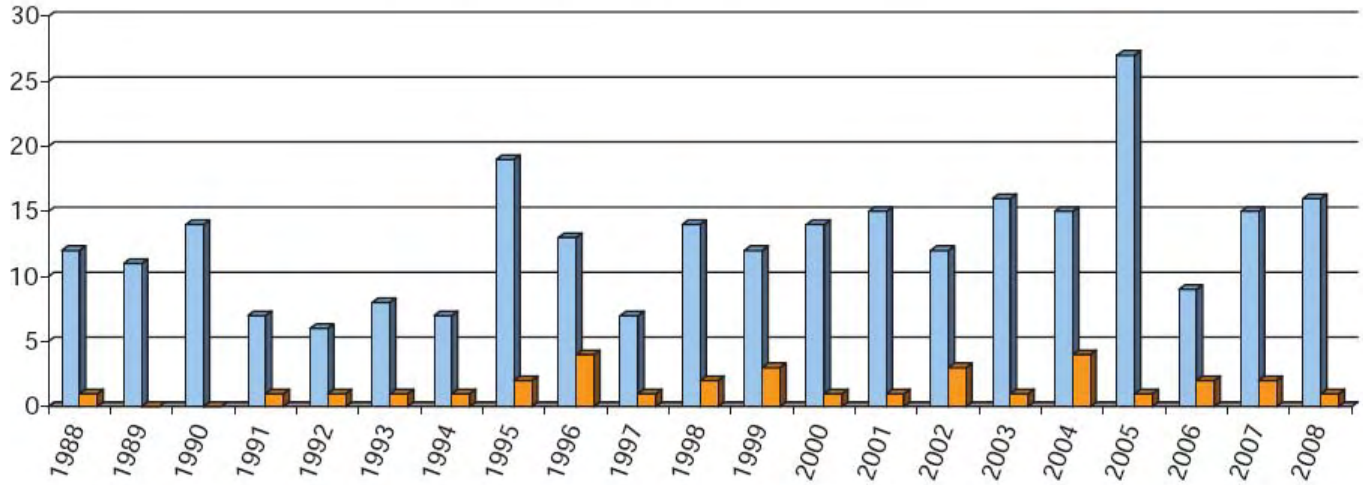
## Hurricane Totals For Past 20 Years




| Years | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total For Year | 12 | 11 | 14 | 7 | 6 | 8 | 7 | 19 | 13 | 7 | 14 | 12 | 14 | 15 | 12 | 16 | 15 | 27 | 9 | 15 | 16 |
| Affecting Dare County | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 4 | 1 | 2 | 3 | 1 | 1 | 3 | 1 | 4 | 1 | 3 | 3 | 1 |

Total For Year  Affecting Dare County

## C. Earthquakes

***What Is 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, Modified Mercalli Intensity (MMI), Moment Magnitude and Peak Ground Acceleration (PGA), 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 tenfold increase in wave amplitude, or a 244-fold increase in energy.

Intensity is most commonly measured using the Modified Mecalli 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). A detailed description of the Modified Mercalli Scale of Earthquake Intensity (and its correspondence to the Richter Scale) is below.

***Earthquakes in North Carolina:***

Earthquakes are relatively infrequent by not uncommon in North Carolina. Epicenters of North 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 1929 in this area, it has the potential to produce an earthquake of significant intensity in the future.

North Carolina's vulnerability to earthquakes decreases from west to east in relation to the Eastern Tennessee Seismic Zone. Generally, there are three different zones of seismic risk in North Carolina that correspond to different effective peak velocity-related accelerations of ground movement. The eastern portion of the State faces minimal effects from seismic activity. Locations in the middle and southeastern areas of the State face a moderate

hazard from seismic activity, while the area from Mecklenburg County west through the Blue Ridge faces the greatest risk from seismic activity. These different levels of risk correspond to proximity to areas with historical seismic activity and changes in topography.

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

***Earthquakes in Dare County***

Dare County has no history of earthquakes.

**Table 6. Modified Mercalli Scale of Earthquake Intensity**

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

**Probability of Occurrence for Earthquake**
(From State Hazard Mitigation Plan, October 2007)

## D. Landslides

### *What is a Landslide?*

Common throughout the mountainous Appalachian region, landslides are described as downward movement of a slope and materials under the force of gravity. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (mining and construction of buildings, railroads, and highways), and natural factors (geology, precipitation, and topography).

Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snow melt, changing the earth into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. Other types of landslides include: rock slides, slumps, mudslides, and earth flows. All of these differ in terms of content and flow.

***Causes of Landslides:***

Landslides occur when masses of rack, earth, or debris move down a slope. Therefore, gravity acting on an overly steep slope is the primary cause of a landslide. There are activated by storms, fires, and by human modifications to the land. New landslides occur as a result of rainstorms, earthquakes, and various human activities.

***Predicting Landslides:***

The best predictor of future landslides is past landslides because they tend to occur in the same places. Existing or old landslides may be found in the following areas:

- On or at the base of slopes;
- In or at the base of minor drainage hollows;
- At the base or top of an old fill slope;
- At the base or top of a steep cut slope; or
- Developed hillsides where leach field septic systems are used.

***High Risk Factors:***

The following conditions may exacerbate the effects of landslides:

- Erosion: Erosion caused by rivers, glaciers, or ocean waves created by overly steep slopes.
- Unstable Slopes: rock and soil slopes are weakened through saturation by snowmelt or heavy rains.
- Earthquakes: The shaking from earthquakes creates stress that makes weak slopes fail.
- Vibrations: Machinery, traffic, blasting, and even thunder may cause vibrations that trigger failure or weak slopes.
- Increase of Load: Weight or rain/snow, fills, vegetation, stockpiling rock or ore from waste piles, or from man-made structures may cause weak slopes to fail.
- Hydrologic Factors: Rain, high water tables, little or no ground cover, numerous freeze/thaw cycles may cause weak slopes to fail.
- Human Activity: These include development activities such as cutting and filling along roads and removal of forest vegetation. Such activities are capable of greatly altering slope form and ground water conditions which can cause weak slopes to fail.
- Removal of Lateral and Underlying Support: Erosion, previous slides, road cuts and quarries can trigger failure of weak slopes.
- Increasing of Lateral Pressures: Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- Regional Tilting: Geologic movements can trigger weak slopes to fail.

***Landslide Maps:***

The three most useful types of landslide maps are: 1) landslide inventories; 2) landslide susceptibility maps; and 3) landslide hazard maps.

- Landslide Inventories: Landslide inventories identify areas that appear to have failed due to landslides, including debris flows and cut-and-fill failures. Detailed inventories depict and classify each landslide and show scarps, zones of depletion and accumulation, active versus inactive slides, geological age, rate or movement, and other pertinent data on the depth and type of materials involved in sliding. Overlaying a geologic map with an inventory map that shows existing landslides can identify specific landslide-prone

geologic units. For this reason, a landslide inventory is essential for preparing a landslide susceptibility map.

- Landslide Susceptibility Maps: Landslide susceptibility maps depict areas that have the potential for landslides by correlating some of the principal factors that contribute to landslides – steep slopes, geologic units that lose strength when saturated, and poorly drained rock or soil – with the past distribution of landslides. These maps indicate the relative stability of slopes; however, they do not make absolute predictions. More complex maps may include additional information such as slope angle, and drainage.
- Landslide Hazard Maps: Landslide hazard maps show the real extent of the threat: where landslides have occurred in the past, where they are likely to occur now, and where they could occur in the future. They contain detailed information on the types of landslides, extent of slope subject to failure, and probable maximum extent of ground movement. These maps can be used to predict the relative degree of hazard in a landslide area.

***Landslides in Dare County***

Dare County has no history of landslides.

## E. Nor'easters

***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 (from the northeast), 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. This is particularly true off the North Carolina coastline where, on average, the Gulf Stream is closest to land north of 32 degrees latitude. 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.

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 North Carolina:***

The coastal counties of North Carolina are most vulnerable to the impacts of nor'easters. Since the storms typically make landfall with less warning than hurricanes (due to their rapid formation right along the coast), residents may be caught at home unprepared. As with hurricanes, vulnerability is proportional to structural strength, with mobile homes particularly vulnerable.

***Nor'easters in Dare County***

Dare County is a high risk for nor'easters with several major nor'easters impacting the county over the last 50 years. Improved weather forecasting and information dissemination to the public have reduced the life-threatening possibility of such storms, however, the potential for property loss and severe structure damage remains high.

**Table 7. The Dolan-Davis Nor'easter Intensity Scale** *(Based upon levels of coastal degradation)*

| 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 |

**Historical Impact**

A number of nor'easters have impacted North Carolina in recent decades. During the past five years, there has been a noticeable increase in both the frequency and intensity of storms. In April 1988, a winter storm generated 55 mile per hour winds and 10-foot seas that washed over Highway 12 and closed down ferry service to and from Hatteras Island. During a three-week period in March of 1989, three successive winter storms caused major beach erosion (up to 100 feet in some areas) and damage totaling $5 million. 28 homes were deemed uninhabitable/unlivable and several businesses were damaged. No lives were lost in this event. The loss of dunes has resulted in having no buildable ocean front lots.

Late October, early November 1990, which loosened a dredge barge that struck and destroyed approximately five roadway segments of the Bonner Bridge. Another event of a nor'easter in struck Dare County on Halloween 1991, causing substantial beach erosion.

The "Storm of the Century" in March 1993 brought sustained winds of 41 miles per hour with gusts up to 63 mph, generated water levels up to 7.5 feet above mean sea level, and spawned three tornados.

In January and February a series of winter nor'easters where the responsible for causing moderate / major beach erosion and property damage along the beaches of Dare County. The total cost for the events was approximately one million dollars. A nor'easter in November 2006 generated over two million dollars and closed Highway NC 12 for several days. A State of Emergency was declared for this storm. Another series of nor'easters in September/October of 2008 caused one million dollars, mainly along the oceanfront in South Nags Head.

Nor'easters have forced the closure of Highway NC 12, in Rodanthe, over a dozen times in the past five years.

## F. Thunderstorms

***What is A Thunderstorm***

Thunderstorms are the result of convection in the atmosphere. They are typically the byproduct 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 (rising air parcels can also result from air flows over mountainous areas). 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 tornados.

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. The half million tons of condensed water release 300 trillion calories of energy, equivalent to about 100 million kilowatt-hours of electricity, or several Hiroshima-sized atomic bombs.

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 super cooled 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.

***Thunderstorms in North Carolina:***
Thunderstorms are common throughout North Carolina, and have occurred in all months of the year. Thunderstorm-related deaths and injuries in North Carolina have peaked during July and August. Because mountainous areas disrupt the inflow of air near the surface of squall lines and individual thunderstorms, organized thunderstorm activity is generally not a strong in western North Carolina, and thus tornado activity is muted in this region.

***Thunderstorms in Dare County***

While not listed as a natural hazard by the National Climatic Data Center, thunderstorms occur frequently during the spring and summer, and would be considered a high risk. The risk of lightning strikes and tornadoes/waterspouts is also a possibility during thunderstorm activity, in fact, lightning strikes to structures are a frequent occurrence.

## G. Tornadoes

***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 North Carolina:***

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

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

The mountains and northern piedmont of North Carolina experience the lowest frequency of tornadoes because of less favorable conditions for severe thunderstorm activity in those regions. The highest frequency of tornadoes historically has occurred in the southeastern portion of the State.

***Tornadoes in Dare County***

The hazard risk for tornadoes in Dare County is high as categorized by the National Climatic Data Center. The majority of tornadoes occurring in the county are formed as waterspouts that then travel over land. Rarely do any exceed F1 on the Fujita-Pearson scale, however on July 31, 1978 a waterspout turned tornado killed one person and injured six with over $500,000 damage. Dare County has an aggressive all hazards plan that would respond to any tornado threat.

***Tornado Measurement:***

Tornadoes are characterized by damage patter, F0 through F5 on the Fujita-Pearson Tornado Scale. The table below shows the tornado category, expected damages, and corresponding wind speed. The Fujita-Pearson Tornado Scale is provided in Table 8.

**Table 8. The Fujita-Pearson Tornado Scale**

| F-Scale | Damage | Winds (mph) | Path Length (miles) | Mean Width (miles) |
|---|---|---|---|---|
| F0 (Weak) | Light | 40-72 | < 1 | < 0.01 |
| F1 (Weak) | Moderate | 73-112 | 1-3.1 | 0.01-0.03 |
| F2 (Strong) | Considerable | 113-157 | 3.2-9.9 | 0.04-0.09 |
| F3 (Strong) | Severe | 158-206 | 10-31 | 0.1-0.31 |
| F4 (Violent) | Devastating | 207-260 | 32-99 | 0.32-0.99 |
| ) 9LRBICW | ,CFUHGLEGI | | | ! |

**H. Wildfire**

A Wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. A wild land fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An Urban-wild land Interface fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wild land 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.

***Wildfires in North Carolina:***
North Carolina, with its large amount of wooded areas, is included among the states with a high risk of wildfire. As development has spread into areas of North Carolina which were previously rural, new residents have been relatively unaware of the hazards posed by wildfires and have used highly flammable material for construction buildings. This has increased the threat of loss of life and property, and has also resulted in a greater population of people less prepared to cope with wildfire hazards. The southern coastal plain is particularly vulnerable to wildfire hazard. The mountain region has also experienced wildfires.

***Wildfires in Dare County***
Dare County is a moderate risk to wildfire according to the National Climatic Data Center. The area of concern is the urban interface with woodland areas that are heavy with accumulated fire load from overgrowth or decaying vegetation from hurricane wind damage. Dare County has a very active association with NC Division of Forestry and National Fish and Wildlife Agency in accessing wildfire risk and response. There is no data on frequency of wildfires in Dare County.

***Factors Affecting Wildfire Behavior:***
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.

Topography (slope) is important because it affects the movement of air (and thus the fire) over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. In general terms, the steeper the slope of the land, the faster a fire can spread up the slope. A topographic map can help identify areas of the community with slopes less than 40%, between 41% and 60%, and greater than 61%, corresponding to low, moderate and steep gradients relative to the spread of wildfires.

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. The average number of days per year or critical fire weather experienced in the community can be obtained from the local or state fire marshal, forestry department, or department of natural resources. The National Weather Service or NOAA Websites can help determine past weather conditions.

***Wildfire Measurement:***

To determine fire hazard severity for your community, use the Fire Hazard Severity Table below. You may have more than one classification in your community depending on the degrees of the slope and fuel models. Fire Hazard Severity is provided in Table 9.

**Table 9. Fire Hazard Severity**

| 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 | 41-60 | >61 | <40 | 41-60 | >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 |

**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)

## I. Severe Winter Storm

***What Are Severe Winter Storms?***

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets and extreme cold. Extreme snow events are the most potentially disruptive to society, for they can bring down power lines, trees and lead to roof collapses. All forms of severe winter weather can make traveling treacherous. Severe winter storms are extra-tropical cyclones fueled by strong temperature gradients and an active upper-level jet stream. The winter storms that impact North Carolina generally form in the Gulf of Mexico or off the southeast Atlantic Coast. Few of these storms result in blizzard conditions, defined by the presence of winds in excess of 35 mph, falling and blowing snow, and a maximum temperature of 200 Fahrenheit.

While the frequency and magnitude of snow events are highest in the mountains due to elevation, the geographical orientation of the mountains and Piedmont contribute to a regular occurrence of freezing precipitation events (e.g., ice pellets and freezing rain) in the Piedmont. Such ice events (up to and including ice storms) are often the result of cold air damming (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 supercooled (liquid below the melting point of water) or re-freezes. In the former case, supercooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet).

***Severe Winter Storms in North Carolina:***
The entire state of North Carolina has a likelihood of experiencing severe winter weather. The threat varies by location and by type of storm. Coastal area typically face their greatest 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.

Cold air damming contributes to elevated freezing rain and ice storm events in the Piedmont of North Carolina. These events occur at least as often as moderate or severe snow events in this region.

The mountains of North Carolina usually receive several snowfalls of 4 to 6 inches in a given winter weather season. There has been at least one severe winter storm at some location in the mountains each year for the past several decades. The western area of the state is more likely to experience greater and more frequent snowfalls and blizzards than other locations in the state. The mountains also have the highest number of extreme on-day snowfalls.

***Severe Winter Storms in Dare County***
The National Climatic Data Center indicates a low hazard probability for severe winter storms in Dare County. Dare County has a very aggressive all hazards response plan that would be utilized in the event of severe winter storms.

**J. Tsunami**

**Definition:** A tsunami is a series of waves of extremely long wave length and long period, which are generated in a body of water by impulsive disturbance that displaces the water. Tsunamis are primarily associated with earthquakes that occur in oceanic and coastal regions. Landslides, volcanic eruptions, nuclear explosions and the impacts of objects from outer space (such as meteorites, comets) can also generate tsunamis.

**Description:** As a tsunami crosses the deepest parts of an ocean, its length from the crest to crest may be a hundred miles or more, yet its height from crest to trough will only be a few feet or less. Tsunami cannot be felt aboard ships nor can they be seen from the air in the open ocean. In the deepest oceans, the waves will reach speeds exceeding 600 mph (970 km/hr). When the tsunami enters the shoaling water of coastlines in its path, the velocity of its waves and the height of the waves increases dramatically. It is in shallow waters that a large tsunami can crest to heights exceeding 100 feet (30m) and strike with devastating force (West Coast and Alaska Tsunami Warning Center, NOAA).

**Historical Occurrences:** Tsunamis are very rare along the Atlantic Coast of the United States. There is evidence that one tsunami occurred along cracks some 16,000 to 18,000 years ago (Associated Press, 2000). The tsunami referred to as the 1929 Grand Banks Canada event (precipitated by an earthquake that possessed a Richter Scale

magnitude of 7.2) impacted the Maine shoreline. However, North Carolina will be venerable to a large-scale tsunamis in the future due to its relative proximity to the Canary Island of La Palma in Africa. La Palma has the potential to experience a volcanic eruption which would trigger a land slide capable of causing a large-scale tsunami event for the entire Atlantic seaboard of the United States. High levels of gas hydrates located along the continental shelf could also cause tsunamis in North Carolina.

**Tsunamis in Dare County:** While the potential for a tsunami in Dare County exist the likelihood of an occurrence would be extremely rare given the history of the hazard. The placement of NOAA buoys for tsunami detection has increased the warning capability and notification to emergency agencies in the threat area. (see risk assessment map of tsunami threat for North Carolina)

**K. Coastal Erosion**

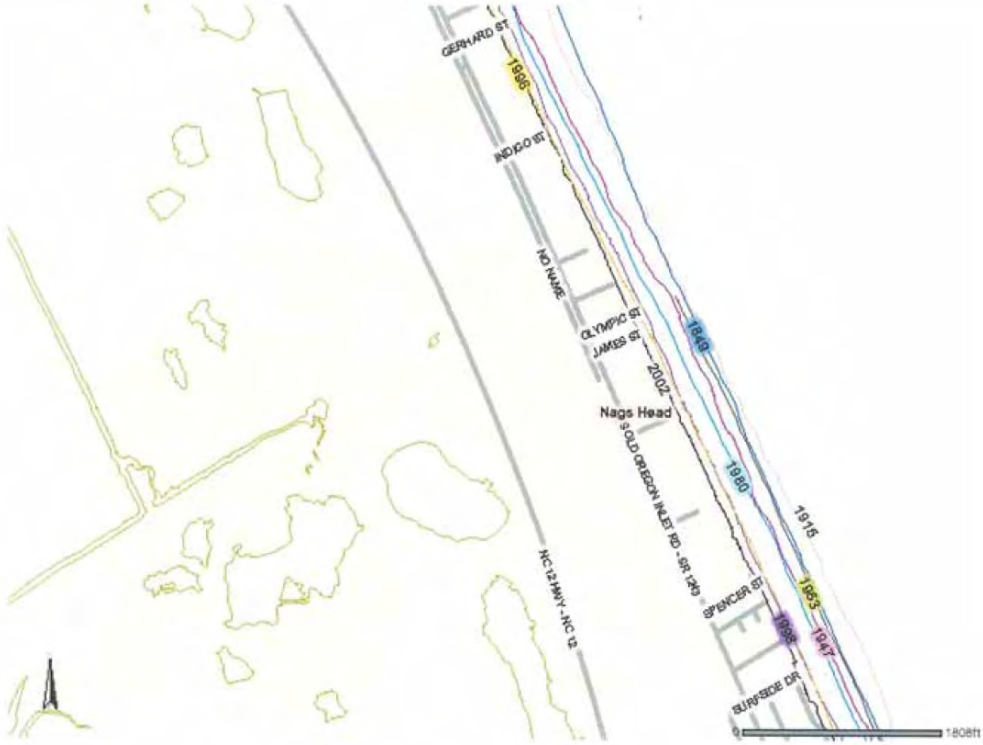
**Definition:** Coastal erosion is the wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm over a period of years, through the action of wind, water or other geologic processes. Wind, waves and long shore currents are the driving forces behind coastal erosion. This removal and deposit of sand permanently changes beach shape and structure. Sand may be transported to land-side dunes, deep ocean trenches, other beaches and deep ocean bottoms. Additional factors involved in coastal erosion include human activity, sea-level rise, seasonal fluctuations and climate change.

**Description:** The beach system is considered to be in dynamic equilibrium. This means that sand is moved from one location to another, but it does not leave the system. For example, winter storms may remove significant amounts of sand, creating steep and narrow beaches. During the summer, gentle waves return the sand, widening beaches and creating gentle slopes. Sand movement will not be consistent from year to year in the same location, however, because so many factors are actively involved in coastal erosion. Episodic erosion is induced by a single storm event. Episodic erosion considers the vertical component of two factors: general beach profile lowering and localized conical scour around foundations supports. Episodic erosion is relevant to foundation embedment depth and potential undermining. The term Erosion Hazard Area (EHA) is defined as an anticipated area being lost to shoreline retreat over a given period of time. The projected inland extent of the area is measured by multiplying the number of years by the average annual long-term recession rate.

**Historical Occurrences:** North Carolina first evaluated long-term average erosion rates for the state's 300-mile ocean coastline in 1979. The Division of Coastal Management evaluates these rates about every five years. The most recent erosion figures for North Carolina were generated in 1998. Of the 312 miles of shoreline mapped, the 1998 update showed long-term average annual erosion rates of 2 feet per year along 193 miles of shore line. Of this figure, 99 miles of shoreline had accreted (gained) sand. The amount of severely eroding shoreline-areas with erosion rates greater than 5 feet per year – decreased from 21 percent of the coast in 1992 to 18 percent of it in 1998.

The erosion hazard was dramatized recently by the predicament of the Cape Hatteras lighthouse in Dare County. When the lighthouse was constructed in 1870, it was situated 1500 feet from the shore. By late 1987, the lighthouse stood only 160 feet from the sea and was in danger of collapsing, despite temporary protective measures to reduce the rate of beach erosion. In 1999, the National Park Service successfully moved the lighthouse back 2900 feet, at a cost of $9.8 million.

**Coastal Erosion in Dare County:** The effects of coastal erosion along the beaches of Dare County is a constant, on-going problem whose implications will have infrastructure and economic implications as more and more of the beach font is lost due to storms, sea level rise and lack of beach stabilization. (see sample map below of shoreline erosion by decade)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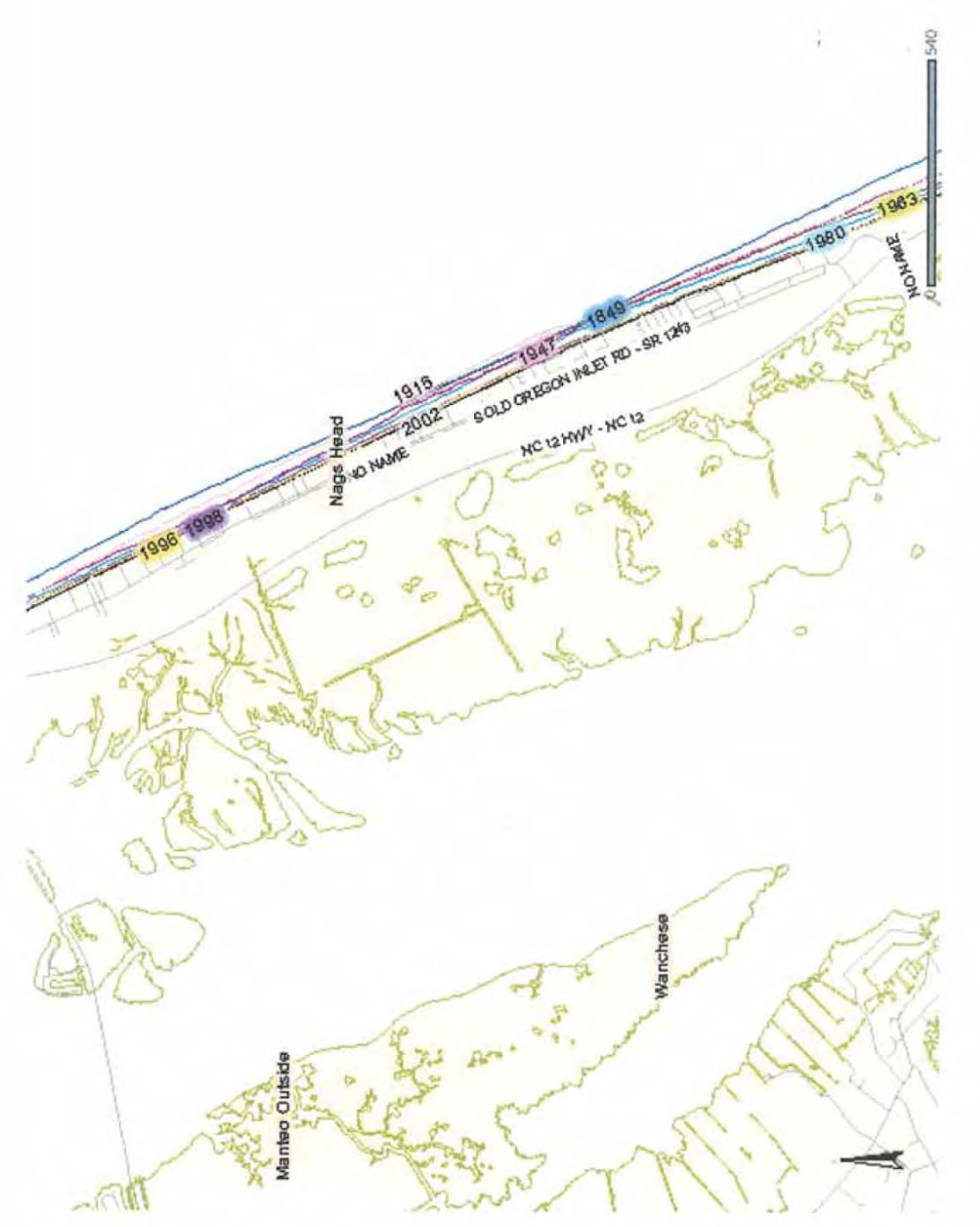
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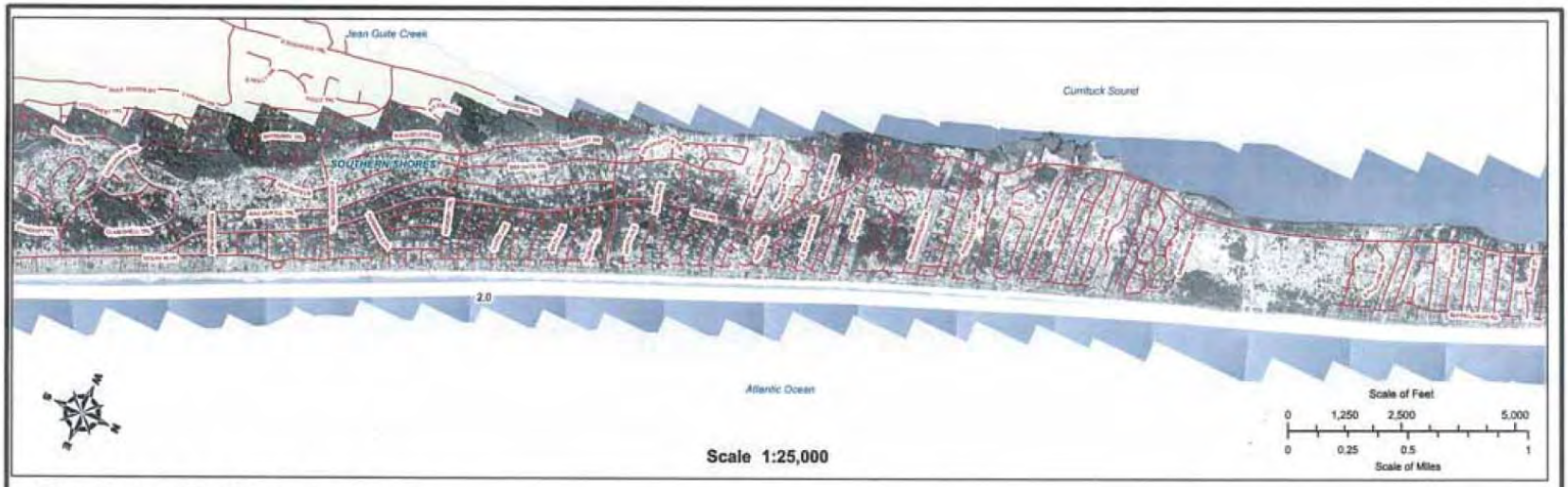


# Duck to S. Sanderling

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

This map is for general information only. The map illustrates average rates of shoreline change over approximately 50 years. The information presented here is not predictive nor does it reflect the short-term erosion that occurs during storms. This map may not be suitable for property-specific determination of erosion rate factors due to its small scale. For a site-specific determination contact your CAMA Local Permit Officer or the regional field office of the North Carolina Division of Coastal Management.

***Funding for this project was provided by:***

National Oceanic and Atmospheric Administration, Federal Emergency Management Agency, and North Carolina Division of Emergency Management

***1998 Long-term average annual shoreline change rate developed by:***

NC State University's Kenan Natural Hazards Mapping Program and North Carolina Division of Coastal Management

***For more information contact:***

NC Division of Coastal Management:

1638 Mail Service Center
Raleigh, NC 27699-1638
(919) 733 – 2293

Or visit:

www.nccoastalmanagement.net

***How to read Setback Factors***

5.5 → "5.5" Indicates a 1998 Setback (Erosion) Factor of 5.5 Feet / Year

### Legend

**1998 Setback Factor**

- 2.0 Ft. / Yr.
- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
- ★ *This general area has been influenced by beach nourishment either for beach protection or dredge disposal. This action artificially lowers the erosion rate in this area.*



NC Division of Coastal Management GIS - Printed: May, 2003 (KRR)

# N. Kill Devil Hills to S. Duck

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

This map is for general information only. The map illustrates average rates of shoreline change over approximately 50 years. The information presented here is not predictive nor does it reflect the short-term erosion that occurs during storms. This map may not be suitable for property-specific determination of erosion rate factors due to its small scale. For a site-specific determination contact your CAMA Local Permit Officer or the regional field office of the North Carolina Division of Coastal Management.

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***How to read Setback Factors***

2.0 → "2.0" Indicates a 1998 Setback (Erosion) Factor of 2.0 Feet / Year

**Legend**

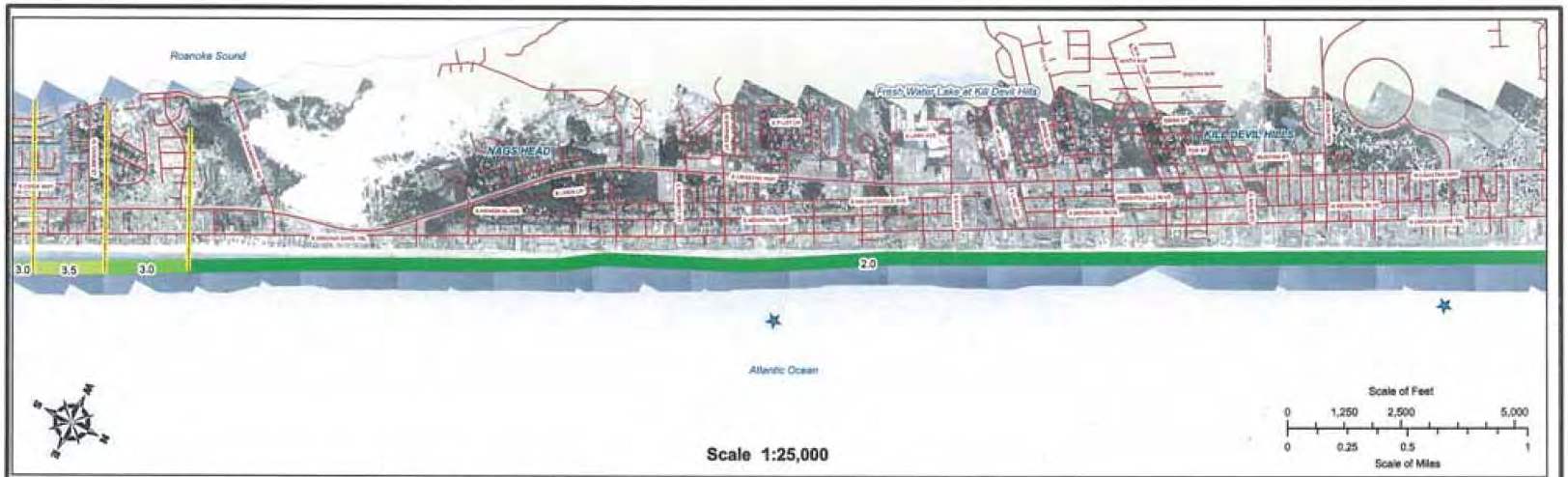
**1998 Setback Factor**

- 2.0 Ft. / Yr.
- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area *(Slight color transparency)*
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
- ★ *This general area has been influenced by beach nourishment either for beach protection or dredge disposal. This action artificially lowers the erosion rate in this area.*

***Page 55 of 60***

NC Division of Coastal Management GIS - Printed: May, 2003 (KRP)




# N. Nags Head to S. Kill Devil Hills

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

This map is for general information only. The map illustrates average rates of shoreline change over approximately 50 years. The information presented here is not predictive nor does it reflect the short-term erosion that occurs during storms. This map may not be suitable for property-specific determination of erosion rate factors due to its small scale. For a site-specific determination contact your CAMA Local Permit Officer or the regional field office of the North Carolina Division of Coastal Management.

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***How to read Setback Factors***

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**1998 Setback Factor**

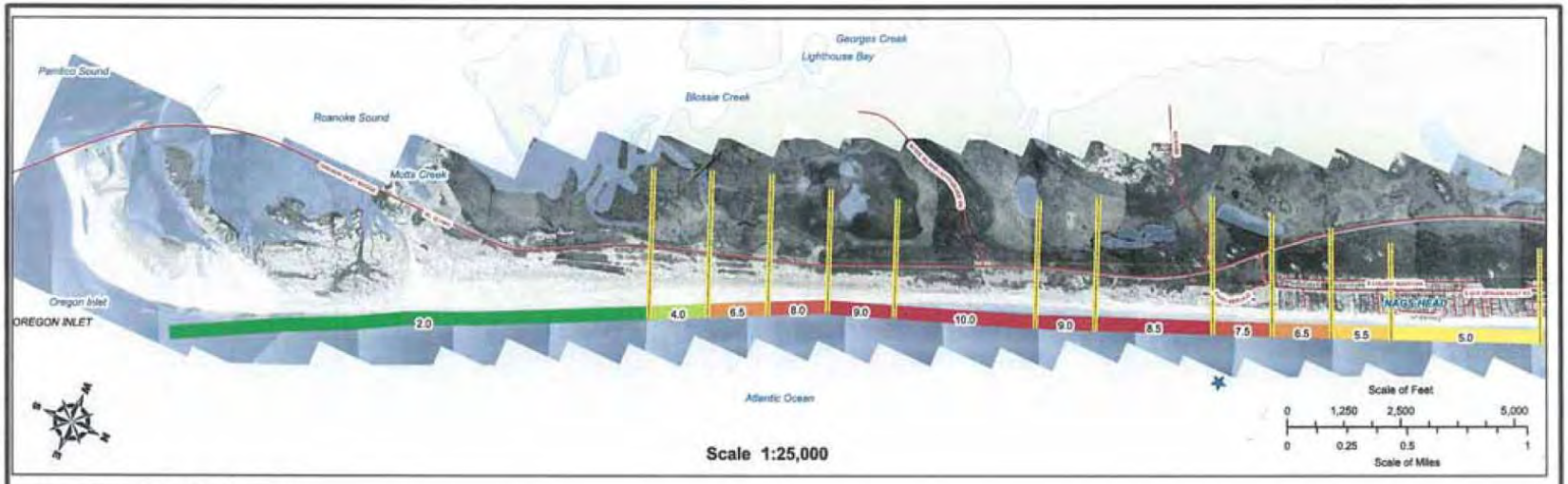
- 2.0 Ft. / Yr.
- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

**Legend**

- Inlet Hazard Area *(Slight color transparency)*
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
- ★ *This general area has been influenced by beach nourishment either for beach protection or dredge disposal. This action artificially lowers the erosion rate in this area.*

***Page 54 of 60***

NC Division of Coastal Management GIS - Printed: May - 2003 (KRS)




# S. Bodie Island

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

This map is for general information only. The map illustrates average rates of shoreline change over approximately 50 years. The information presented here is not predictive nor does it reflect the short-term erosion that occurs during storms. This map may not be suitable for property-specific determination of erosion rate factors due to its small scale. For a site-specific determination contact your CAMA Local Permit Officer or the regional field office of the North Carolina Division of Coastal Management.

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***1998 Long-term average annual shoreline change rate developed by:***

NC State University's Kenan Natural Hazards Mapping Program and North Carolina Division of Coastal Management

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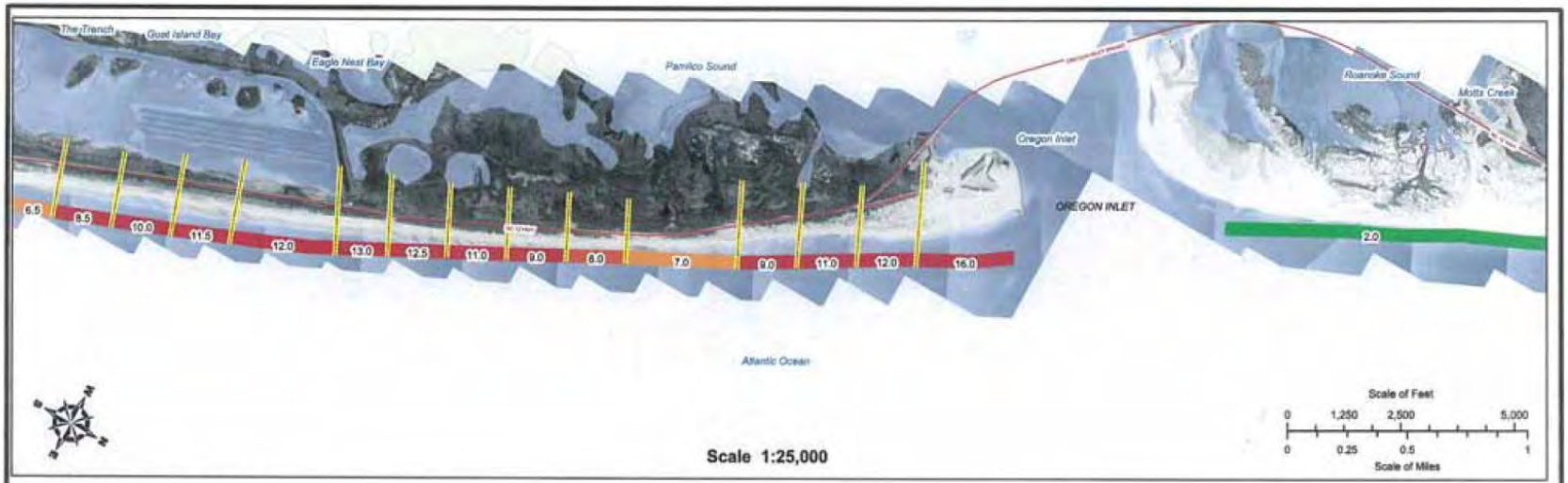
### Legend

**1998 Setback Factor**

- 2.0 Ft. / Yr.
- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area *(Slight color transparency)*
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
- ★ *This general area has been influenced by beach nourishment either for beach protection or dredge disposal. This action artificially lowers the erosion rate in this area.*




# N. Pea Island

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

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National Oceanic and Atmospheric Administration, Federal Emergency Management Agency, and North Carolina Division of Emergency Management

***1998 Long-term average annual shoreline change rate developed by:***

NC State University's Kenan Natural Hazards Mapping Program and North Carolina Division of Coastal Management

***For more information contact:***

NC Division of Coastal Management:

1638 Mail Service Center
Raleigh, NC 27699-1638
(919) 733 – 2293

Or visit:

www.nccoastalmanagement.net

***How to read Setback Factors***

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**Legend**

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- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area *(Slight color transparency)*
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads

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***Page 51 of 60***

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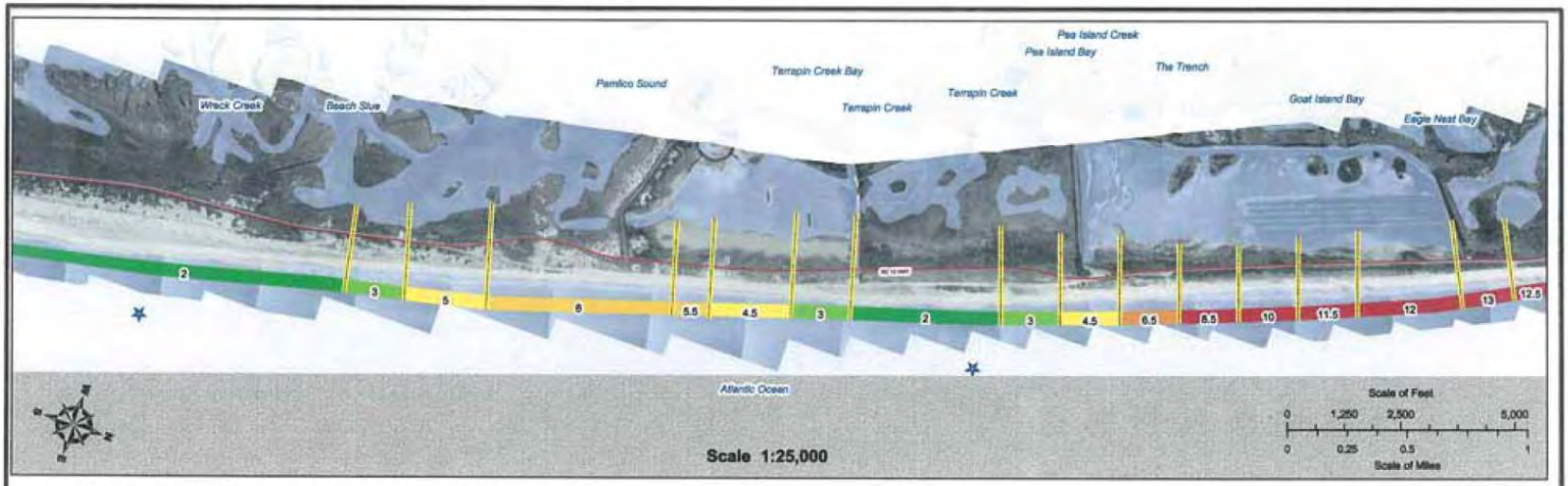


# S. Pea Island

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

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- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

**Legend**

- Inlet Hazard Area *(Slight color transparency)*
- Setback Factor Boundary
- Roads
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NC Division of Coastal Management GIS – Printed: May – 2003 (KRR)

# Hatteras Island at Rodanthe

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

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North Carolina
Division of Coastal Management

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- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area (Slight color transparency)
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
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NC Division of Coastal Management GIS - Printed: May, 2003 (KRP)

# Hatteras Island at Salvo

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

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### Legend

**1998 Setback Factor**

- 2.0 Ft. / Yr.
- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area (Slight color transparency)
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads

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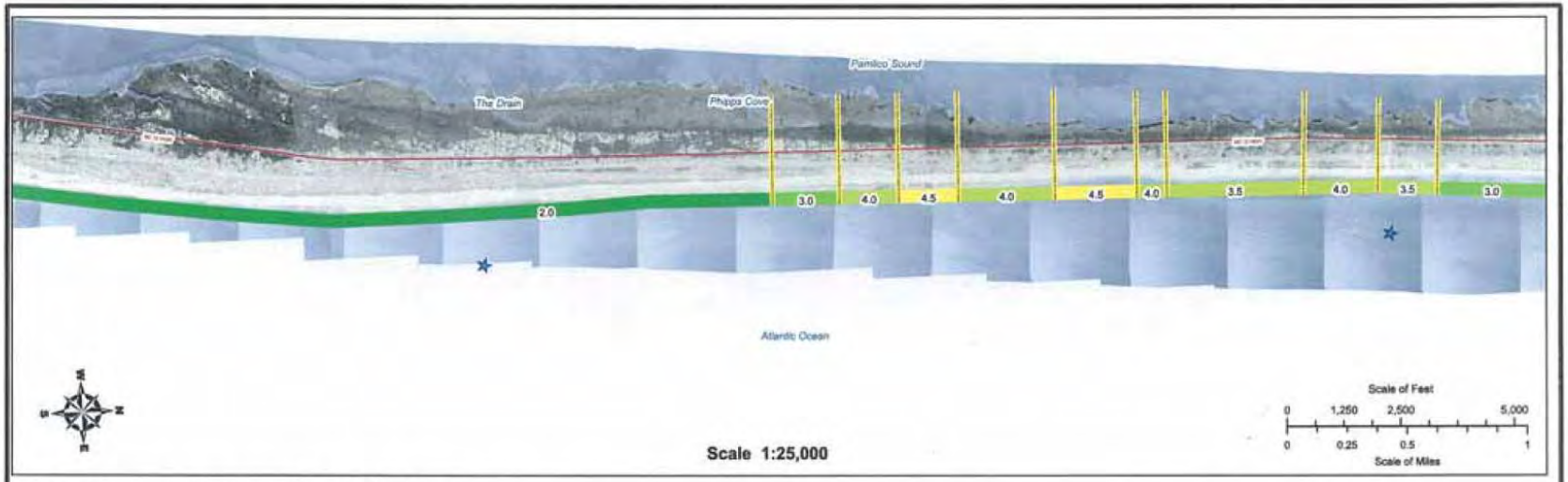


# Hatteras Island at N. Avon

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

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- 2.5 - 3.0 Ft. / Yr.
- 3.5 - 4.0 Ft. / Yr.
- 4.5 - 5.0 Ft. / Yr.
- 5.5 - 6.0 Ft. / Yr.
- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

**Legend**

- Inlet Hazard Area (Slight color transparency)
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
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# Hatteras Island at Avon

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

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North Carolina
Division of Coastal Management

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- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

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- Setback Factor Boundary
- Roads

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***Page 46 of 60***

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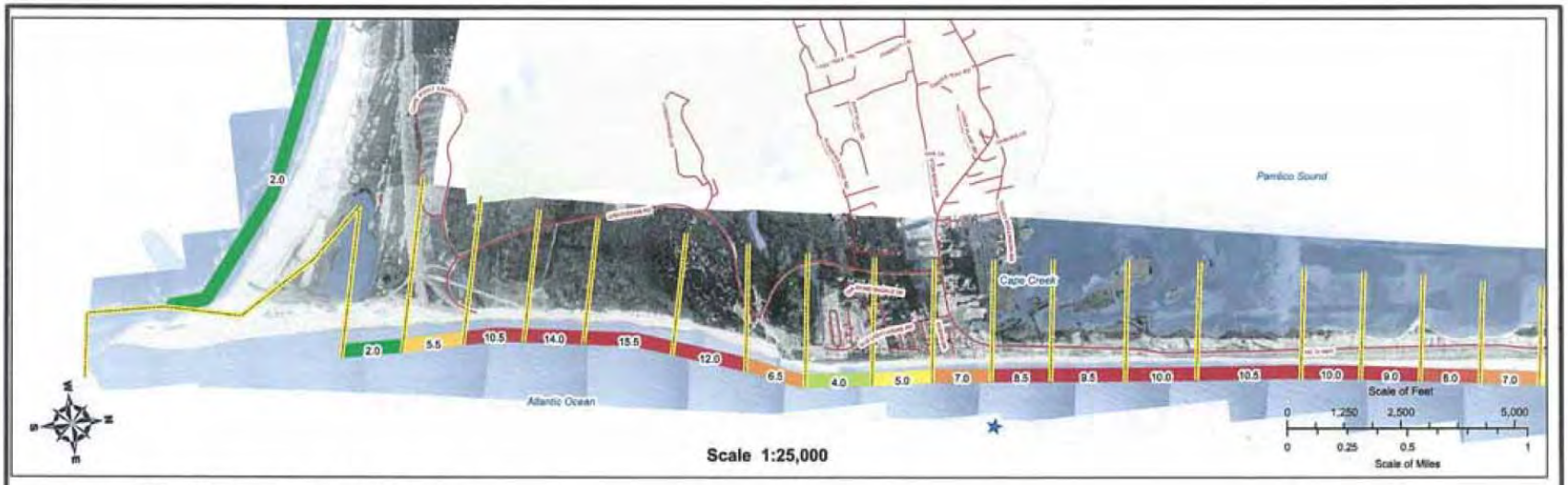


# Cape Hatteras at Buxton

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

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North Carolina
Division of Coastal Management

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**Legend**

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- 3.5 - 4.0 Ft. / Yr.
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- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

- Inlet Hazard Area *(Slight color transparency)*
- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads
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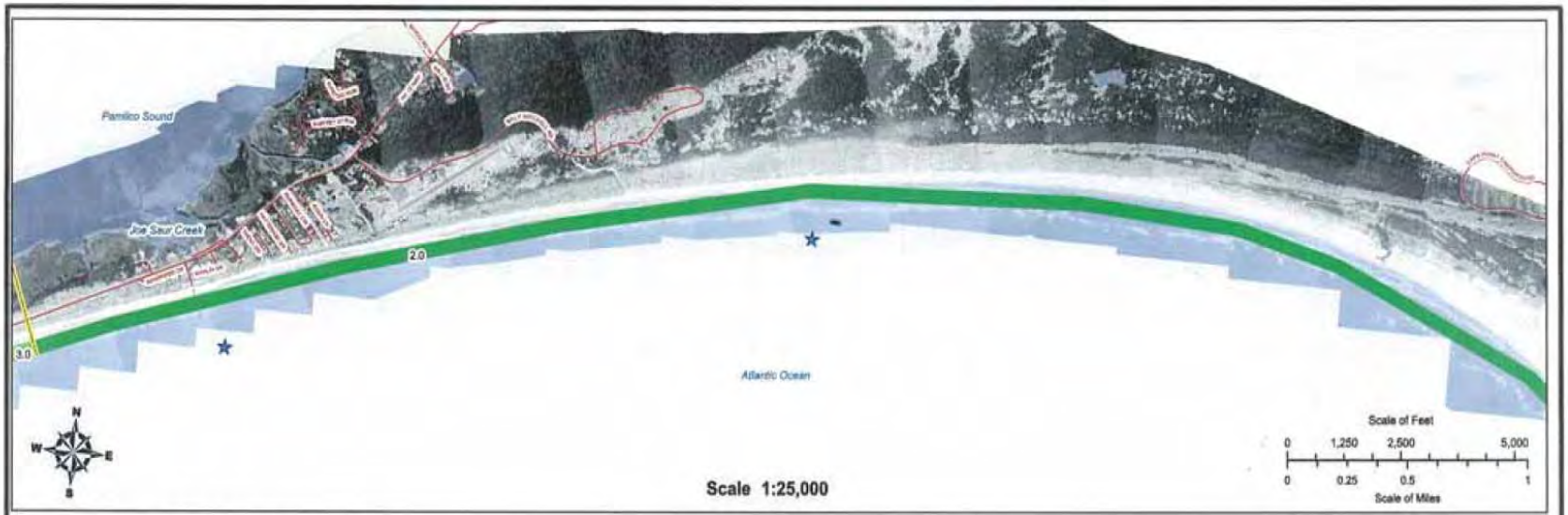
NC Division of Coastal Management GIS - Printed: May, 2003 (KRR)




# Cape Hatteras

## *Long-Term Average Annual Shoreline Change Study & Setback Factors*

**Updated Through 1998**

### REGIONAL MAP

North Carolina
Division of Coastal Management

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- 6.5 - 7.0 Ft. / Yr.
- 7.5 - 8.0 Ft. / Yr.
- > 8.0 Ft. / Yr.

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- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads

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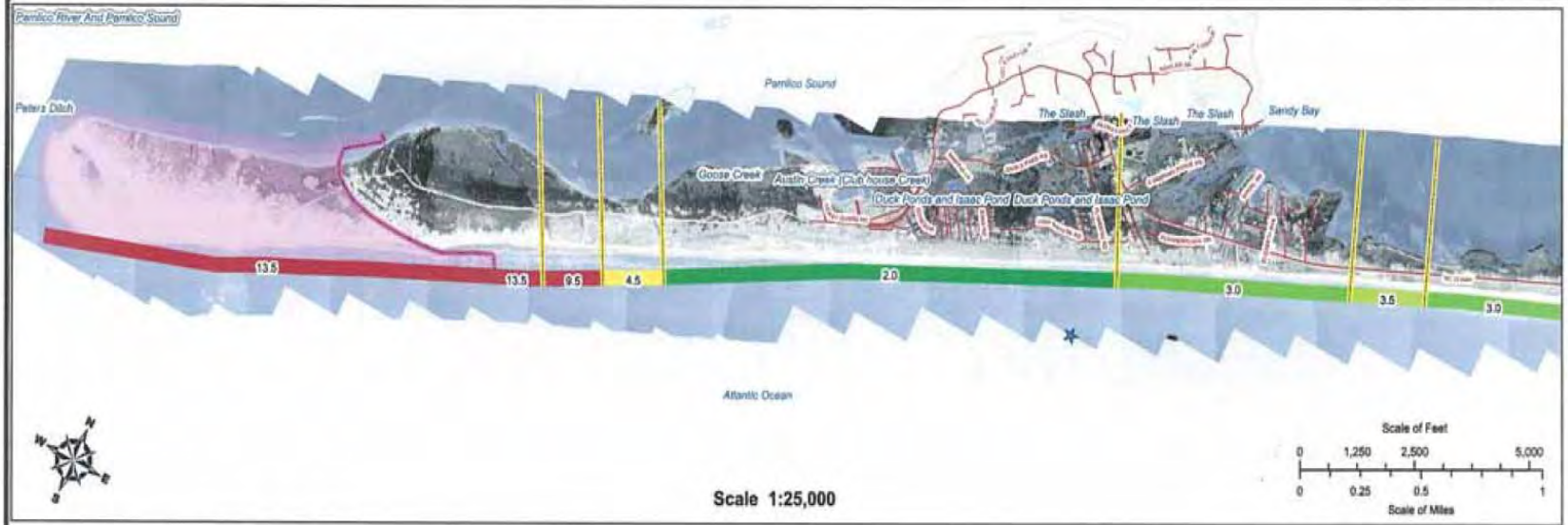
***Page 44 of 60***

NC Division of Coastal Management GIS - Product: May - 2003 (KRR)




# W. Hatteras Island

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**Updated Through 1998**

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- Inlet Hazard Area Boundary
- Setback Factor Boundary
- Roads

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***Page 43 of 60***

NC Division of Coastal Management GIS - Printed: May - 2003 (KRP)

## L. Rip Currents

***What is a Rip Current?***

A rip current is a narrow channel of water flowing seaward from the beach through areas of breaking waves, occurring over the waters and the bays of an ocean. Rip currents often form when the gradient wind is strong and directly onshore or when the swell from distant extra tropical or tropical cyclones impinges on the coast.

***Description***

Rip currents are shallow water processes that do not pull swimmers underwater, but push swimmers seaward in a narrow channel of fast moving water. Rip currents form when water that has been pushed against the near shore sandbar begins to return to deeper water through a narrow depression in the bar exiting to deeper water. Typically, rip currents can be found anytime.

Near the beach, rip currents are narrow (10-100 feet wide) with increasing width as they extend up to 1000 feet offshore. The velocity of the water can be as high as 5 mph, stronger than any swimmer can attain. Rip currents can also be found next to piers and jetties.

***Rip Currents in Dare County***

Drowning is the leading cause of accidental death in Dare County with rip currents being the single factor related to cause of death. The large number of visitors to the over 130 miles of oceanfront and the extreme dynamics of the oceanfront play a significant role in the number of deaths. To counter the potential loss of life there are highly trained lifeguard services that provide work during the summer season that are deployed along the oceanfront to assist swimmers and educate the visitors as to danger of rip currents. A yearly media campaign is utilized to inform the public of the rip current threat, this includes local daily broadcast of rip current information on the televised government access channel, brochures provided by the National Park Service and local lifesaving agencies and rip current awareness days to highlight the rip current dangers to visitors. (See graph of swimming deaths in Dare County.)

**Detailed History of Rip Currents In North Carolina**

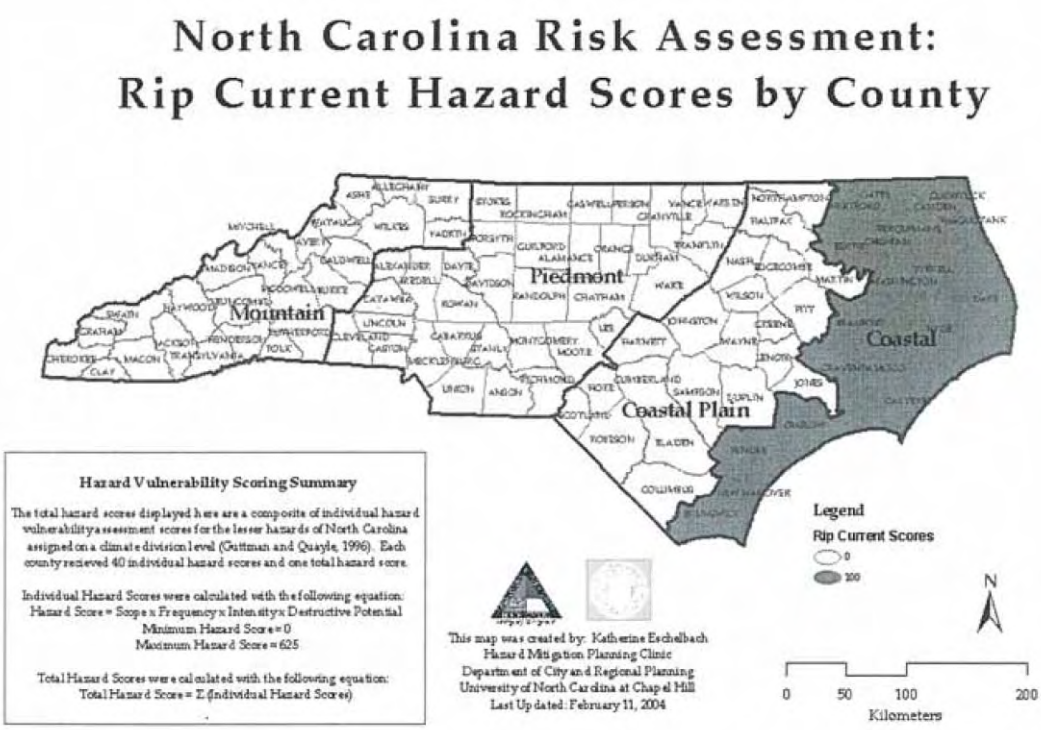
| Storm Surge / Ocean Surf Events | | | | | |
|---|---|---|---|---|---|
| # | Event | Duration | Location or County | Severity | Extent of Damages |
| 1 | Rip Currents | 08/13/1995 | Dare (Rodanthe) | Fatalities: 2 Injuries: 3 | Property: $0 Crop: $0 |
| 2 | Rip Currents | 07/01/1997 | New Hanover (Carolina Beach) | Fatalities: 0 Injuries: 1 | Property: $0 Crop: $0 |
| 3 | Rip Currents | 07/14/1997 | New Hanover | Fatalities: 0 Injuries: 0 | Property: $0 Crop: $0 |
| 4 | Rip Currents | 07/14/1997 | Pender (Surf City, Topsail) | Fatalities: 0 Injuries: 1 | Property: $0 Crop: $0 |
| 5 | Rip Currents | 08/11/2000 | New Hanover (Wrightsville Beach & SW) | Fatalities: 0 Injuries: 0 | Property: $0 Crop: $0 |
| 6 | Rip Currents | 08/20/2000 | New Hanover (Kure Beach) | Fatalities:1 Injuries: 0 | Property: $0 Crop: $0 |
| 7 | Rip Currents | 09/13/2000 | New Hanover (Kure Beach) | Fatalities: 3 Injuries: 0 | Property: $0 Crop: $0 |
| 8 | Rip Currents | 05/31/2002 | Carteret | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 9 | Rip Currents | 06/22/2002 | Dare (Rodanthe) | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 10 | Rip Currents | 06/23/2002 | Carteret (15 miles West of Atlantic Beach) | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 11 | Rip Currents | 09/09/2004 | Cape Hatteras | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 12 | Rip Currents | 07/18/2004 | Atlantic Beach | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 13 | Rip Currents | 07/28/2004 | Ocracoke | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 14 | Rip Currents | 08/05/2004 | Nags Head | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 15 | Rip Currents | 09/22/2004 | Corolla | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 16 | Rip Currents | 09/23/2004 | Corolla | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 17 | Rip Currents | 05/27/2005 | Kill Devil Hills | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 18 | Rip Currents | 06/22/2005 | Nags Head | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 19 | Rip Currents | 07/27/2005 | Carolina Beach | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |
| 20 | Rip Currents | 07/24/2006 | Carteret | Fatalities: 1 Injuries: 0 | Property: $0 Crop: $0 |

(From State Hazard Mitigation Plan, October 2007)

**Rip Current Hazard Scores by County**

The chart below represents the relative location of Rip Current hazard vulnerability across the state of North Carolina. The vulnerability score for each county represents the scope, frequency, intensity and destructive potential of this hazard and is an indication of future probability based on its relative score to other counties in the state.

(From State Hazard Mitigation Plan, October 2007)




## M. Drought

### *What Is A Drought?*

Drought is defined as a deficit in normal precipitation for a region over a period of time sufficient to cause impacts. Impacts are important, without the abnormal impacts to sectors such as water supply, agriculture and fire danger, there is not drought, only dry weather, so impacts to these and other sectors is a primary way of measuring drought. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., principal season of occurrence, delays in the start of rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind and law relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

Drought should not be viewed as merely physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation then expected resulting from natural climatic variability) and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed counties and resulting economic and environmental impacts and personal hardships have understood the vulnerability of all societies to this “natural’ hazard.

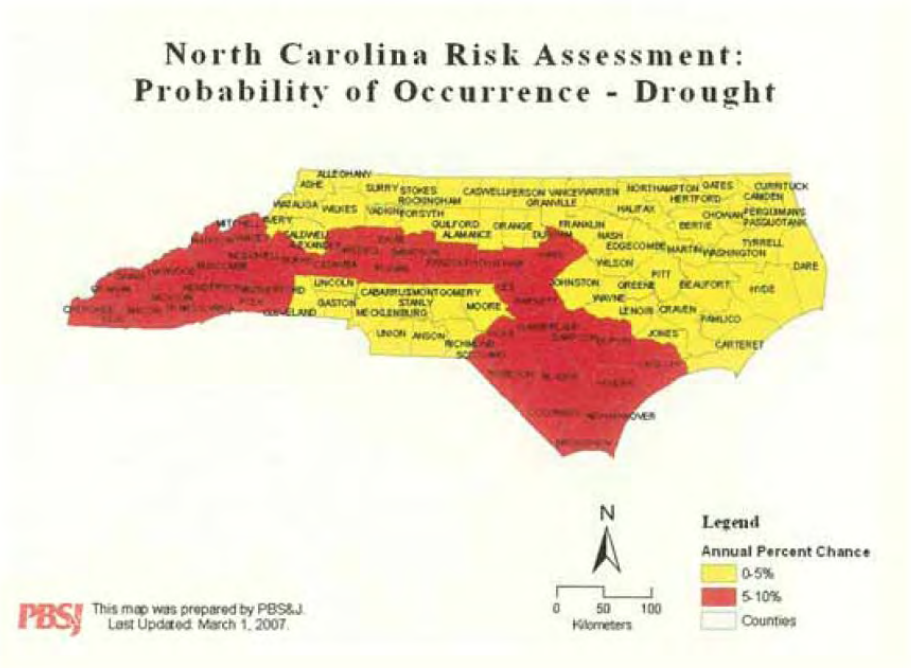
***Description***

Drought is a protracted period of deficient precipitation resulting in extensive changes to daily societal activities. Drought in North Carolina is broken down to in five conditions from exceptional drought conditions (D4) to impending drought conditions (D0).

***Droughts in Dare County***

Dare County does not have a history of drought and has a low probability of drought occurrence. (Annual percent chance 0-5).

**Probability of Occurrence for Drought**
(From State Hazard Mitigation Plan, October 2007)



NORTH CAROLINA
Drought Management
Advisory Council

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**Hot Topics:** Drought Legislation, Conservation Tips, Drought FAQ

US Drought Monitor of
**NORTH CAROLINA**

November 11, 2008
Valid 8 a.m. EDT

**Drought Classifications**
- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

County Boundaries ☐ Major River Basins (View Map)
Hi-Resolution Image | Print Version
The U.S. Drought Monitor focuses on broad scale conditions. Information provided for North Carolina is relative to the information provided from all other states and the North Carolina Drought Management Advisory Council. Local conditions may vary.

## North Carolina Drought Advisory

**Released: November 13, 2008**

The North Carolina Drought Advisory issued by the Drought Management Advisory Council has been updated to reflect drought conditions on November 11, 2008 indicated on the weekly U.S. Drought Monitor of North Carolina. Until further notice, the NCDMAC strongly urges the implementation of drought response actions, for all water users located in or dependent on water resources from the areas of the state experiencing the following drought conditions:

(D4) Exceptional drought conditions.

(D3) Extreme drought conditions.

(D2) Severe drought conditions.

(D1) Moderate drought conditions.

(DO) Impending drought conditions (abnormally dry conditions).

**County Drought Classification**

If the US Drought Monitor of NC shows more than one drought designation in a county, the drought classification for each county published by the North Carolina Drought Management Advisory Council is the highest drought designation that applies to at least twenty five percent (25%) of the land

### Counties Under Current Advisory

D4 - Exceptional Drought

Cherokee County
Clay County
Henderson County
Jackson County
Macon County
Transylvania County

**Total: 6**

D3 - Extreme Drought

Buncombe County
Graham County
Haywood County
Madison County
Polk County
Rutherford County
Swain County
Yancey County

**Total: 8**

**D2 - Severe Drought**

Avery County
Burke County
Caldwell County
Camden County
Chowan County
Cleveland County
Currituck County
Gates County
McDowell County
Mitchell County
Pasquotank County
Perquimans County
Watauga County

**Total: 13**

**D1 - Moderate Drought**

Alexander County
Alleghany County
Ashe County
Beaufort County
Bertie County
Catawba County
Dare County
Davie County

area of the county.

## Drought Classification and Response Actions

### D4-Exceptional Drought

The NCDMAC urgently advises all water users in the counties that are indicated on the US Drought Monitor Map of North Carolina as suffering from Exceptional Drought (D4) conditions to enact the following precautions in addition to previous advisories until further notice:

All water users are advised to follow their Water Shortage Response Plan (WSRP). An effective WSRP should adhere to the guidelines set forth by the water use rules during drought that became effective March 19, 2007. Water users without a written plan are advised to follow the applicable default water use reduction measures outlined in Section .0614 of the rules during exceptional drought designations.

Limit water usage to those uses that are essential to ensure public health and safety.

Prepare for the likelihood of community water systems requiring water rationing.

Participate in regional and local coordination for the management of water resources.

Stay informed on drought conditions and advisories (www.ncdrought.org).

### D3-Extreme Drought

The NCDMAC urgently advises all water users in the counties that are indicated on the US Drought Monitor Map of North Carolina as suffering from Extreme Drought (D3) conditions to enact the following precautions in addition to previous advisories until further notice:

All water users are advised to follow their Water Shortage Response Plan (WSRP). An effective WSRP should adhere to the guidelines set forth by the water use rules during drought that became effective March 19, 2007. Water users without a written plan are advised to follow the applicable default water use reduction measures outlined in Section .0614 of the rules during extreme drought designations.

Stay informed on drought conditions and advisories (www.ncdrought.org).

Participate in regional and local coordination for the management of water resources.

Reduce socially and economically important water uses to ensure the availability of water for critical needs (e.g. firefighting, health and safety, etc.).

Revisit and/or explore, if not already accomplished, alternative water sources and reuse options.

### D2-Severe Drought

The NCDMAC strongly advises all water users in the counties that are indicated on the US Drought Monitor Map as suffering from Severe Drought (D2) conditions to enact the following precautions in addition to previous advisories until further notice:

Implement Water Shortage Response Plans, if not already enacted.

Stay informed on drought conditions and advisories (www.ncdrought.org).

Participate, as appropriate, in regional and local coordination for the management of water resources.

Reexamine water delivery systems to minimize water loss and maximize water use efficiency.

Eliminate nonessential uses of water.

Edgecombe County
Forsyth County
Gaston County
Greene County
Halifax County
Hertford County
Hyde County
Iredell County
Lincoln County
Martin County
Mecklenburg County
Northampton County
Pamlico County
Pitt County
Rowan County
Stokes County
Surry County
Tyrrell County
Washington County
Wilkes County
Yadkin County

**Total: 29**

**D0 - Abnormally Dry**

Anson County
Cabarrus County
Carteret County
Craven County
Davidson County
Guilford County
Jones County
Lenoir County
Montgomery County
Nash County
Randolph County
Rockingham County
Stanly County
Union County
Warren County
Wayne County
Wilson County

**Total: 17**

Evaluate the feasibility of incorporating water reuse, reclamation and/or recycling into daily operations.

Seek to reduce water usage by, at least, the same percentage as the percent differential between normal seasonal water supply availability and the actual water supply availability resulting from current drought conditions.

Increase public awareness and educational outreach programs emphasizing the need to conserve water.

**D1 - Moderate Drought**

The NCDMAC advises all water users in the counties that are indicated on the US Drought Monitor Map as suffering from Moderate Drought (D1) conditions to enact the following precautions in addition to previous advisories until further notice:

Adhere to local water use restrictions.

Participate, as appropriate, in regional and local coordination for the management of water resources.

Stay informed on drought conditions and advisories (www.ncdrought.org).

Project water needs and available water supply for a ninety day period from the issuance of this advisory.

Assess your vulnerability to the drought conditions and adjust water usage to prolong available supply.

Inspect water delivery system components (e.g. irrigation lines, fixtures, processing equipment, water system lines, etc.), repair leaks and ensure that existing equipment is operating as efficiently as possible.

Minimize nonessential uses of water.

Implement available public awareness and educational outreach programs emphasizing the need to conserve water.

**D0 - Abnormally Dry**

The NCDMAC requests all water users in the counties that are indicated on the US Drought Monitor Map as suffering from Abnormally Dry (D0) conditions to closely monitor their water supply source for diminished capacity and take precautions to prepare for impending drought conditions.

Review and be prepared to implement your Water Shortage Response Plans at the appropriate time.

Participate, as appropriate, in regional and local coordination for the management of water resources.

Stay informed on drought conditions and advisories (www.ncdrought.org).

# U.S. Drought Monitor of North Carolina

November 11, 2008

**Drought Classifications**
- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

http://www.ncdrought.org/print.php 11/19/2008

## N. Terrorism

***What is Terrorism?***

Terrorism is not new, and even though it has been used since the beginning of recorded history it can be relatively hard to define. Terrorism has been described variously as both a tactic and strategy; a crime and a holy duty; justified reaction to oppression and an inexcusable abomination. Obviously, a lot depends on whose point of view is represented.

Terrorism has often been an effective tactic for the weaker side in a conflict. As am asymmetric form of conflict, it confers coercive power with many of the advantages of military force at a fraction of the cost. Due to the secretive nature and small size of terrorist organizations, they often offer opponents no clear organization to defend against of to deter.

The United States Department of Defense defines terrorism as "the calculated use of unlawful violence or threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments of societies in the pursuit of goals that are generally political, religious, or idealogical." The FBI uses this as a description: "Terrorism is the unlawful use of force and violence against persons and property to intimidate or coerce a government, the civilian population, or and segment thereof, in furtherance of political or social objectives." The U.S. Department of State defines "terrorism" to be the premeditated politically – motivated violence perpetrated against non-combatant targets by sub-national groups or clandestine agents, usually intended to influence an audience." Less specific and considerably less verbose is the British Government definition of terrorism as "A criminal act that influences an audience beyond the immediate victim."

***Description***

There are three perspectives of terrorism: the terrorist's, the victim's and the general publics'. The phrase "one man's terrorist is another man's freedom fighter" is a view terrorist themselves would accept. Terrorist do not see themselves as evil. They believe they are legitimate combatants, fighting for what they believe in, by whatever means possible. A victim of a terrorist act sees the terrorist as a criminal with no regard for human life. The general publics' view is the most unstable. The terrorists take great pains to foster a "Robin Hood" image in hope of swaying the general publics' point of view toward their cause. This sympathetic view of terrorism has become an integral part of their psychological warfare and needs to be countered vigorously.

Terrorism has demonstrated increasing abilities to adapt to counter-terrorism measures and political failure. Terrorists are developing new capabilities of attack and improving the efficiency of existing methods. Additionally, terrorist groups have shown significant progress in escaping from a subordinate role in nation-state conflicts, and becoming prominent as international influences in their own right. They are becoming more integrated with other sub-state entities, such as criminal organizations and legitimately chartered corporations, and are gradually assuming a measure of control and identity with national governments. Terrorist are improving their sophistication and abilities I n virtually all aspects of their operations and support. The aggressive use of modern technology for information management, communications and intelligence has increased the efficiency of these activities. Weapons technology has become more increasingly available, and the purchasing power of terrorist organizations is on the rise. The ready availability of both technology and trained personnel to operate it for any client with sufficient capital allows the well – funded terrorist to equal or exceed the sophistication of governmental counter – measures. Likewise, due to the increase in information outlets and competition with increasing numbers of other messages, terrorism now requires a greatly increased amount of violence or novelty to attract the attention in now requires. The tendency of major media to compete for ratings and the subsequent revenue realized from increases in their audience size and share produces pressures on terrorist to increase the impact and violence of their actions to take advantage of the sensationalism terrorist violence requires.

***Terrorism in Dare County***

There has never been an act of Terrorism in Dare County, however given the number of visitors to the many national sites/monuments in the County and the ability of terrorist to strike at will in most any area it is prudent for Dare County to recognize the terrorist threat. Built into the Dare County Emergency Response Plan is the ability to respond to all hazards emergency situations. Dare County recognize the Homeland Security Advisory System which contains actionable information about an incident involving, or a threat targeting, critical national networks of infrastructures or key assets.

(See chart for color code breakdown)

**O. Transportation (Bridge)**

***Definition***

The loss of any bridge would be described as the physical interruption of travel on the roadway, either man-made or natural.

***Description***

Dare County is surrounded by water. Access to the area is gained by crossing bridges making the loss of any bridge a potential economic disaster to the area. Identifying a bridge as a natural hazard may be misunderstood, but in terms of economic loss as described in the analysis determining what is considered as a disaster, the Mitigation Planning team felt this was representative.

***Loss of Bridge in Dare County***

The following events can be used to demonstrate this:

- The Croatan Sound Bridge was closed for approximately 10 weeks in 1986 due to a vessel striking the bridge and collapsing the navigation span.
- The Oregon Inlet Bridge was closed for approximately three weeks in 1988 when a section of the bridge collapsed due to maintenance problems.
- the Oregon Inlet Bridge was closed for six months in 1990 when a dredge collapsed a span in the bridge.

**P. Pandemic**

***Definition***

According to the World Health Organization (WHO), a pandemic is an epidemic of infectious disease that spreads through populations across a large region; for instance a continent, or even the world. A pandemic can start when three conditions have been met:

- Emergence of a disease new to a population
- Agents infect humans, causing serious illness
- Agents spread easily and sustainably among humans

***Description***

A pandemic occurs when a new virus appears against which the human population has no immunity, resulting in epidemics world-wide with enormous numbers of deaths and illness. With the increase in global transport, as well as urbanization and overcrowded conditions, epidemics due to the new influenza virus are likely to quickly take hold around the world. If an influenza pandemic were to occur today, we could expect: The pandemic virus to spread

rapidly due to the high level of global traffic. Vaccines, antiviral agents and antibiotics to treat secondary infections to be in short supply, with a period of several months before vaccine becomes available.

Medical facilities to be overwhelmed with demands to care for both influenza and non-influenza patients. Widespread illness to result in sudden and potentially significant shortages of personnel to provide essential community services. In the past, pandemics have resulted in increased morbidity and mortality and great social disruption. In the 20th century, the most severe pandemic occurred in 1918019 and caused an estimated 40-50 million deaths worldwide. Current epidemiological models project that a pandemic could result in 2 to 7.4 million deaths globally.

***Pandemic in Dare County***

There have been no recorded Pandemics outbreaks in Dare County.

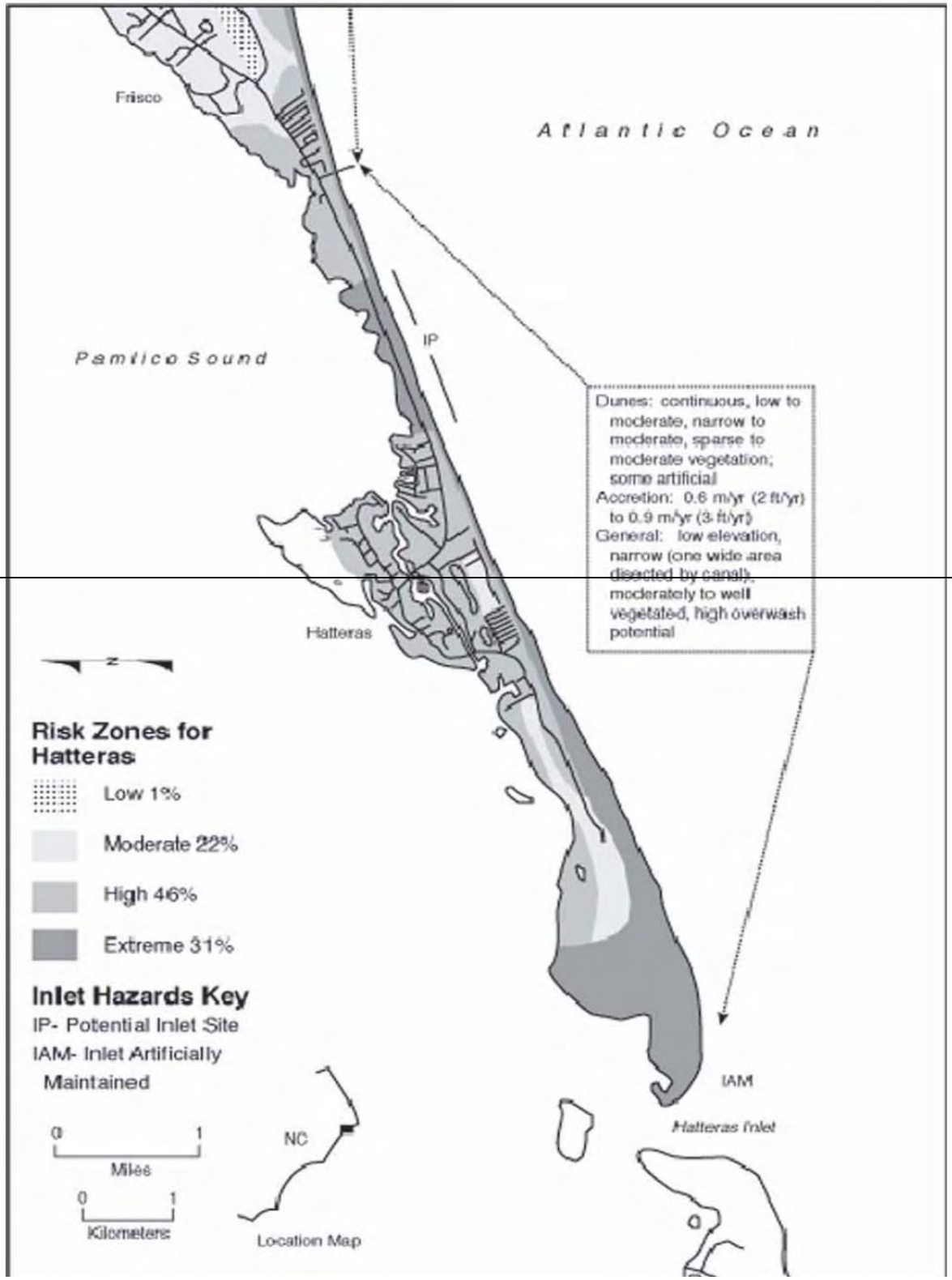
The table below represents the Hazard Identification and Analysis and corresponding Hazard Index scores. In Bold are the most threatening natural hazards to Dare County.

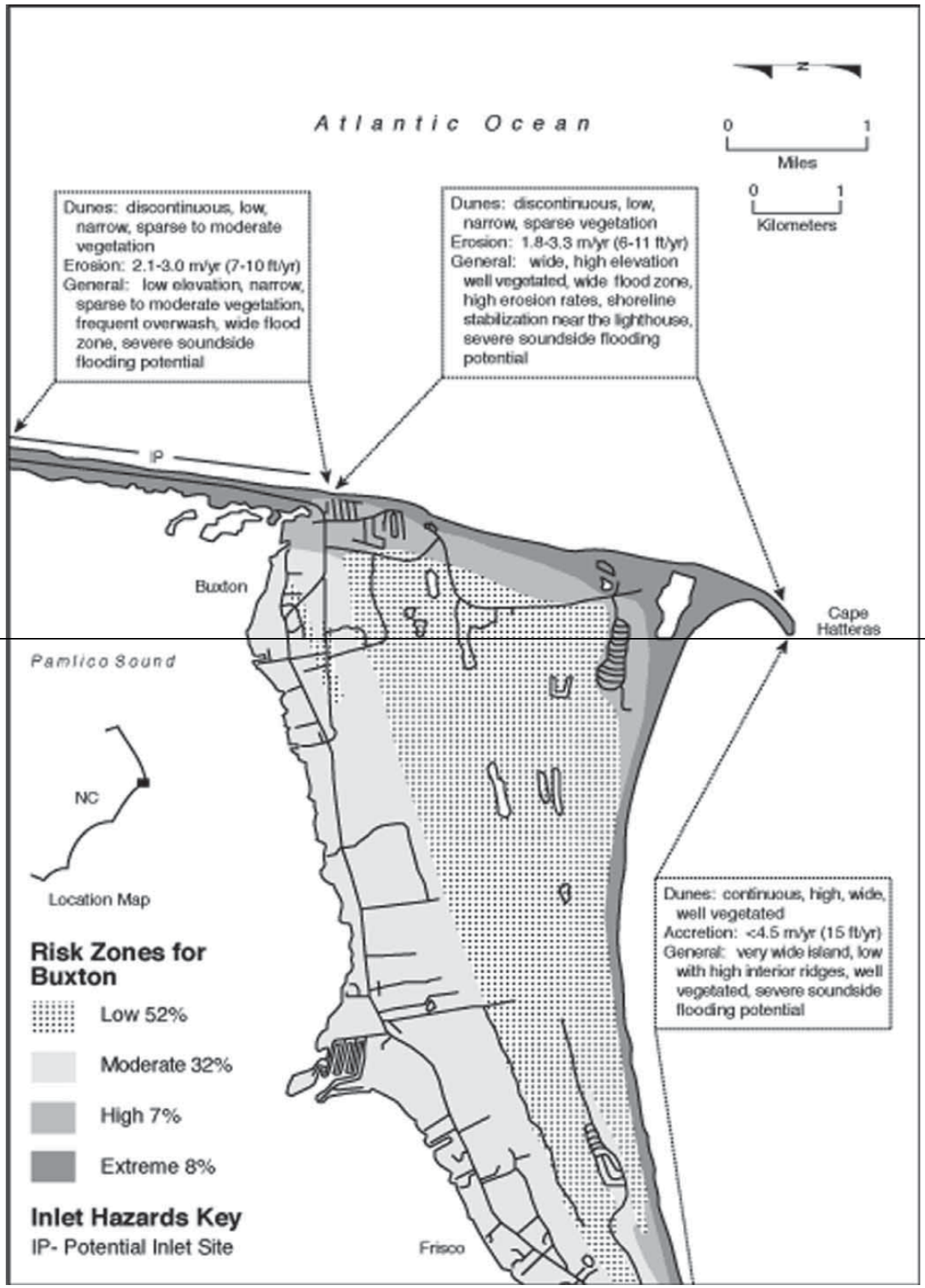
- **Hurricanes**
- **Nor'easters**
- **Flooding**
- **Coastal Erosion**

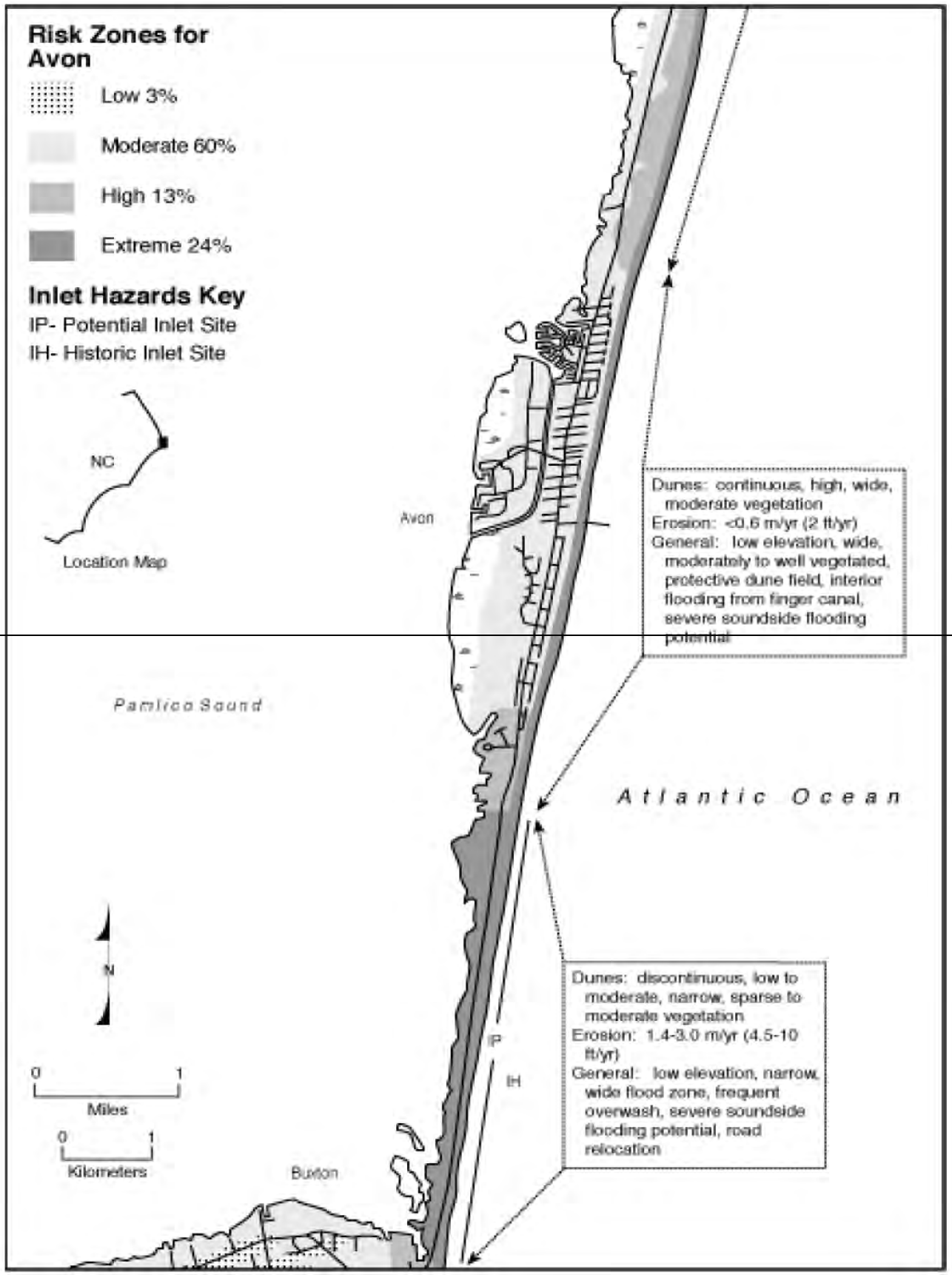
| Hazard Type | Likelihood of Occurance *(Highly Likely, Likely, Possible unlikely)* | Intensity Rating *(Relative Terms)* | Catastrophic *(Critical, Limited Negligible)* | Conclusion Rank |
|---|---|---|---|---|
| Earthquake | Unlikely | Low | Negligible | 2 |
| **Tidal Flooding** | Highly Likely | High | Critical | 5 |
| **Hurricanes** | Highly Likely | High | Catastrophic | 5 |
| Land Slides | Unlikely | Low | Negligible | 1 |
| **Nor'Easters** | Highly Likely | High | Critical | 4 |
| Thunderstorms | Highly Likely | Moderate | Negligible | 2 |
| Tornadoes | Possible | Moderate | Limited | 3 |
| Wildfires | Possible | Low | Limited | 2 |
| Winterstorms | Likely | Moderate | Limited | 3 |
| Tsunami | Unlikely | High | Critical | 1 |
| **Coastal Erosion** | Highly Likely | Moderate | Critical | 5 |
| Rip Currents | Highly Likely | High | Limited | 3 |
| Drought | Unlikely | Low | Negligible | 1 |
| Bridge Collapse | Possible | Moderate | Critical | 3 |
| Terrorism Event | Unlikely | Low | Negligible | 1 |
| Pademic Event | Unlikely | Moderate | Catastrophic | 1 |

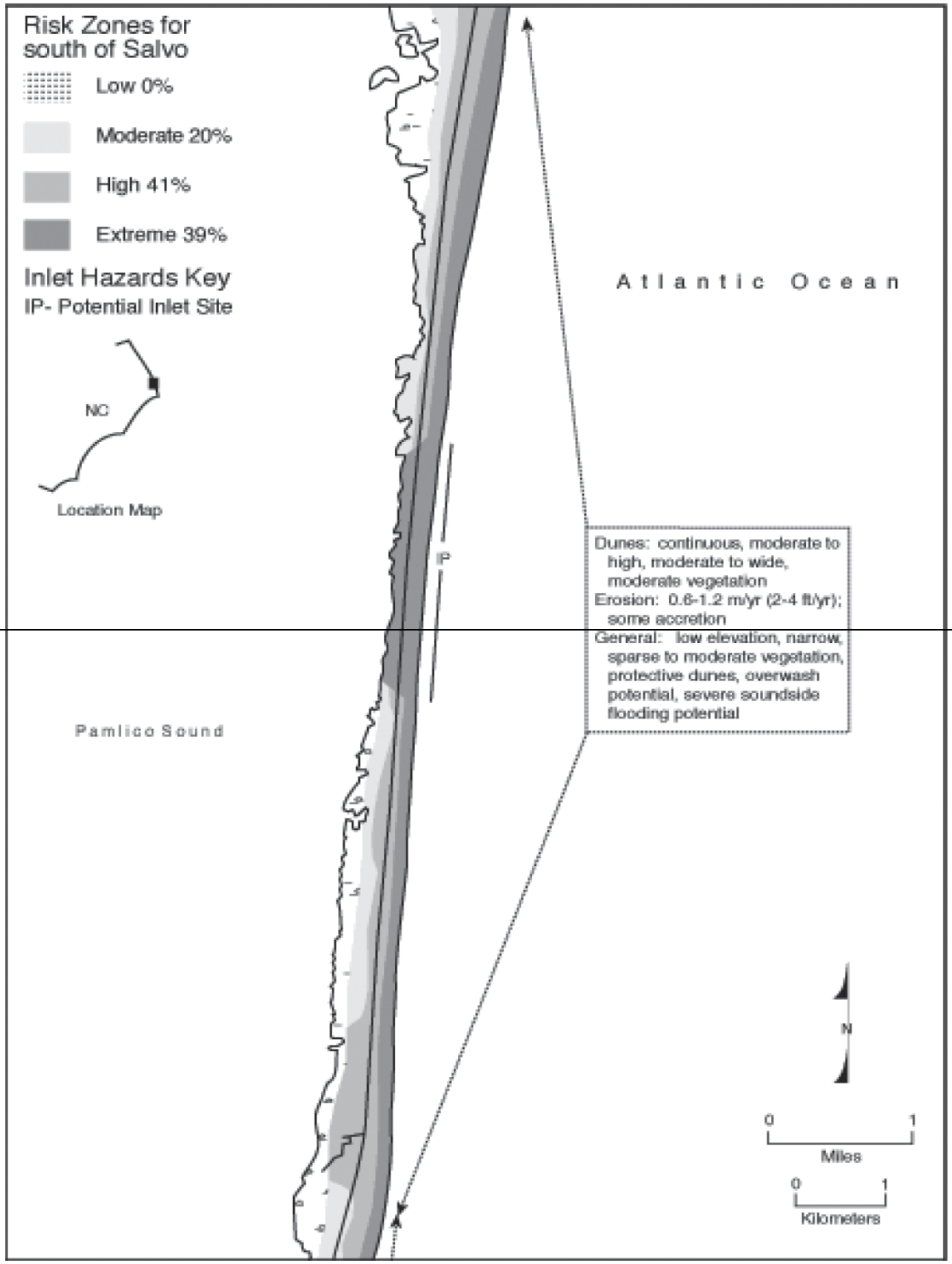
Likelihood of Occurrence – estimates the likelihood of each type of hazard occurring in Dare County.

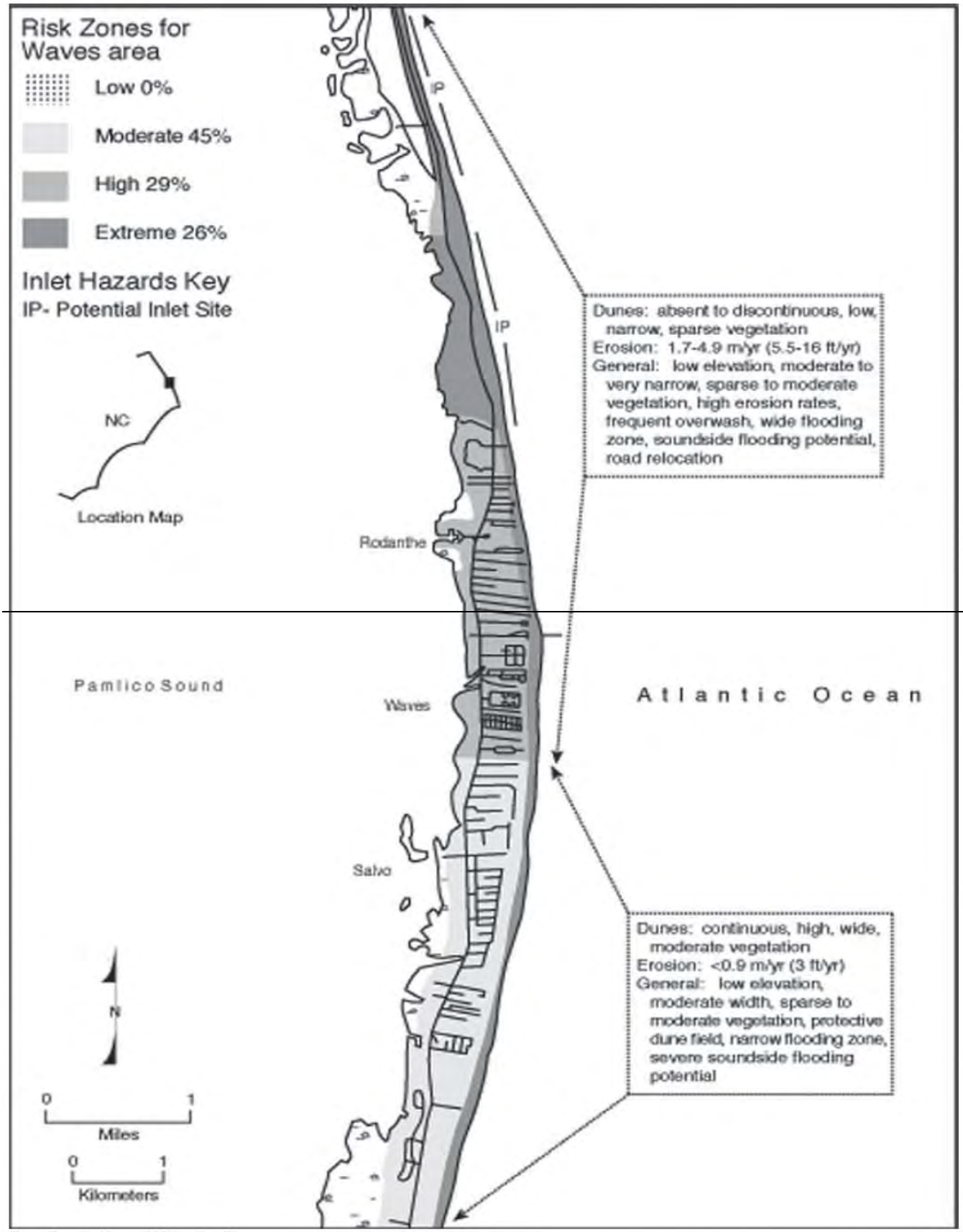
**Coastal Hazard Maps:**

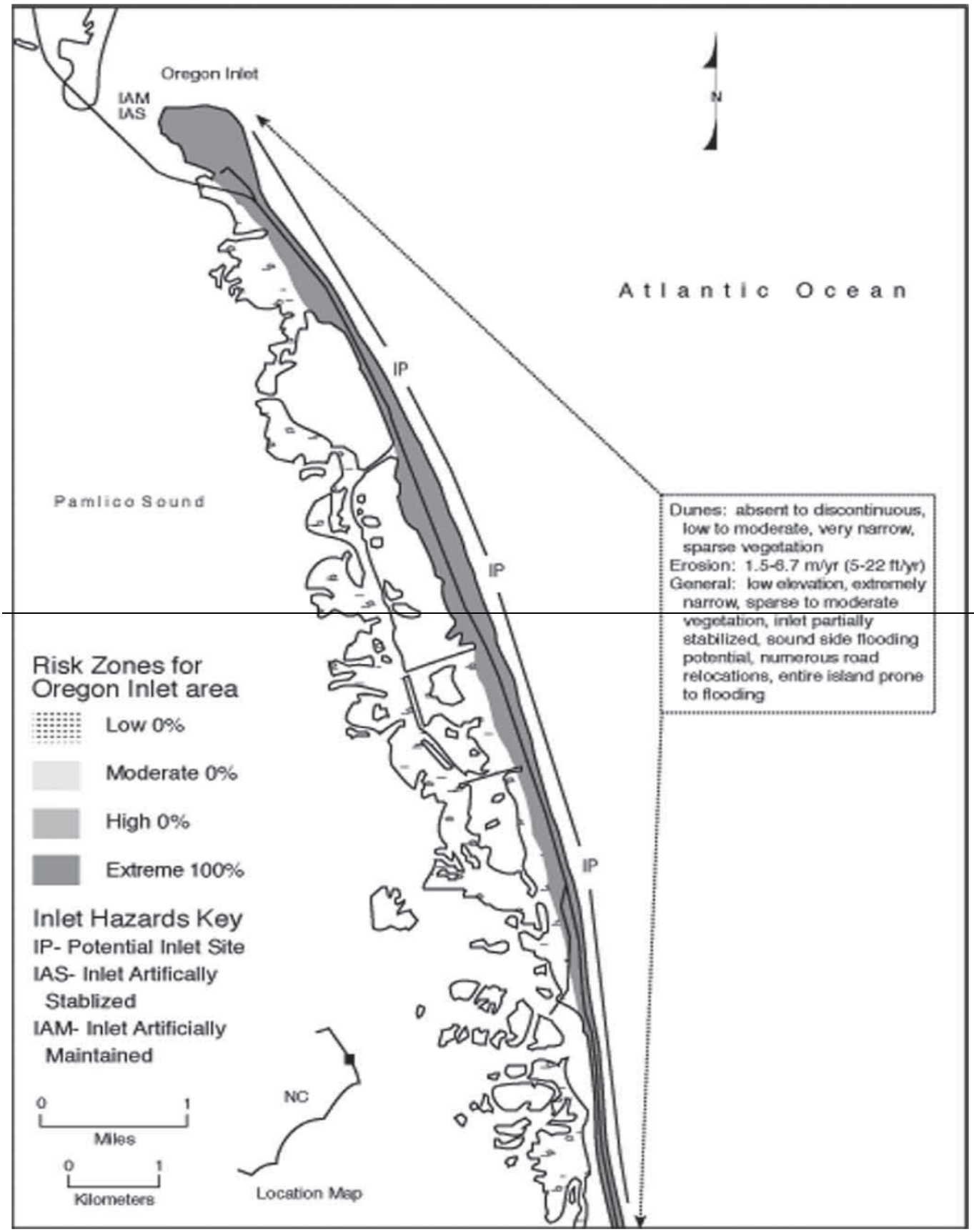


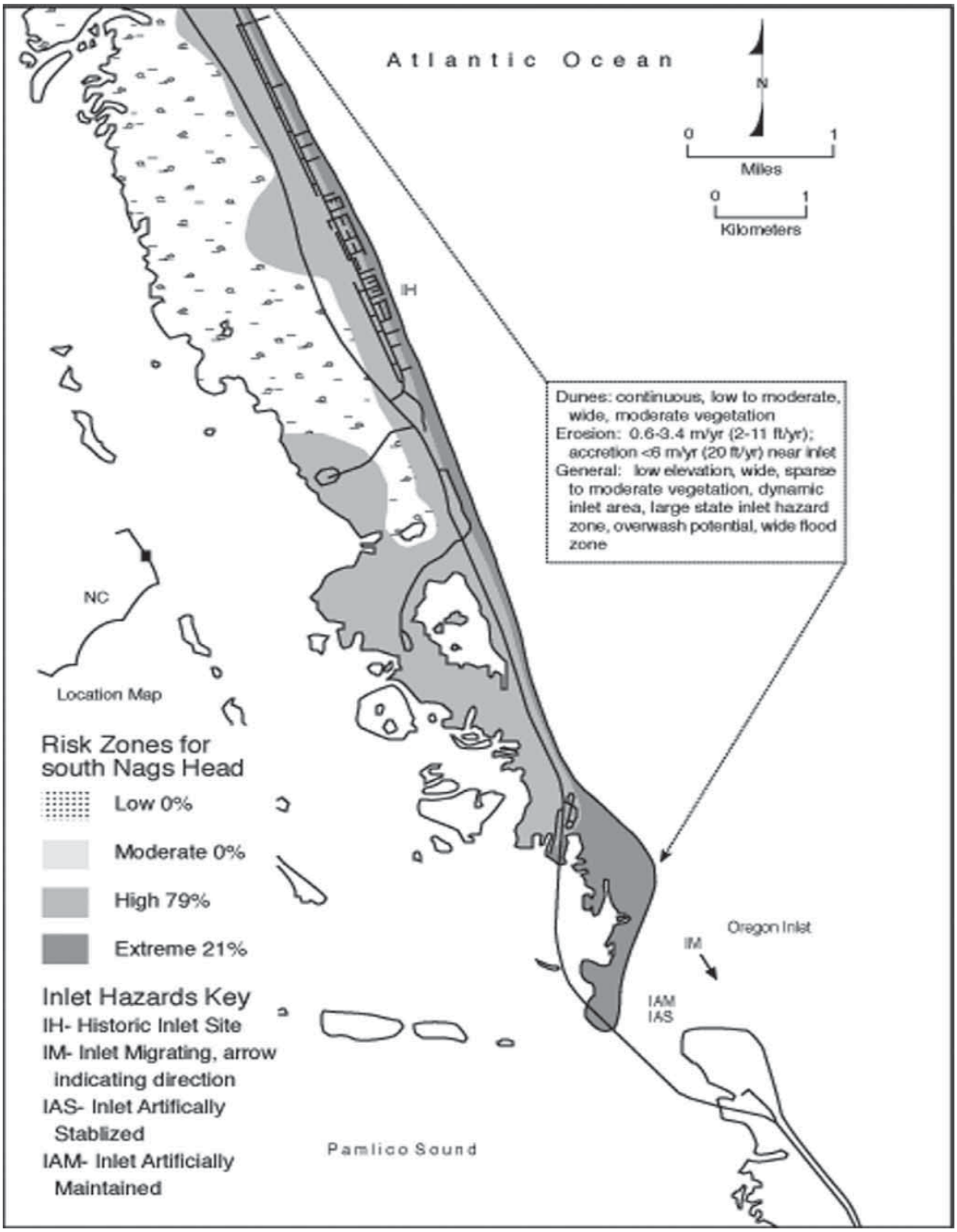

Atlantic Ocean
N
0
1
Miles
0
1
Kilometers
Dunes: discontinuous, low, narrow, sparse to moderate vegetation
Erosion: 2.1-3.0 m/yr (7-10 ft/yr)
General: low elevation, narrow, sparse to moderate vegetation, frequent overwash, wide flood zone, severe soundside flooding potential
Dunes: discontinuous, low, narrow, sparse vegetation
Erosion: 1.8-3.3 m/yr (6-11 ft/yr)
General: wide, high elevation well vegetated, wide flood zone, high erosion rates, shoreline stabilization near the lighthouse, severe soundside flooding potential
IP
Buxton
Cape Hatteras
Pamlico Sound
NC
Location Map
Dunes: continuous, high, wide, well vegetated
Accretion: <4.5 m/yr (15 ft/yr)
General: very wide island, low with high interior ridges, well vegetated, severe soundside flooding potential
Risk Zones for Buxton
Low 52%
Moderate 32%
High 7%
Extreme 8%
Inlet Hazards Key
IP- Potential Inlet Site
Frisco

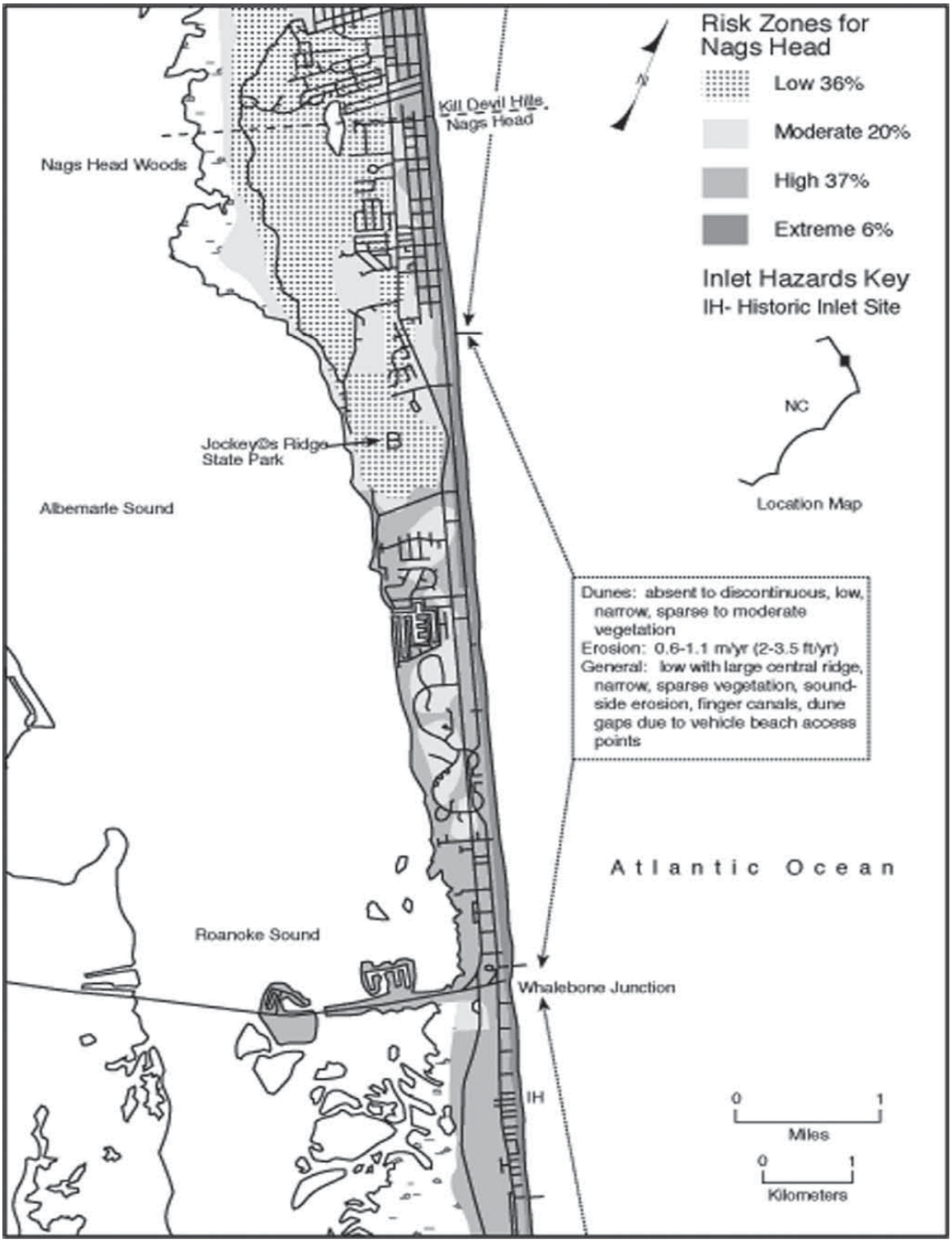

Risk Zones for Avon
Low 3%
Moderate 60%
High 13%
Extreme 24%
Inlet Hazards Key
IP- Potential Inlet Site
IH- Historic Inlet Site
NC
Location Map
Avon
Dunes: continuous, high, wide, moderate vegetation
Erosion: <0.6 m/yr (2 ft/yr)
General: low elevation, wide, moderately to well vegetated, protective dune field, interior flooding from finger canal, severe soundside flooding potential
Pamlico Sound
Atlantic Ocean
N
0
1
Miles
0
1
Kilometers
IP
IH
Dunes: discontinuous, low to moderate, narrow, sparse to moderate vegetation
Erosion: 1.4-3.0 m/yr (4.5-10 ft/yr)
General: low elevation, narrow, wide flood zone, frequent overwash, severe soundside flooding potential, road relocation
Buxton

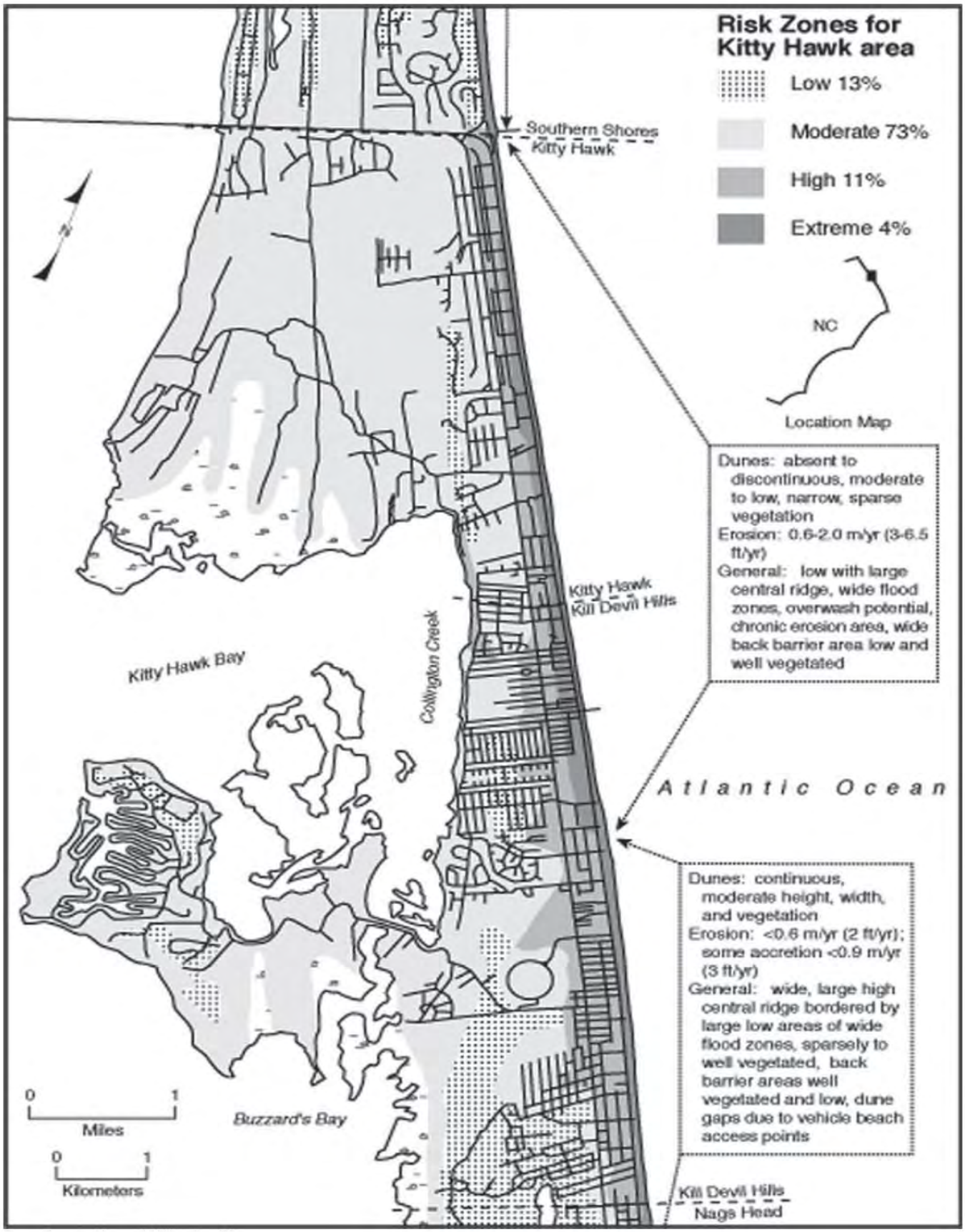

Risk Zones for
south of Salvo
Low 0%
Moderate 20%
High 41%
Extreme 39%
Inlet Hazards Key
IP- Potential Inlet Site
NC
Location Map
Atlantic Ocean
IP
Dunes: continuous, moderate to high, moderate to wide, moderate vegetation
Erosion: 0.6-1.2 m/yr (2-4 ft/yr); some accretion
General: low elevation, narrow, sparse to moderate vegetation, protective dunes, overwash potential, severe soundside flooding potential
Pamlico Sound
N
0
1
Miles
0
1
Kilometers

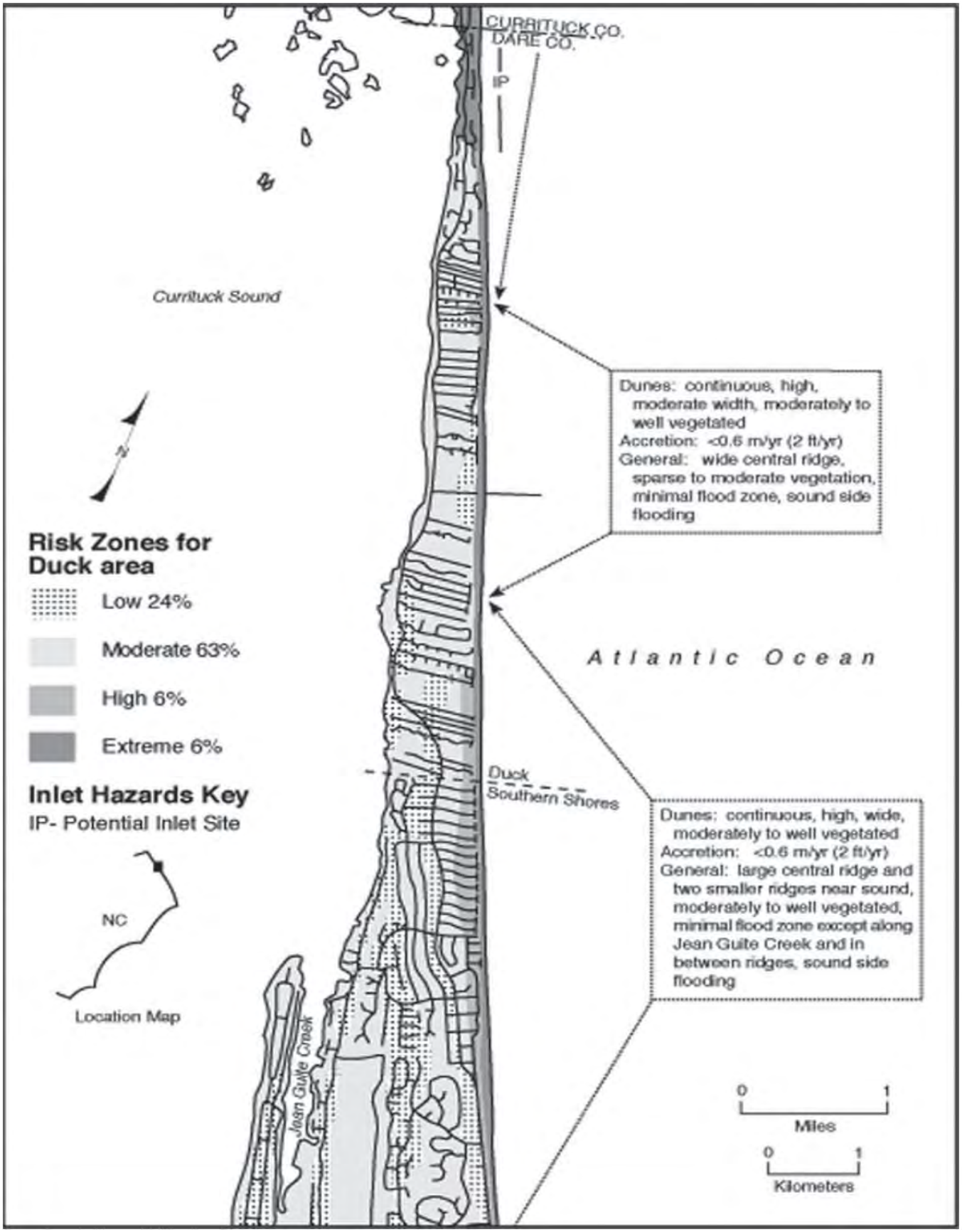

Risk Zones for Waves area
Low 0%
Moderate 45%
High 29%
Extreme 26%
Inlet Hazards Key
IP- Potential Inlet Site
NC
Location Map
IP
IP
Dunes: absent to discontinuous, low, narrow, sparse vegetation
Erosion: 1.7-4.9 m/yr (5.5-16 ft/yr)
General: low elevation, moderate to very narrow, sparse to moderate vegetation, high erosion rates, frequent overwash, wide flooding zone, soundside flooding potential, road relocation
Rodanthe
Pamlico Sound
Atlantic Ocean
Waves
Salvo
Dunes: continuous, high, wide, moderate vegetation
Erosion: <0.9 m/yr (3 ft/yr)
General: low elevation, moderate width, sparse to moderate vegetation, protective dune field, narrow flooding zone, severe soundside flooding potential
N
0
1
Miles
0
1
Kilometers


Oregon Inlet
IAM
IAS
N
Atlantic Ocean
IP
IP
IP
Pamlico Sound
Dunes: absent to discontinuous, low to moderate, very narrow, sparse vegetation
Erosion: 1.5-6.7 m/yr (5-22 ft/yr)
General: low elevation, extremely narrow, sparse to moderate vegetation, inlet partially stabilized, sound side flooding potential, numerous road relocations, entire island prone to flooding
Risk Zones for Oregon Inlet area
Low 0%
Moderate 0%
High 0%
Extreme 100%
Inlet Hazards Key
IP- Potential Inlet Site
IAS- Inlet Artifically Stablized
IAM- Inlet Artificially Maintained
0
1
Miles
0
1
Kilometers
NC
Location Map


Atlantic Ocean
N
0
1
Miles
0
1
Kilometers
IH
Dunes: continuous, low to moderate, wide, moderate vegetation
Erosion: 0.6-3.4 m/yr (2-11 ft/yr); accretion <6 m/yr (20 ft/yr) near inlet
General: low elevation, wide, sparse to moderate vegetation, dynamic inlet area, large state inlet hazard zone, overwash potential, wide flood zone
NC
Location Map
Risk Zones for south Nags Head
Low 0%
Moderate 0%
High 79%
Extreme 21%
Inlet Hazards Key
IH- Historic Inlet Site
IM- Inlet Migrating, arrow indicating direction
IAS- Inlet Artifically Stablized
IAM- Inlet Artificially Maintained
Oregon Inlet
IM
IAM
IAS
Pamlico Sound


Risk Zones for Nags Head
Low 36%
Moderate 20%
High 37%
Extreme 6%
Inlet Hazards Key
IH- Historic Inlet Site
NC
Location Map
Kill Devil Hills
Nags Head
Nags Head Woods
Jockey@s Ridge State Park
Albemarle Sound
Dunes: absent to discontinuous, low, narrow, sparse to moderate vegetation
Erosion: 0.6-1.1 m/yr (2-3.5 ft/yr)
General: low with large central ridge, narrow, sparse vegetation, sound-side erosion, finger canals, dune gaps due to vehicle beach access points
Atlantic Ocean
Roanoke Sound
Whalebone Junction
IH
0
1
Miles
0
1
Kilometers


Risk Zones for Kitty Hawk area
Low 13%
Moderate 73%
High 11%
Extreme 4%
NC
Location Map
Southern Shores
Kitty Hawk
Kitty Hawk
Kill Devil Hills
Kitty Hawk Bay
Collington Creek
Atlantic Ocean
Buzzard's Bay
Kill Devil Hills
Nags Head
Dunes: absent to discontinuous, moderate to low, narrow, sparse vegetation
Erosion: 0.6-2.0 m/yr (3-6.5 ft/yr)
General: low with large central ridge, wide flood zones, overwash potential, chronic erosion area, wide back barrier area low and well vegetated
Dunes: continuous, moderate height, width, and vegetation
Erosion: <0.6 m/yr (2 ft/yr); some accretion <0.9 m/yr (3 ft/yr)
General: wide, large high central ridge bordered by large low areas of wide flood zones, sparsely to well vegetated, back barrier areas well vegetated and low, dune gaps due to vehicle beach access points
0
1
Miles
0
1
Kilometers


CURRITUCK CO.
DARE CO.
IP
Currituck Sound
Dunes: continuous, high, moderate width, moderately to well vegetated
Accretion: <0.6 m/yr (2 ft/yr)
General: wide central ridge, sparse to moderate vegetation, minimal flood zone, sound side flooding
Risk Zones for Duck area
Low 24%
Moderate 63%
High 6%
Extreme 6%
Atlantic Ocean
Inlet Hazards Key
IP- Potential Inlet Site
Duck
Southern Shores
Dunes: continuous, high, wide, moderately to well vegetated
Accretion: <0.6 m/yr (2 ft/yr)
General: large central ridge and two smaller ridges near sound, moderately to well vegetated, minimal flood zone except along Jean Guite Creek and in between ridges, sound side flooding
NC
Location Map
Jean Guite Creek
0
1
Miles
0
1
Kilometers

# **APPENDIX B:** ASSESSMENT OF VULNERABILITY

Vulnerability is defined as a weakness in the design, implementation or operation of an asset, system or network that can be exploited by an adversary or disrupted by a natural hazard or technological failure. Vulnerability to a natural hazard measures the extent to which people are expected to experience physical harm and the likelihood of property damage. Vulnerability to natural hazards exists both at the present and in the future. Present levels of development and growth generate conditions, which expose people and property to some degree of vulnerability to natural hazards. As an area experiences an increase of decrease in development and growth, that degree of vulnerability will change. Dare County is vulnerable to a number of natural hazards and described in the table on page 8, the most prevalent of these are hurricanes, nor'easters, coastal erosion and flooding.

Each hazard is unique to Dare County in terms of impact, frequency, economic impact, area of occurrence and potential loss of life.

For the assessment of Vulnerabilities Dare County focused on the four (4) hazards that affect the area. See Appendix A for a complete list of hazards that Dare County is vulnerable to, also see Hazard Index Score Table on page 128.

Hurricanes occur on average of every 2.5 years. These natural hazards have the most potential for loss and economic loss and are the subject of much community preparation and awareness.

Losses due to flooding within Dare County can be attributed to elevated tide levels, high winds and erosion. All of these conditions are present during storm surges generated in the Atlantic Ocean by tropical storms and hurricanes. In addition, this surge can come from the Pamlico, Albemarle, Croatan and Currituck Sounds where high winds associated with hurricanes and tropical systems can be more damaging than the initial landfall of these systems. Not all storms that pass close to the area produce extremely high surge, attributed passing at low tides and astronomical circumstances. Similarly, storms, which produce flooding conditions in one area, may not necessarily produce flooding conditions in other parts of the area due to the long geographical make-up of the county.

Dare County also experiences severe nor'easters, which can occur at any time during the year. Unlike a hurricane, which may pass over the coastal location in a fraction of the day, nor'easters may blow from the same direction over long distances for several days with high winds and occurring during numerous high tide periods. The contribution from nor'easters to the overall storm surge elevation in Dare County can be significant.

Coastal erosion is a byproduct of hurricanes, nor'easters and flooding. The constant wearing away a shoreline results in the loss of property and the infrastructure developed on the property. The economic impact to the Dare County economy and the state tax base is considerable over time. Also, the attraction to the visitor population is diminished unless the proper disposal of debris created by the damage caused by the erosion is properly removed.

**Hazard Areas**

Much of Dare County is located adjacent to the Pamlico, Albemarle, Roanoke, Croatan , or Currituck Sounds and their tributaries. Similar to those portions of Dare County exposed to the Atlantic Ocean, these soundside areas are susceptible to flooding during hurricanes or other weather events where extended periods of gusty winds push the estuarine waters up their banks.

In early 1990's weather patterns made soundside flooding a dominant issue. In the latter half of the decade, ocean over wash from tropical storms, hurricane, and Nor'easters changed the focus and directed attention to the issue of beach erosion and the vulnerability of NC 12 on Hatteras Island to these conditions. The trend has continued into the next century, creating more attention on the continued coastal erosion problem that stems from multiple

hurricanes and coastal storms that threaten to sever the land route to Hatteras Island and cause major economic problems for the population from this area.

Due to the proximity of Dare County to the Atlantic Ocean, three kinds of natural hazard areas have been designated as Areas of Environmental Concern (AECs) by the NC Coastal Resources Commission. All three fall into the general category of Ocean Hazard Areas:

1. Inlet Hazard Areas that are lands adjoining Oregon and Hatteras Inlets for variable distances as determined by the Coastal Resources Commission. The inlet hazard areas are natural hazard areas that are especially vulnerable to erosion, flooding, and other adverse effects of sand, wind, and water because of their proximity to dynamic ocean inlets. The inlet hazard area AEC extends landward from the mean low water line to a distance sufficient to encompass that area in which the inlet, will, based on statistical analysis, migrate and shall consider such factors as previous inlet territory, structurally weak areas near the inlet (such as an unusually narrow barrier island, an unusually long channel feeding the inlet, or an over wash area), and external influences such as jetties and channelizations.

2. Ocean Erodible Areas, which overlaying the frontal dune includes the distance landward from the first line of stable natural vegetation along the entire oceanfront. This is the area in which there exists a substantial possibility of excessive erosion and significant shoreline fluctuation. The seaward boundary of this area is the mean low water line. The landward extent of this area can generally be described as 60 times the average annual erosion rate for the particular location, plus the distance that the shoreline is likely to erode as a result of a 100-year storm. For specific language concerning these distances, the reader should consult the CAMA AEC standards, Section .0304.

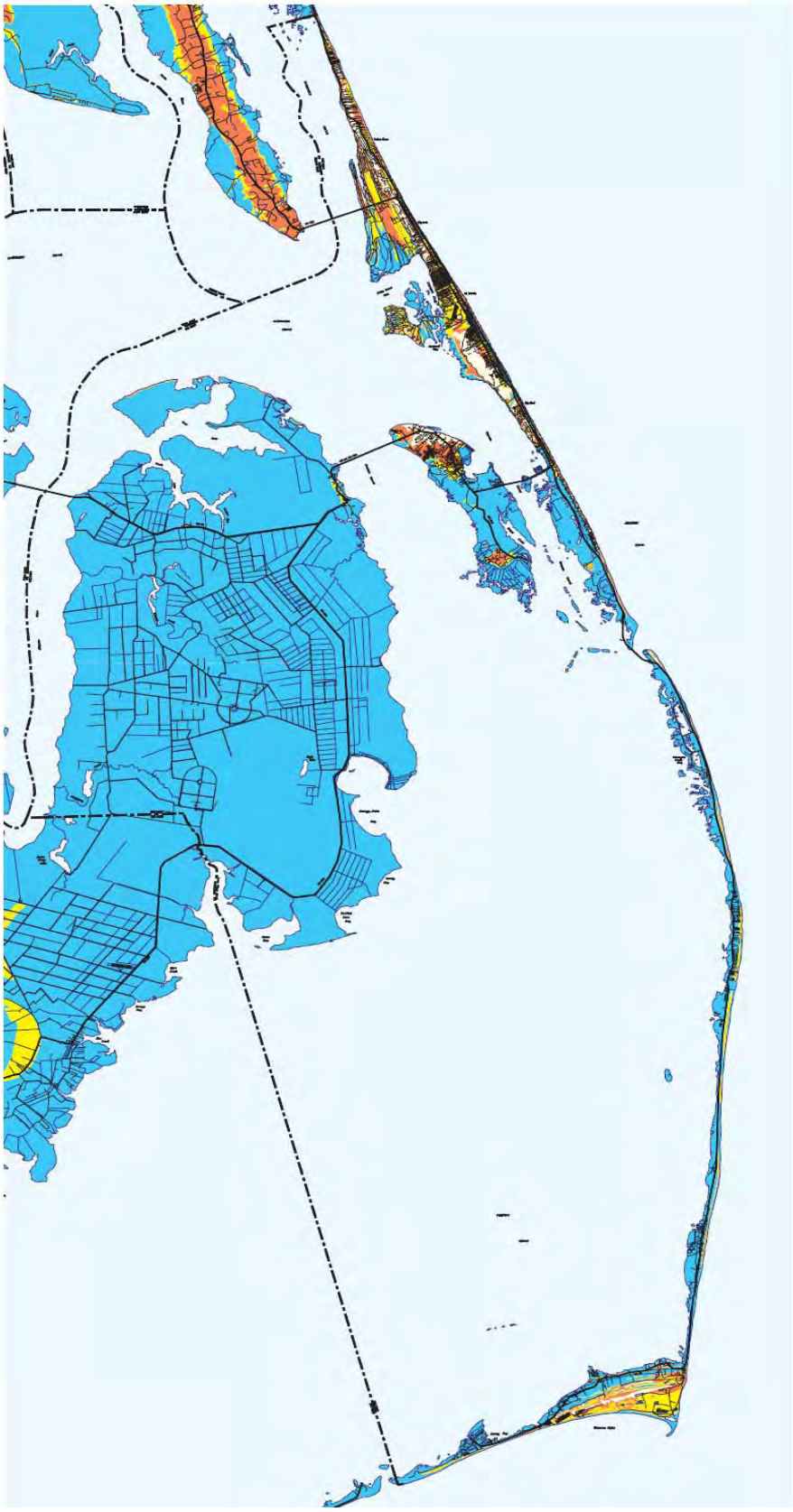
3. High Hazard Flood Areas are areas subject to high velocity waters during a 100-year storm event. These are identified as V zones on the National Flood Insurance rate maps. This is the area subject to high velocity waters (including but not limited to, hurricane wave wash), and a storm having a 1% chance of being equaled or exceeded in any given year, as identified as zones V1-30 on the flood insurance rate maps of the Federal Insurance Administration. In Dare County, virtually all of the ocean shoreline along the Outer Banks is included in a high hazard flood area AEC. Fortunately, an extensive system of natural and manmade dunes has been preserved and/or created in the majority of the high hazard flood zones. As a result, most of the so-called V zones in the unincorporated areas of Dare County are confined to an area oceanward of the dune system.

The only manmade hazards identified in Dare County are those associated with civilian and military aircraft operations. The civilian aircraft operations in Dare County are the Dare County Regional Airport located on Roanoke Island, First Flight Airstrip location in Kill Devil Hills, and the Billy Mitchell Airstrip located on Hatteras Island. The US Air Force and US navy operate bombing and artillery ranges with air restrictions on the Mainland portion of Dare County near Stumpy Point.

Land within the three civilian airport facilities approach zones is subject to hazardous conditions associated with aircraft take-offs and landings. Land development near these civilian facilities must be carefully evaluated to ensure that is does not interfere with the safe operation of the facilities.

Since September 11, 2001 with the terrorist attack on the trade center in New York planning for any mitigation planning strategy must now incorporate the possibility of man-made hazards to include terrorism and pandemic events. While the likelihood of such events occurring in Dare County are minimal, not identifying them would weaken our overall planning strategy and reduce the ability to respond to such events.

The following figures are the Flood Hazard areas of Dare County



Dare County is located along the coastal plain of North Carolina and is best noted for its lengthy strands of barrier island beaches. The County's boundaries encompass approximately 800 square miles of which 390 square miles are land and the remaining 410 square miles are covered by water. Dare County geographically divide~~s~~ itself into a mainland area, a northern and southern stretch of islands, and historic Roanoke Island. These landmasses are surrounded by water bodies that include the Atlantic Ocean to the east, the Pamlico Sound to the west, the Albemarle Sound, the Roanoke Sound, the Croatan Sound, the Currituck Sound and the Alligator River. Oregon Inlet and Hatteras Inlet allow access to the Atlantic Ocean from these many inland waterways.

Prior to the expansive growth of the past three decades, land use in Dare County was a mix of dispersed home sites and essential-need service establishments. During the growth period, market forces directed the establishment of a variety of land uses into the existing setting. As a result of this "mixing" of land uses, compatibility issues have developed. Further contributing to the compatibility issue is a lack of zoning controls or formalized zoning maps for some areas of unincorporated Dare County. This lack of zoning has often resulted in incompatible land uses located adjacent to one another or an incompatible architecture style in close proximity to existing structures. A recent trend among the developed areas is a pattern of new and larger residential structures that do not match the scale of existing development.

Another compatibility issue concerns the development of land along the County's major transportation routes, NC 12, US 158 and US 64. Movement of traffic along these routes has been drastically impeded by commercial land use accessed from these roads and a series of traffic signals, particularly during peak summer months.

All of the compatibility issues in Dare County are compounded by the extraordinary amount of land held in public ownership. These publicly owned properties include the Alligator River National Wildlife Refuge, the Fort Raleigh complex, the Cape Hatteras National Seashore, the Pea Island Wildlife Refuge, the NPS Wright Brothers complex, the US Air Force/Navy bombing ranges, and the Buxton Woods Coastal Preserve. Over 98% of the total land area of unincorporated Dare County is in federal ownership, with 0.5% in state, local or exempt ownership. There is a great deal of pressure to use and develop the remaining 1.5% of the privately owned land. In addition, the privately owned lands are further limited by a number of State and Federal regulatory programs.

The planning jurisdiction of Dare County, which includes the unincorporated areas of Martins Point, Colington, the Hatteras Island villages of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras, the Mainland villages of Manns Harbor, East Lake and Stumpy Point, and Roanoke Island including Wanchese. Not included in the study area are the incorporated towns of Kitty Hawk, Southern Shores, Kill Devil Hills, Nags Head, Duck and Manteo. These towns prepared Hazard Mitigation Plans separately.

The following is a complete analysis and narrative description of each village in the four planning areas using existing tax records.

**Analysis of Planning Area**

**North Dare Planning Area:**

**MARTINS POINT**

MARTINS POINT- Martin's Point Subdivision is located adjacent to the Town of Southern Shores with commercial development along the frontage of US 158 and the majority of the subdivision is platted as residential lots. A manned guard gate limits access to the residential section which identifies the area as a gated community in the regulations regarding debris removal/clean up for any federal declared disaster. For years, the development of Martins Point was under the extraterritorial zoning jurisdiction of Southern Shores, however, the residential portions of the subdivision reverted back to the County's jurisdiction in October 2000. The area is a comprised of large residential structures, mostly for year-round residents. Access to the area is limited by a manned guardhouse. Central water is supplied by Dare County and individual on-site septic systems are used for wastewater. The commercial areas remain under the ETJ of Southern Shores. Fire protective services are contractually provided by Southern Shores and law enforcement is provided by the Dare County Sheriff's Office.

**KILL DEVIL HILLS/OUTSIDE/COLINGTON**

Kill Devil Hills OUTSIDE/COLINGTON – The KDH Outside tax district includes the area locally known as Baum Bay and is located adjacent to the Kill Devil Hills municipal boundary and continues to the first bridge along Colington Road. The development patterns for Baum Bay and Colington can be distinguished b the variation of land uses found throughout the islands. This variation in land use is the result of decades of unregulated land use. However, in 1997, a zoning map was adopted for all of Colington and the Baum Bay area. The largest subdivision in the area, Colington Harbor was zoned in 1985. Both areas continue to be a largely year-round community with a mix of single-family residences, mobile homes and a handful of commercial uses. The presence of rich estuarine shorelines prompted the Colington area to be a fishing village with an emphasis on crabbing prior to the discovery of the Outer Banks as a tourist resort. Colington Harbor is a gated community subject to FEMA regulations for debris removal for federal declared disasters. Colington Harbor boasts a population of approximately 7000 year round residents.

Commercial fishing and crabbing continues to be an important source of income for many Colingtonians and a source of recreational pleasure for visitors. Commercial fishing and traditional land uses played an important role in the development of a zoning map to facilitate these uses but limit the commercial growth potential of Colington. The development of the First Flight Schools (K-12) complex nearby serves as an additional attraction to many families moving to the area. Access to the area is along SR 1217, a winding two-lane road with limited right-of-way width. This heavily traveled secondary road represents a major challenge to transportation planners in NCDOT 1st district. Improvements to SR1217 have been approved to elevate the roadway and eliminate many of the curves and bends. This work is scheduled to begin in 2009.

The residential development is primarily year-round residents with a mixture of long-term rentals. Along SR 1217, there is a mixture of homes and businesses. The area is served by the Dare County regional water system but is dependent on septic tanks for wastewater treatment. However, the existing Baycliff development approved in the late 1980s is served by a small privately owned treatment facility. Many small multi-family subdivisions have developed during the past five years adding to the density and traffic to the area.

**South Dare Planning Area:**

RODANTHE

Traveling south from Oregon Inlet on NC 12, Rodanthe is the first Hatteras Island village after Pea Island Wildlife Refuge. Similar to the other areas of unincorporated Dare County, Rodanthe lacks any defined pattern of development other than that which id found along NC 12, the only major transportation route in the village.

Another cluster of commercial development surrounds the Hatteras Island Fishing Pier. Elsewhere, residential lots and structures of various sizes and ages can be found throughout the village. In 1997, the County constructed a reverse osmosis plant for the Rodanthe Waves Salvo area. The development potential for the village has been enhanced by this critical water supply but continues to be limited by poorly drained soils. The availability of a central water supply has contributed to the quality of life in Rodanthe be eliminating the need for private wells for potable water. In the past, private wells had been inundated by ocean over wash, saltwater intrusion, and encroachment by multiple drain field/septic tank systems.

The Rodanthe village areas continues to be one of the last frontiers in unincorporated Dare County in terms of the residents continued resistance to land use controls. However, as the land use almost everywhere else in Dare County comes under zoning ordinances, the introduction of unpopular or incompatible uses and/or structures has prompted some civic leaders to rethink the need for zoning.

There are two principle transportation issues in Rodanthe. The first is largely a result of the absence of subdivision regulations decades ago that has left the village with a multitude of private roads I poor condition. Secondly, the principle route, NC 12, is at times unreliable due to ocean over wash and a regulatory/environmental dilemma that has stymied transportation planners at NCDOT. However, a multi-agency task force has been working for several years in an effort to develop both short-term and long-term alternatives for the management and maintenance of NC 12.

**WAVES**

The village of Waves is predominantly detached residential structures with some commercial development. Like, Rodanthe, free market forces has established themselves along NC 12. In addition, a number of large travel trailer parks and campgrounds are located in Waves. The village has also benefited from the construction of the reverse osmosis plant but development is still limited by soil characteristics that are poorly drained.

**SALVO**

Salvo is bordered by the village of Waves on the north end and the Cape Hatteras National Seashore on the south end. The development of Salvo is similar to Rodanthe and Waves with both residential and commercial structures located along NC 12. The commercial development is focused mainly on providing services to the seasonal population. The construction of the reverse osmosis plant has removed the reliance on private wells for the Salvo residents but development is still limited by the poorly drained soils found throughout Hatteras Island. Salvo will continue to develop in the established patterns with a mix of permanent homes and businesses along NC 12 and seasonal residents along the immediate ocean and estuarine shorelines.

**AVON**

AVON – Avon village can be separated into two distinct areas within its boundaries. The first is the residential development and businesses established to serve the seasonal visitors and the other, the year-round population located within the old village of Kinnakeet. Along the NC 12 corridor, the majority of land is already developed with mostly residential structures offered for resort rentals or platted as residential lots. The commercial establishments along NC 12 cater mainly to the seasonal population's needs but also provide services to the year-round populations as evidenced by the island only franchise grocery store and newly developed medical center. A private package treatment plant serves the southside portion of the Kinnakeet Shores subdivision; on-site septic systems are used for wastewater treatment.

Inside the village, neighborhoods are residences of the year-round population of Avon, with a mixture of single-family homes and mobile homes. The influence of commercial fishing is evident within the old village, particularly along the harbor front. Avon is a blend of the old and the new with the soundside village composed of extended families and the new areas developing as a resort accommodations and service community.

**BUXTON**

Buxton is a growing commercial and institutional mid-point of Hatteras Island. The existing Cape Hatteras School is located in Buxton and a new elementary school is under construction also. Buxton is comprised of mostly year-round residents and serves as a commercial hub for the entire island. The County constructed a multi-use recreational facility known as the Fessenden Center in Buxton in the mid 1990s that is widely used for recreational sports and other community gatherings. The Group Cape Hatteras Coast Guard base located in Buxton lends to the strong sense of community of the village. The Buxton Woods maritime forest influences a good portion of the residential development occurring in Buxton.

Development in the Buxton Woods forest must comply with the County's special zoning regulations established to preserve the maritime forest setting. Buxton will continue to serve as the commercial and institutional center of Hatteras Island with a mix of single-family homes and modest residential development serving the year-round residents of the area.

**FRISCO**

Similar to Buxton, development in Frisco is influenced by the maritime forest known as Buxton Woods. Several older subdivisions on the soundside of Frisco are beginning to develop with seasonal and year-round homes. Minimal zoning regulations of the S-1 district that permits all uses is established outside the areas zoned SED-1 for the maritime forest. In 1998, efforts to adopt more restrictive zoning were unsuccessful due to lack of a community consensus of desired land use patterns along the vacant road frontage on NC 12. As a result, commercial development has continued to dominant the NC 12 road corridor. This pattern of development is expected to

continue in Frisco due to the restrictive nature SED-1 zoning of Buxton Woods and the lack of use-specific guidelines of the S-1 zoning.

**HATTERAS**

HATTERAS – Hatteras village is the southern most village of Hatteras Island and serves as an entry point for Dare County as a result of the location of the Hatteras-Ocracoke ferry landing at the village/County boundary. The influence of commercial and sport fishing is evident in Hatteras village and many year-round residents make their homes in Hatteras. Previously platted subdivisions have been developed mostly as second homes and rental structures. Commercial development is centered along NC 12 that runs through the village. A commercial hub has also developed around the ferry landing as part of the Hatteras Landing planned unit development approved by Dare County in the early 1990s. Hatteras has done well in retaining its coastal village character while accommodating growth directed to the seasonal population. Central water is available from the Dare County Regional water system.

**Roanoke Island Planning Area:**

**ROANOKE ISLAND** (outside Manteo)

This area of Dare County is predominantly made up of a year-round population. A mixture of single-family residential structures and mobile homes are located in the area. This section of Dare County is the oldest and most traditional setting for year-round residency. The location of central sewer lines along the portion of US 64 that stretches from the southern Manteo town boundary to the Pirates Cove development has influenced the commercial development of Roanoke Island. This area includes several subdivisions along RS 1123, (Burnside Road), the County Detention Center and several other County facilities located on SR 1118 (Driftwood Drive).

Commercial developments have been constructed along this section of US 64 that fall under the planning jurisdiction of Dare County but are connected to the central sewer service of the Town of Manteo. The availability of central sewer from Manteo and the construction of a new bridge from the Mainland to the US 64/NC 345 intersection will continue to influence this area of Roanoke Island. The construction of a new courthouse and visitor's bureau near the new bridge landing will result in a new center of activity away from the traditional downtown area of Manteo. One of the unique features of the area is the overlay corridor district that runs from the Umstead Bridge to Baum Bridge that establishes architectural and vegetation protection provisions along the frontage of US 64. Roanoke Island is also home to the Dare County regional airport and several cultural facilities, including the North Carolina Aquarium and Fort-Raleigh-Elizabethan Gardens complex.

**WANCHESE**

Located at the southern end of Roanoke Island, Wanchese is best described as a coastal fishing community with land development supporting this industry. A large portion of the community has been developed as the Wanchese Seafood Industrial Park by the State. In recent years, this facility has finally begun to developed some established businesses, but yet to reach its full potential due to the uncertainly of the dynamic and unreliable conditions of Oregon Inlet, which is the only ocean inlet for northern Dare County. Wanchese is also home to several boat manufacturing firms. Other commercial development is devoted to the immediate community needs. The population is almost entirely year-round residents of extended families.

Residential development is a mixture of single-family homes and mobile homes. The area is unzoned with residents seemingly satisfied with the lack of land development restrictions. Wanchese is a year-round community with strong ties to the commercial fishing and boating industries.

**Mainland Planning Area:**

**MANNS HARBOR**

Manns Harbor is located on the Mainland of Dare County. Rural in nature, Manns Harbor is comprised mostly of year-round residents with limited commercial development . However, the landing of the new Roanoke Sound Bridge is located at the US 64 intersection in Manns Harbor and it is anticipated that this will greatly influence the

community over the next several years. Although Manns Harbor is currently unzoned, there has been considerable interest in a possible zoning map as a result of the residents recognizing possible changes associated with the new bridge landing. Existing development patterns reflect a somewhat disorganized mix of residential uses, service-related businesses and even some light manufacturing (boat building). Manns Harbor is the largest of the Mainland villages.

**MASHOES**

The small village of Mashoes is located off US 64 from Manns Harbor. It is a small community with a handful of year-round residents and not commercial land uses. A use specific Zoning Map and Ordinance has been adopted for this community, which relies on private wells and individual on-site septic systems for wastewater treatment.

**EAST LAKE**

The majority of the Mainland area is under the jurisdiction of the Federal Government as either the Alligator River Wildlife Refuge or the US Navy/Air Force Bombing range. There is little development in East Lake except for the residential uses for the area's handful of permanent residents. Most homes are located along US 64. Dare County's heritage, as a rural area and sportsman paradise remains evident in East Lake. Like Manns Harbor, this area is unzoned.

**STUMPY POINT**

Located off US 264, Stumpy Point is somewhat isolated from the other areas of Dare County with a majority of the property owned by permanent residents. The influence of commercial fishing is evident in Stumpy Point due to its proximity to the Pamlico Sound. The poor soils and low elevations have limited development in Stumpy Point despite a waterfront community. A central water system solely for Stumpy Point is being constructed by the County to provide more suitable potable water for the residents, who currently use private wells with an undesirable water quality. This service is scheduled for completion in early 2003. Stumpy Point has incorporated zoning and water ordinances as part of their land development process.

**COMMUNITY GROWTH PATTERNS**

One common theme that is expressed by the residents and property owners of Dare County is the desire to maintain the coastal village atmosphere that is found throughout the area. This desire is often stated at hearings or workshops where development projects or issues are discussed.

However, market forces and the limited amount of privately owned land available for development in Dare County often conflict with the attempt to maintain this coastal village atmosphere.

Use-specific zoning with an emphasis on residential zoning districts has been one technique used by Dare County officials to manage the growth and development. Since the early 1990's, zoning maps for the villages of Hatteras, Avon, Buxton and Colington have been adopted. County efforts to establish zoning maps for the other villages of Dare County were supported on the land use plan survey and these efforts will continue. The construction of the new bridge from Mainland Dare County to the intersection of US 64 and NC 345 on Roanoke Island will have tremendous influence on the growth patterns of these two landing areas. Currently Manns Harbor is unzoned but the need for land use regulations to address the impacts of the bridge on the village has been identified. On Roanoke Island, the presence of the new bridge landing and the availability of central sewer from the Town of Manteo are influencing the land use patterns of this area. A new Dare County Courthouse and Dare County Visitors Center is planned for the general vicinity of the new bridge landing. This area of Roanoke Island will continue to be the focus of development pressure due to the central wastewater service lines located along the US 64 right-or-way.

In other areas of unincorporated Dare County, free-market forces continue to fuel the County's development without the need to provide any type of economic stimulators for growth. However, in early 2002, the Dare County Board of Commissioners adopted a gross floor limitation of 20,000 square feet for retail structures in all commercial and

industrial zoned areas of unincorporated Dare County. This limitation will impact the growth patterns of unincorporated Dare County and the type and scale of the development that choose to locate in our community.

**Community Facilities**

Over the past several decades, unincorporated Dare County has undergone a transition form sparsely developed and populated villages to a seasonal resort area featuring a mix of commercial and residential development. The demand for infrastructure improvements and public services has increased significantly during this transition period. A discussion of each of these items as follows:

**Water**

Water is provided to customers throughout Dare County by five water treatment plants and associated water distribution systems.

The extension of public water to the village of Stumpy Point has been completed and this community is no longer dependent on private wells for potable water, making Stumpy Point the first mainland community to enjoy the benefits of a treated central water supply.

The areas presently served by the Dare Regional Desalination Facility (North Reverse Osmosis Plant) and the Skyco Plant are the Towns of Duck, Southern Shores, and Kitty Hawk. In addition, the Towns of Nags Head and Kill Devil Hills receive bulk wholesale water from two water plants. The Joseph Mac Midgett Desalination Plant (RWS Water Facility) serves the villages of Rodanthe, Waves, and Salvo. Avon, Buxton, and Hatteras Villages are supplied water from the Cape Hatteras Water Plant. And the Stumpy Point Reverse Osmosis Water Plant, owned by the Stumpy Point Water and Sewer Authority, serves water to the area of Stumpy Point Village.

The Skyco Water Plant also provides bulk wholesale water to the Town of Manteo and some portions or Roanoke Island outside of the town limits.

Proposed system expansion throughout other areas of Roanoke Island that do not receive municipal water supplies to date, could take place in the future. If funds become available for this project, the County may be in the position to follow through with construction of this expansion.

**WASTEWATER**

Publicly owned wastewater treatment in Dare County is only available from the Town of Manteo, which operates a central wastewater treatment plant. The capacity of this plant is 600,000 gpd with current demand usage at approximately 200,000 gpd. The Town does offer excess wastewater capacity to projects within the unincorporated areas of Roanoke Island that are adjacent to its service boundaries. It is recognized that these projects that choose to use the central wastewater treatment from Manteo will eventually be annexed by the Town. There is little prospect for other publicly owned central wastewater treatment plants due to environmental constraints with surface water discharge and a lack of suitable soils for land application.

There are several privately owned and operated central wastewater treatment plants in Dare County. The two are located within the County's unincorporated boundaries. The Baycliff subdivision in Colington features a small package treatment plant for this residential subdivision. A central package treatment plant also services the Kinnakeet Shores Soundside Subdivision. The soundside residential phases of this division and the commercial complex known as Hatteras Island Plaza are connected to this treatment plant. There are other privately owned plants are located within the municipalities of the County.

Onsite septic tank and drain field systems serve as the predominant method of wastewater treatment in Dare County. In situations where the intensity of land use or soil limitations preclude the use of a traditional septic system, alternative engineered methods of wastewater treatment have been used. These include low-pressure systems and peat systems. These systems have become more popular in the past several months, but their maintenance record remains unknown since the use of the systems is relatively new in North Carolina.

The Stumpy Point Water & Sewer District is now constructing a wastewater treatment plant in the village of Stumpy Point on the Dare County mainland. This system is expected to be completed and start up by early 2010. This system is permitted for 227 individual STEP pump stations, 20,260 linear feet of service laterals, 19,880 linear feet of low pressure main, 3,140 linear feet of force main and a treatment facility. The treatment facility is permitted to discharge 50,000 gallons per day of treated wastewater into the Stumpy Point canal. The facility is to be a membrane assisted advanced tertiary treatment system with ultraviolet light disinfection. The system will produce a very high quality effluent stream that is not expected to have any noticeable environmental impact or hazard.

**Dare County Critical Facilities**

Critical facilities include those facilities that are necessary in the daily operation of a community and those that might be hazardous to a community. Certain critical facilities are vital to the response and recovery efforts in the wake of a disaster and others will be critical for long-term recovery operations, resulting from a natural or technological hazard. Identification of critical facilities will make it possible to predict the consequences of disaster, and to expedite the response of necessary resources from outside the area of impact.

These include fire and rescue facilities, schools, Health/Medical Facilities, major thoroughfares and communication facilities. Dare County critical facilities are indicated below and shown on Firegure B#. The ability to protect these facilities from damage is critical to the welfare of the communities in Dare County in the wake of a future natural event.

Several categories of critical facilities have been identified in Dare County to include:

- Electrical distribution system components
- Health/Medical Facilities
- Transportation Networks
- Communications Network Components
- Public Buildings
- Emergency Services Facilities
- Water Distribution/Drainage Facilities
- Historical Structures
- Landfill and Debris Sites
- Public/Private Supply Centers

*Source: Dare County Emergency Operations Plan*

There are 160,652.99 acres within the unincorporated areas of Dare County. This analysis includes the unincorporated areas of the county. Susceptibility of property in Dare County was analyzed using three different flooding scenarios: 100-year, SLOSH-Slow, and SLOSH – Fast.

Using the 100-year flood models (the FIRM model, or the model insurance rates are based on), the AO Zone contains 141.28 acres of develop property. The AE Zone contains 151,481.23 acres of developed property. The VE Zone contains 5,305.34 acres of developed property. According to the Dare County tax records, the developed properties in the AO Zone contain structures that (the total property value minus the land value) amount to $64,972,900. The developed properties in the AE Zone contain structures amount to $802,836,200. The VE Zone contains structures amounting to $17,760,300.

The SLOSH Slow Storm Zone contains 140,759.68 developed acres that would be affected by a Category 1 or Category 2 hurricane. A storm of this magnitude would affect structures worth $717,059,400. A Category 3 storm would affect 26,403.28 developed acres, for a total building value of $170,298,200. A Category 4 or 5 storms would affect 6,196.15 developed acres less than the previous three categories and total building values of $150,826,100.

The SLOSH-Fast Storm Zone contains 173,397.10 developed acres that would be affected by a Category 1 or Category 2 hurricane. A Storm of this magnitude would affect structures worth $551,118,700. A Category 3 storm

would affect 37,166.68 developed acres, for a total building value of $252,441,100. A Category 4 or 5 storms would affect 27,136 developed with a total building value of $236,906,600.

*Individual analysis for each Geographic Planning Area are included in appendix D.*

**Repetitive Loss Structures**
Dare County has approximately 850 buildings that participate in the flood insurance program in 10 flood prone areas. Two of these are located adjacent to the Atlantic Ocean and 8 are located on the soundside.

The 10 flood prone areas are located in the AE & VE zones, with base flood elevations ranging from 6 to 16 feet MSL.

The average ground elevation in these areas range from 3 to 6 feet MSL. Historically during periods of flooding there is storm surge 2 to 3 feet above normal tide level and standing floodwaters of 1 to 2 feet above ground elevation. In Dare County, the total number of Flood Insurance Policies written since 1978 is 10,223. The number of closed, paid loss claims is 3,743 and the total number of paid claims is $55,106,971. Claims are not broken down by subdivision according to FEMA.

Dare County
Repetitive Losses
By District
N
Duck
6
VE Flood Zone
Southern Shores
Kitty Hawk
AE Flood Zone
Kill Devil Hills
97
VE Flood Zone
Nags Head
203
Manteo
12
AE Flood Zone
AE Flood Zone
VE Flood Zone
Manns Harbor
5
Wanchese
11
VE Flood Zone
AE Flood Zone
Stumpy Point
20
Rodanthe
76
VE Flood Zone
Waves
2
VE Flood Zone
Avon
43
Frisco
18
Hatteras
58
Buxton
36
VE Flood Zone
0 3 6 12 Miles
Dare County
Emergency Management
J. Phillips

# APPENDIX C: COMMUNITY CAPABILITY ASSESSMENT

**Legal Capability**

Local governments in North Carolina only have the legal authority that is granted to them to exercise by the state. This principle is commonly known as "Dillon's Rule," where all power is vested in the state and can only be exercised to the extent delegated. This rule applies to all of North Carolina's counties and cities.

Enabling legislation in the North Carolina General Statutes grants legal authority to the counties and cities. Local regulations that are enacted within the state's enabling authority do not automatically meet judicial acceptance. All regulations placed by local governments on land use and building practices must meet the procedural requirements of the 14th Amendment of the U.S. Constitution, or they may be found invalid. Constitutional protections apply to federal and state governments, as well as all municipalities. All mitigation measures taken by local governments in a regulatory sense must be worded and enforced in a manner that is consistent with the parameters set by the state and federal constitutions.

Local governments have a variety of mitigation measures that are consistent with all constitutional protections and within the limits of Dillon's Rule. All local government powers fall within one of four basic groups of powers: regulation, acquisition, taxation, and spending. Mitigation measures may be carried out under each of the four types of powers.

**A. <u>Regulations</u>**

1. **General Police Powers**

North Carolina's local governments possess a broad range of regulatory powers at their disposal. North Carolina General Statutes grant general police powers to counties and cities, allowing them to adopt and enforce ordinances that define, prohibit, regulate, or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people, and to define and abate nuisances, including public health nuisances. Some hazard mitigation measures can be included under the general police power available to local governments. Without Building Code Council approval 143-138 section E only Floodplain Management and fire prevention codes may be changed.

**2. Building Codes/inspections**

A number of mitigation measures involve structural modifications and retrofitting homes to be less susceptible to natural hazards. Many of these measures are accomplished through use of the building code. North Carolina has a mandatory building code (NCGS 143-138) imposed throughout the state. Counties and cities are granted the authority to adopt more stringent local building code requirements, but they may not adopt regulations that are less restrictive than the state building code.

**3. Land Use**

Regulatory authority granted to local governments by the state is the most commonly used manner that counties and towns use to control the use of land within its jurisdiction. Using various land use regulations, a local government may control the amount, timing, density, quality, and location of new development. Land use regulatory authority includes the power to adopt and enforce zoning ordinances, floodplain ordinances, and subdivision regulations.

**4. Planning**

In order to exercise the regulatory powers granted by the North Carolina General Statutes, local governments are required to designate a planning agency. The planning agency may perform a number of duties, including: making studies of the area; determine objectives; prepare and adopt plans for achieving those objectives; develop and recommend policies; ordinances and administrative means to implement plans; and perform other related duties.

**5. Subdivision Regulations**

Subdivision regulations govern the division of land for development or sale. These regulations can be used for mitigation purposes in various ways. They may prohibit the subdivision of land subject to flooding. Subdivision regulations may also set a standard of public infrastructure that ensures it is adequate for the assessed risk. They may require that developments be built in a hazard-resilient manner, such as requiring "deep" lots in shorefront areas to remedy shoreline erosion. However, 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.

**6. Floodplain Regulations**

Structures built in the floodplain are subject to damage by rising waters. In addition to increasing the number of properties at risk, development in the floodplain reduces the flood storage capacity of these areas, resulting in greater flood heights. Communities should consider the relocation, elevation or acquisition of buildings in the floodplain. At a minimum, elevation and relocation guidelines should meet NFIP standards.

## B. Acquisition

In the long run, it is less expensive to acquire and demolish a building than to repeatedly provide for its reconstruction. In addition to reducing the public cost of recovery and reconstruction, acquisition can be a tool for accomplishing other community goals. It can help increase floodplain storage capacity, preserve wetlands, maritime forests, estuaries and other natural habitats, and provide open space, beach access, and parks and recreation areas. There are several alternative ways to approach acquisition of flood prone properties.

### Section 1.01 1. **Fee Simple Acquisition of Land and Damaged Structures**

Land ownership is often defined as a bundle of rights, of which the right to develop is only one. When one person owns all the rights associated with a parcel of land, they are said to own the land "in fee simple." Acquiring a property in fee simple provides a local government with the greatest level of control over the use and disposition of a parcel. 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.

There are four types of buyouts where built property is involved. *Basic buyouts* are community-run programs without a relocation element. *Buyout and infill* programs are designed to encourage the relocation of families and structures from the floodplain to vacant lots in less hazard-prone neighborhoods. Communities operating *buyout and reorganization* plans often create new subdivisions into which they actively relocate houses and businesses. The community will usually sponsor the planning and installation of infrastructure. *Buyout and complete relocation* is the construction of a new town using new or relocated old buildings.

### Section 1.02 2. **Easements**

The owner of an easement has one or more of the rights in a property, leaving the rest of the "bundle" in the hands of the landowner. Easements either grant an affirmative right to use property, such as a right of access, or restrict the landowner's right to use the property in a particular way. Easements can be written either to allow public access or to prohibit it. They must be clear about the restrictions place on the property. They should also allow inspection by public officials to ensure compliance with the easement provisions. An administrative process for policing easements should be established. The best incentive for encouraging the donation of a conservation easement is the fact that the donation may qualify the donor for tax credits

**Relocation of Existing Development**

Relocation means involving a building or facility to a less hazard-prone area, either within the same parcel or on a new parcel. This technique is typically used to avoid coastal or riverine flood hazards. "Relocating" can also be used to describe the process of demolishing a building and reconstructing it outside the hazard area.

1. **Spending**

Hazard mitigation principals should be made a routine part of all spending decisions made by local governments. The most common forms of hazard mitigation-related spending techniques is capital improvements programming (CIP) and limiting government expenditures in high-hazard areas.

2. **Capital Improvements Programs (CIP)**

Capital improvements programs are timetables that define when, where, and what level of municipal services a government will supply. Typically a part of the comprehensive plan, the CIP sets public spending on improvements for the ensuing five to ten years. Timetables can be effective at managing growth because it is rarely feasible for a developer to provide water, sewer and other services without a public subsidy.

3. **Taxation**

The power of taxation extends beyond merely the collection of revenue. A number of communities set preferential tax rates for areas that are unsuitable for development and can be used to discourage development in hazardous areas.

4. **Special Assessment Districts**

Special assessment districts apply to property owners who directly benefit from a specific public improvement. These owners of both new and existing development in the district are charged a fee that is proportional to the benefits received from the improvement. There are a number of ways to apply this technique, from temporary assessments that raise revenue for a specific improvement to indefinite assessments that fund independent, special purpose governmental entities.

**Institutional Capability**

Dare County is a chartered county, which is governed by a Board of Commissioner-Manger form of government. Police, Fire, and Rescue departments play a critical role in the mitigation of and response to natural hazards. Additionally, a number of other local agencies plan important roles in the institutional capability. These agencies are:

- Communications Director
- Sheriff
- Tax Officer
- Public Information Officer
- Operations Officer
- Fire Marshal
- NC Highway Patrol
- Amateur Radio
- Civil Air Patrol
- Public Works
- Water Department
- Health Department
- Social Services
- Interfaith Community Outreach
- Tourism Bureau
- Chamber of Commerce
- Cape Hatteras Electric
- Dominion Power
- Superintendent of Schools
- Damage Assessment Officer

- Finance Officer
- Airport Manager
- Board of Realtors
- SPCA

**Technical Capability**

There are a number of local, state, and federal agencies available to help Dare County with various aspects of hazard mitigation. They are:

- NC Division of Community Assistance
- Federal Emergency Management Agency
- Eastern Carolina Council
- NC Division of Emergency Management
- National Flood Insurance Program (NFIP)
- Insurance Services Organization (ISO)
- National Oceanic & Atmospheric Administration / National Weather Service
- Universities
- Coastal Resource Commission
- US Forest Service
- US Corps of Engineers

**Fiscal Capability**

**Source of Funding**
Contact the North Carolina Division of Emergency Management for a listing of over 300 government-funding sources for mitigation and disaster assistance (available on CD).

**Hazard Mitigation Grant Program (HMPG)**
The Federal Disaster Assistance Act (Stafford Act) provides funds authorized by the federal government and made available by FEMA for a cost-share program to states. The HMPG provides 75% of the funds while the states provide 25% of the funds for mitigation measures through the post-disaster planning process. The Division of Emergency Management administers the program in this state. The state share may be met with cash or in-kind services. The program is available only for areas affected by a Presidentially Declared disaster.

**Disaster Preparedness Improvement Grant (DPIG)**
This grant provides federal matching funds for communities to develop hazard mitigation plans, expand existing plans, update disaster preparation plans, and to prepare the administrative plans required to qualify for Hazard Mitigation Grant Program grants. Funds for the DPIG are provided by FEMA and the Division of Emergency Management administers the program in each state.

**Flood Mitigation Assistance Program (FMAP)**
This program provides grants for cost-effective measures to reduce or eliminate the long-term risk of flood damage to the built environment and real property. The program's main goal is to reduce repetitive losses to the National Flood Insurance Program. The FMAP is available to eligible communities every year, not just after a Presidentially Declared disaster. Funds for the FMAP are provided by FEMA and the Division of Emergency Management administers the program in each state.

**Flood Mitigation Assistance Program (FMAP)**
This program provides grants for cost-effective measures to reduce or eliminate the long-term risk of flood damage to the built environment and real property. The program's main goal is to reduce repetitive losses to the National Flood Insurance Program. The FMAP is available to eligible communities every year, not just after a Presidentially Declared disaster. Funds for the FMAP are provided by FEMA and the Division of Emergency Management administers the program in each state.

**Public Assistance Program (PA)**
The Public Assistance provides federal aid to communities to help save lives and property in the immediate aftermath of a disaster and to help rebuild damaged facilities. Grants cover eligible costs associated with the repair, replacement, and restoration of facilities owned by state or local governments and nonprofit organizations. The Public Assistance program is administered by FEMA.

**Small Business Administration Disaster Assistance Program**
This program provides loans to businesses affected by Presidentially Declared disasters. The program provides direct loans to businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible. Nonprofit organizations are also eligible. The SBA administers the Disaster Assistance Program.

**Community Development Block Grants (CDBG)**
The CDBG program provides grants to entitlement communities (metropolitan cities and urban counties) for post-disaster hazard mitigation and recovery following a presidential declaration of a Major Disaster of Emergency. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and redevelopment of disaster-affected areas. Funds may also be used for emergency response activities, such as debris clearance and demolition and extraordinary increases in the level of necessary public services. HUD provides funds for the CDBG and the Division of Community Assistance administers the program in each state.

**Table 13. Community Capabilities Assessment**

| Policies & Programs | Document Reference | Effectiveness (High, Medium, Low) | Cost (High, Medium, Low) | Rational for Effectiveness |
|---|---|---|---|---|
| **1.Preventative –** keep flood problems from getting worse. They are usually administered by building, zoning, planning, and/or code enforcement officers. | | | | |
| Subdivision regulations | Adopted November 29, 1982. Revised June 3, 1991 | Medium | Low | Medium because regulations do not specifically address flood hazards |
| Zoning ordinance | Revised February 4, 2002 | Medium | Low | Medium because zoning is not enforced throughout unincorporated Dare County |
| Floodplain regulations | Adopted 1993 | High | Low | |
| Stormwater management plan | Land Use Plan | High | High | High because the regulations require new development to provide for stormwater |
| Open space preservation | N/A | High | Low | High because most of the land is under Federal or State protection |
| Dune and beach maintenance (storm protection plan) | Land Use plan 1994 | High | High | High because it provides protection to structures |
| **2. Property Protection** – usually undertaken by property owners on a building-by-building or parcel basis. | | | | |
| Building elevation | Land use Plan | High | Low | High because by elevating building it reduces the damage in storm events |
| Insurance | Flood insurance study | High | Low | High because well insured structures can be repaired or replaced |
| **3. Natural Resources Protection** – Preserve or restore natural areas or the natural functions of floodplain and watershed areas | | | | |
| Wetlands protection | Section 404, Clean Water Act of 1972 | High | Low | High because wetlands provide a natural function of the floodplain |
| Erosion and sediment control | CAMA | High | Low | |
| Coastal barrier protection | CAMA | High | Low | High because measures protect against erosion |
| **4. Structural Projects** – Keep flood waters away from an area with a levee, reservoir, or other flood control measure, They are designed by engineers and managed or maintained by public works | | | | |
| Levees/floodwalls/seawalls (Avon) | Army Corps of Engineers | Medium | Low | Medium because methods can protect property against erosion |
| Channel modification | Army Corps of Engineers | High | Low | High because channelization can significantly increase runoff |
| Beach nourishment | Army Corps of Engineers | High | High | High because methods can protect against erosion |
| **5. Public Information Activities** – advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains | | | | |
| Outreach projects | N/A | High | Low | High because most people take the outreach materials |
| Map information | Project Impact | High | Low | High because it provides a map of storm surge so property owners can tell where storm surge occurs |
| Technical assistance | N/A | High | Low | High because there is a number of state and federal agencies |
| Local access channel | N/A | High | Low | High because it provides information in storm events |
| Public information officer | Dare County | High | Low | High because officer provides press releases and other vital information in storm events |

# APPENDIX D: GEOGRAPHIC PLANNING AREAS

**Demographic Projections**

The State Data Center provides population projections through the year 2020. These figures project a continued increase in permanent population with a year-round population in 2010 listed as 37,112 persons and a total in 2020 of 44,061. The following table depicts the population projections from the State Data Center

**Table 14. Population Projections for Dare County**

| YEAR | PROJECTION |
|---|---|
| July 2005 | 33,505 |
| July 2010 | 37,269 |
| July 2015 | 40,594 |
| July 2020 | 44,061 |

One of the most difficult statistics to generate reliably is the seasonal peak population of Dare County. The difficulty is centered on the summer months when beautiful weather can result in thousands of spontaneous visitors in addition to the planned vacationers. These guests may choose from a variety of accommodations that include hotels, motels, campgrounds, rental cottages, and the unannounced visit to a friend's house. A new trend in resort accommodations in Dare County is the construction of multiple bedrooms large structures that resemble single-family homes but are built to be occupied by multiple parties on a short-term rental basis. These structures often include generous amenity packages including spas and pools.

Best estimates of the summer seasonal population are approximately 200,000. The number assumes full occupancy of every available mode of occupancy listed above. Given the dynamic nature of tourism, an exact figure is almost impossible to calculate. For purposes of planning for many capital needs and service demands, Dare County must use the peak population figures because at any given time, the peak population or some variant thereof will generate a related demand for services.

**Future Land Use Needs**

Future land use needs in unincorporated Dare County will center around development in existing residential subdivisions and a limited amount of commercial development, mostly focused on the seasonal population. However, as the permanent population of Dare County continues to grow the focus of the commercial development will sift to meeting the needs of the year-round population as well.

The capacity of the remaining undeveloped land in Dare County to accommodate new development will be limited by the availability of soils that can support septic tank systems. As previously state, there are no publicly owned central wastewater treatment plants in unincorporated Dare County and no such system is planned. Alternative engineered wastewater systems, such as peat systems and low-pressure pipe systems, are being used more extensively then before but these systems are more costly and their maintenance record is undetermined at this point. Most development will continue to function with traditional septic tank nitrification fields, thus the amount of suitable lands available in Dare County for development serves as a natural growth inhibitor.

Current zoning ordinances, limit minimum lot sizes for new subdivisions to 15,000 square feet for central water or 20,000 square feet for private well use. The maximum dwelling density allowed under the current zoning codes is 10 units per acre. Dare County does not provide dwelling density increases for the provision of central wastewater and it is unlikely that minimum lot sizes will be decreased. These regulations will influence the future land

development patterns. However, it should be mentioned that the residual capacity of the central wastewater treatment plant for the Town of Manteo will impact the section of Roanoke Island that in within the service district of this treatment plant. Annexation requests and line extension request may result in increased development and dwelling density in this area of unincorporated Dare County.

As discussed throughout this Pan, residential development is the preferred land use. Although, commercial usage is generally considered the "highest and best" use for the commercially zoned property, this is not always the case in Dare County, where the seasonal accommodations market results in the development of commercially zoned land with residential structures offered for short-term occupancy.

As the year-round population continues to grow, public infrastructure projects such as schools, recreation facilities, transportation improvements and other public needs will compete for the remaining undeveloped land. All of these factors are compounded by the large amount of publicly owned land in Dare County. Over ~~80%~~ 98%of the vacant land in Dare County is under federal, state or otherwise protected ownership that precludes its development. This extraordinary amount of public ownership increases development pressures on the remaining privately owned parcels. Balancing the needs for services and goods of our residents and visitors on this limited amount of privately owned land is a major influence on the future land use of Dare County.

An analysis of the tax files in an effort to determine the number of vacant individual parcels and vacant platted subdivision lots in unincorporated Dare County was conducted.

The individual parcels vary in size and it was not evident from the tax records the size of the individual parcels. It should be understood that these parcels may possibly be subdivided into smaller tracts if the minimum lot size requirements can be met. The following table details the results of this analysis. This table is for the unincorporated portions of Dare County and does not include information on the individual municipalities.

Detailed tables of each tax district in unincorporated Dare County can be found in Appendix C of the Dare County Land Use Plan.

**Table 15. Vacant Land Analysis** - Dare County Unincorporated Districts **(January 2009)**

| Taxable Status | # of Parcels | Existing Land Use | Acres of Land | % of Total Land Area | Assessed Land Value | % of Total Land Value |
|---|---|---|---|---|---|---|
| Inactive | 40 | Washouts | 28.24 | 0.001% | - | 0.000% |
| Taxable | 1365 | Individual Parcels | 35,522.86 | 1.294% | 162,250,600 | 8.799% |
| Taxable | 3246 | Subdivision Lots | 3,447.51 | 0.126% | 603,186,000 | 32.713% |
| Exempt | 6 | Religious | 5.38 | 0.000% | 404,900 | 0.022% |
| Exempt | 12 | Non-Profit | 49.47 | 0.002% | 4,558,400 | 0.247% |
| Exempt | 114 | Property Owners Association | 82.22 | 0.003% | 4,756,000 | 0.258% |
| Exempt | 3 | Utilities | 1.45 | 0.000% | 345,400 | 0.019% |
| Exempt | 33 | Federal | 2,691,763.61 | 98.088% | 977,863,500 | 53.033% |
| Exempt | 97 | State | 12,227.12 | 0.446% | 62,344,000 | 3.381% |
| Exempt | 101 | Dare County | 1,112.85 | 0.041% | 28,144,200 | 1.526% |
| Exempt | 3 | Other Municipalities | 0.97 | 0.000% | 37,400 | 0.002% |
| **Totals** | **5020** | | **2,744,241.68** | **100%** | **1,843,890,400** | **100%** |

Table 16. Vacant Land Analysis - Town of Manteo (January 2009)

| Taxable Status | # of Parcels | Existing Land Use | Acres of Land | % of Total Land Area | Assessed Land Value | % of Total Land Value |
|---|---|---|---|---|---|---|
| Taxable | 44 | Individual Parcels | 577.16 | 87.532% | 7,738,000 | 15.438% |
| Taxable | 216 | Subdivision Lots | 43.96 | 6.667% | 39,750,100 | 79.304% |
| Exempt | 1 | Religious | 0.24 | 0.036% | 230,700 | 0.460% |
| Exempt | 21 | Property Owners Association | 35.02 | 5.311% | 892,700 | 1.781% |
| Exempt | 1 | Dare County | 0.42 | 0.064% | 385,000 | 0.768% |
| Exempt | 7 | Other Municipalities | 2.57 | 0.390% | 1,127,000 | 2.248% |
| **Totals** | **290** | | **659.37** | **100%** | **50,123,500** | **100%** |

# APPENDIX E: FLOOD INSURANCE POLICIES AND REPETITIVE LOSS STRUCTURES

**Introduction**

Flooding in the United States is a recurring event, and the severity of flooding varies from year to year and from location to location. Historically, floods have caused more economic loss to the nation than any other natural hazard. Almost 90% of all declared disasters include a flooding component. Flood-related property losses have risen to $6 billion a year, from approximately $3.3 billion in the mid-1980s. Combating the devastating effects of flooding has become a national priority involving flood hazard identification, the purchase of federally-subsidized flood insurance by homeowners, renters and business owners and state and local land-use controls designed to minimize flood loss and guide development away from flood-prone areas. In 1968, through enactment of the National Flood Insurance Act, Congress established a comprehensive risk management program to: (1) Reduce suffering and economic losses due to floods through the purchase of flood insurance; (2) Promote state and local land-use controls to guide development away from flood-prone areas; and (3) Reduce federal expenditures for disaster assistance and flood control.

Dare County has approximately 95% of its land mass in the 100 year flood plain. In 1978 NFIP flood maps were generated with the flood zones delineated and a base for flooding possibilities were available for use in new construction. Dare County currently issues building permits for construction at base flood. Dare County does not have a free board requirement. After Hurricane Bonnie in September of 1998, Dare County established a Hurricane Recovery Mitigation Projects department and a full time staff person as Project Manager. Dare County Board of Commissioners at that time felt that there was a real need for the county government to seek funding for elevation of homes that were built prior to 1978 and that were inconstant danger of damage by flooding events'. As a lot of the homes in our original sound side communities are in low lying areas, flooding events occur with many different types of weather phenomenon. Many of these homes are owned by original Dare County families and often time by older single citizens. With the costs of NFIP coverage based on the elevation of the structure above base flood levels, the costs to the homes that are below the accepted level often times prove to be extremely costly. This cost is more often than not, more than the family that owns and resides in these homes can afford. This is of course, a catch twenty two. They are the ones that need the coverage the most. With the assistance that Dare County can provide to them in seeking funds for elevating these homes above base flood levels, the anticipated damages in these neighborhoods can be greatly reduced. As stated above, with the vast amount of property lying in the 100 year flood zone, relocation is not an alternative that is feasible for our citizens. Likewise, acquisition is not a solution either, as there is no place that they can re-locate in our county for the amount of funds that they would receive from the purchase of their homes. Even if they could, it would disrupt generations of family ties that is so valuable to Dare County.

The common sense factor is elevation. We live in an area that is not doubt subject to flooding; therefore, we need to be above the intrusive flood waters and eliminate flooding damage.

Dare County has been most successful in our endeavor since we began this effort. After Hurricane Bonnie, 10 permanent residential structures were at least one foot above base flood; after Hurricane Floyd, 4 homes are now at least one foot above base flood and Hurricane Isabel which we did in two projects allowed another 21 homes to be elevated to a min. of foot above base flood. Two other CDBG State and Federal grants gave us financially support to elevate another 4 homes and another FEMA/HMGP for Hurricane Ophelia provided funding for two more homes to be elevated at least one foot above base flood. Dare County has a large number of NC licensed general contractors with years of experience in placing homes on an engineered piling foundation. We can go back into the 1940's and 50's and look at homes that were built on our ocean front and they had the same style of construction. Today, we demand engineered foundation plans with the building permit process which enable us to expect a longer life for the structure. There is no doubt that one of our elevated foundations will exceed a mortgage life of thirty years. Also the moving contractors that are supplying the expertise in raising these homes so that the new foundations can be set in place have expanded their capabilities with air cushions and hydraulic pump jacks. Homes can be lifted without damage to them and repositioned on new foundations with ease. The construction involved in

an elevation project consists of first "raising" the structure above the required finished height, removing the old foundation which generally consists of concrete, brick or wooden piers, setting new pilings, building a girder system, lowering the structure down in the new foundation, strapping the house to the foundation according to NC Residential Building Codes for our area, constructing new accesses and steps from the structure to grade level, and replacing all mechanical, electrical & plumbing connections.

Under the first finished floor, there will be insulation to code and underpinned with exterior plywood also according to code. The constructions sites are closely monitored by both project manager and building inspectors.

All elevated structures comply with locally adopted flood plain ordinances. If any of the selected and approved structures for elevation have foundations that are currently constructed of masonry block or brick veneered, the new foundation system will be of masonry block providing that the home is still located in an AE Flood Zone. These foundations will be constructed in a manner to comply with all flood zoning Regulations and building codes by placing permanent flood vents in the foundation walls according to NC State Building Codes and Locally Adopted Flood Plain Ordinances.

**Flood Resistant Materials**

All materials used at or below flood protection elevation (local determination) will be resistant to flood damage. The only electricity allowable at or below flood protection elevation levels is the minimum necessary to meet local / state codes. These electrical items will be exterior waterproof grade.

All areas at or below flood protection elevation are used solely for parking of vehicles, building access, or storage. No habitable living space will be constructed under any elevated structure funded by FEMA/HMGP.

Dare County will continue to evaluate at risk properties and utilize all available funding services provided by State and Federal agencies to continue to provide assistance in reducing property loss.

**Summary – Repetitive Loss Problem**

Historically, flooding has been the most common natural disaster in the United States, costing more in property damages than any other natural disaster. In response to the trend of building homes and businesses in flood-prone areas and the increasing cost of damages caused by floods, Congress created the National Flood Insurance Program (NFIP) in 1968. The object was to reduce future flood losses through flood hazard identification, floodplain management (i.e., land use controls and building codes), and insurance protection. NFIP coverage is available to all owners and occupants of insurable property in a participating community.

Two flood insurance-related policy issues stand out in the 109$^{th}$ Congress. The first issue is the high and continuing cost of paying repetitively flooded properties, and clarifying congressional intent with respect to restoring flood victims to pre-flood conditions. The problem with repetitive loss properties (RLPs) is that the vast majority of these older, generally less-safe properties were "grandfathered" into the NFIP when the program was created and these properties have been repaired multiple times with subsidized flood insurance claim payments. Owners of RLPs' pay less than the full actuarial risk rates. Congress started looking at the RLP problem (and other matters) several years before the National Flood Insurance Reform Act of 1994. The Flood Mitigation Assistance (FMA) Program was authorized as Section 1266 in 1994, and has largely been used to mitigate RLPs. The Bunning-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108-264), signed into law on June 30, 2004, doubled the authorization for that program but did not change its focus, despite some adjustment priorities. The 2004 Act also added two new programs that are focused on RLPs – the Pilot Program and the Individual Property Program. Although the statute authorized $40 million a year for the Pilot Program, subject to annual appropriations, the Administration's budget request for FY2006 did not include funding. Legislation to appropriate the funds (H.R. 2360) is pending.

The second issue, which involves the adequacy of payments and the clarity of policies and procedures for filing and adjusting flood insurance claims after Hurricane Isabel in September 2003, was initially addressed by provisions in the 2004 act that made some programmatic changes to the NFIP and required several studies and reports.

Tables 17 through 29 on the following pages detail the present vulnerability assessments by flood zone for Dare County's unincorporated areas. The data for unincorporated areas is further stratified by the County's dour main geographic areas: Mainland Area, Roanoke Island, North Area (north of Oregon Inlet) and South Area (south of Oregon Inlet).

Tables 30 through 32 provide the vulnerability assessments by flood zone for the Town of Manteo.

Table 33 provides acreage, parcel and assessed value data for each tax district within the four incorporated planning areas.

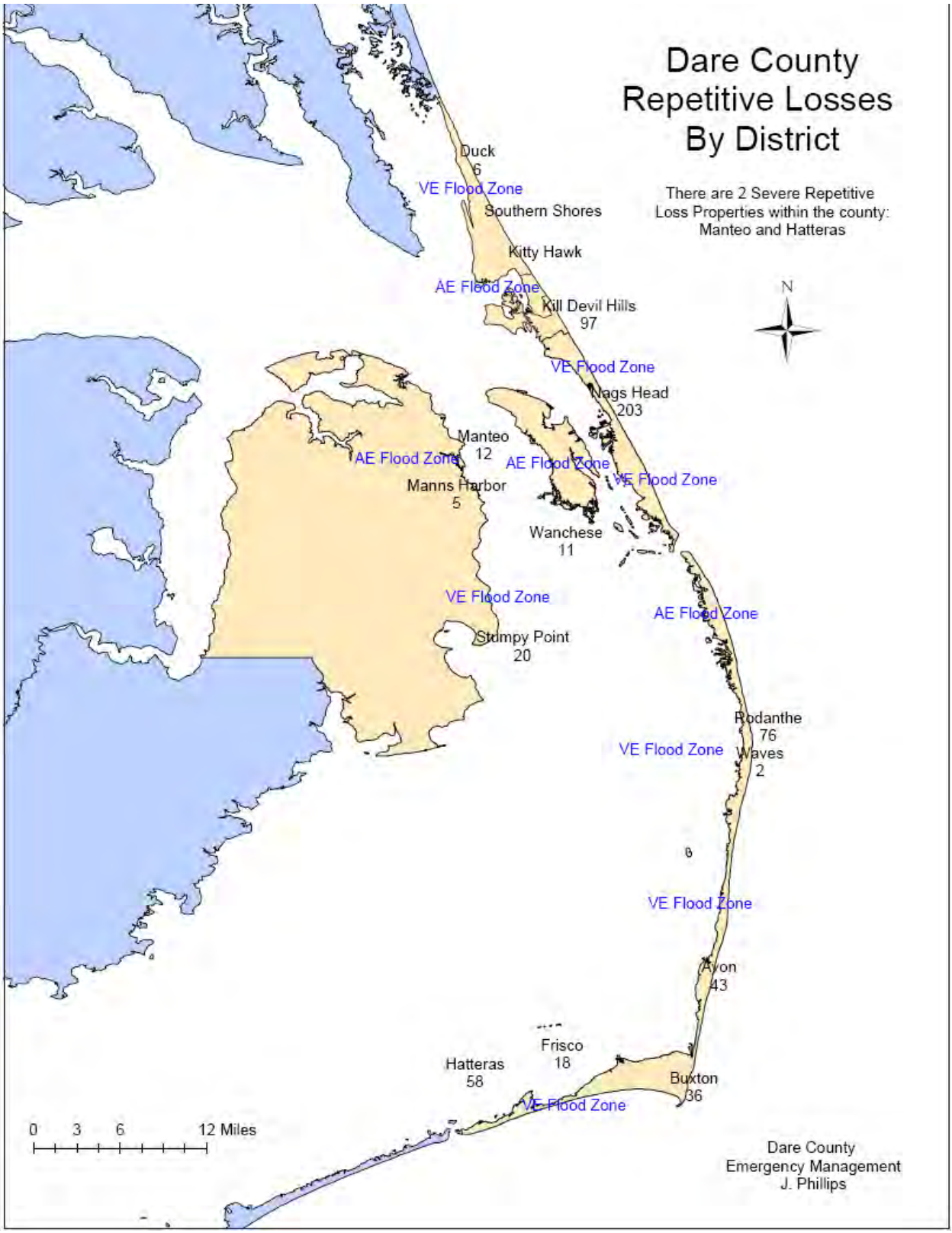

Dare County
Repetitive Losses
By District
There are 2 Severe Repetitive
Loss Properties within the county:
Manteo and Hatteras
N
Duck
6
VE Flood Zone
Southern Shores
Kitty Hawk
AE Flood Zone
Kill Devil Hills
97
VE Flood Zone
Nags Head
203
Manteo
12
AE Flood Zone
AE Flood Zone
VE Flood Zone
Manns Harbor
5
Wanchese
11
VE Flood Zone
AE Flood Zone
Stumpy Point
20
Rodanthe
76
VE Flood Zone
Waves
2
VE Flood Zone
Avon
43
Frisco
18
Hatteras
58
Buxton
36
VE Flood Zone
0 3 6 12 Miles
Dare County
Emergency Management
J. Phillips

**Table 17.** Town of Manteo **Present Vulnerability Assessment**

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| *100 Year Floodplain* | | | | | | | | |
| AE | 253.59 | 1,990.73 | 2,244.32 | 1,530 | 298,422,300 | 16,235,900 | 331,882,200 | 646,540,400 |
| VE | 405.78 | 2,791.58 | 3,197.36 | 383 | 52,567,500 | 16,881,400 | 55,469,000 | 124,917,900 |
| **Subtotal** | **659.37** | **4,782.31** | **5,441.68** | **1,913** | **350,989,800** | **33,117,300** | **387,351,200** | **771,458,300** |
| | | | | | | | | |
| X Zone | - | 0.22 | 0.22 | 1 | - | 300 | 163,300 | 163,600 |
| | | | | | | | | |
| **Total** | **659.37** | **4,782.53** | **5,441.90** | **1,914** | **350,989,800** | **33,117,600** | **387,514,500** | **771,621,900** |

Note:
Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

**Table 18.** Mainland Area **Present Vulnerability Assessment**

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| *100 Year Floodplain* | | | | | | | | |
| AE | 15,715.56 | 103,782.80 | 119,498.36 | 839 | 43,516,000 | 3,718,200 | 67,373,100 | 114,607,300 |
| VE | 7,199.42 | 857.10 | 8,056.52 | 90 | 6,765,100 | 261,000 | 15,644,900 | 22,671,000 |
| **Subtotal** | **22,914.98** | **104,639.90** | **127,554.88** | **929** | **50,281,100** | **3,979,200** | **83,018,000** | **137,278,300** |
| X Zone | 0.41 | 4.29 | 4.70 | 13 | 560,500 | 25,700 | 493,300 | 1,079,500 |
| **Total** | **22,915.39** | **104,644.19** | **127,559.58** | **942** | **50,841,600** | **4,004,900** | **83,511,300** | **138,357,800** |

Note:
Includes the districts of East Lake, Manns Harbor, Mashoes, and Stumpy Point.

Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

**Table 19.** Mainland Planning Area **Present Vulnerability Assessment:** AE Flood Zone

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| Type of Development | Existing Number of Buildings (parcels) | Current Assessed Improvement Value | Current Assessed Total Value | Current Number of People | Projected Number of Buildings (If developed under existing policies) | Projected Assessed Improvement Value | Projected Assessed Total Value | Projected Number of People (If developed under existing policies) |
| Residential | 294 | 29,937,300 | 55,625,100 | 685 | 315 | 32,032,911 | 59,518,857 | 733 |
| Residential-Mobile Home | 154 | 3,489,800 | 13,080,500 | 359 | 157 | 3,559,596 | 13,342,110 | 366 |
| Multi-Family Residential | 0 | - | - | - | - | - | - | - |
| Commercial | 29 | 3,985,800 | 7,692,100 | 68 | 30 | 4,185,090 | 8,076,705 | 71 |
| Manufacturing | 4 | 1,352,800 | 2,352,500 | 9 | 4 | 1,393,384 | 2,423,075 | 10 |
| Miscellaneous Improvements | 27 | 339,000 | 3,275,400 | - | 28 | 349,170 | 3,373,662 | - |
| **SubTotal** | **508** | **39,104,700** | **82,025,600** | **1,121** | **534** | **41,520,151** | **86,734,409** | **1,180** |
| | | | | | | | | |
| Public Buildings & Utilities | 24 | 5,605,100 | 27,622,600 | 192 | 25 | 5,773,253 | 28,451,278 | 198 |
| Other Exempt Improvements | 16 | 2,824,700 | 3,932,600 | 37 | 16 | 2,909,441 | 4,050,578 | 38 |
| **SubTotal** | **40** | **8,429,800** | **31,555,200** | **229** | **41** | **8,682,694** | **32,501,856** | **236** |
| **Total** | **548** | **47,534,500** | **113,580,800** | **1,350** | **575** | **50,202,845** | **119,236,265** | **1,416** |

**Table 20.** Mainland Planning Area **Present Vulnerability Assessment: VE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings** (parcels) | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings** (If developed under existing policies) | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People** (If developed under existing policies) |
| Residential | 28 | 6,700,700 | 13,203,900 | 65 | 30 | 7,169,749 | 14,128,173 | 70 |
| Residential-Mobile Home | 6 | 86,100 | 1,554,600 | 14 | 6 | 87,822 | 1,585,692 | 14 |
| Multi-Family Residential | 0 | - | - | - | - | - | - | - |
| Commercial | 1 | 214,900 | 1,050,600 | 2 | 1 | 225,645 | 1,103,130 | 2 |
| Manufacturing | 0 | - | - | - | - | - | - | - |
| Miscellaneous Improvements | 3 | 24,400 | 1,037,600 | - | 3 | 25,132 | 1,068,728 | - |
| **SubTotal** | **38** | **7,026,100** | **16,846,700** | **82** | **40** | **7,508,348** | **17,885,723** | **87** |
| | | | | | | | | |
| Public Buildings & Utilities | 0 | - | - | - | - | - | - | - |
| Other Exempt Improvements | 0 | - | - | - | - | - | - | - |
| **SubTotal** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Total** | **38** | **7,026,100** | **16,846,700** | **82** | **40** | **7,508,348** | **17,885,723** | **87** |

**Table 21.** Roanoke Island Area **Present Vulnerability Assessment**

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| *100 Year Floodplain* | | | | | | | | |
| AE | 4,427.91 | 2,729.81 | 7,157.72 | 2,426 | 272,214,100 | 12,470,000 | 308,509,700 | 593,193,800 |
| VE | 14,752.65 | 85,159.47 | 99,912.12 | 280 | 36,651,000 | 2,774,000 | 79,031,200 | 118,456,200 |
| **Subtotal** | **19,180.56** | **87,889.28** | **107,069.84** | **2,706** | **308,865,100** | **15,244,000** | **387,540,900** | **711,650,000** |
| X Zone | 334.10 | 900.15 | 1,234.25 | 1,349 | 149,066,200 | 6,002,100 | 161,919,800 | 316,988,100 |
| **Total** | **19,514.66** | **88,789.43** | **108,304.09** | **4,055** | **457,931,300** | **21,246,100** | **549,460,700** | **1,028,638,100** |

Note:
Includes the districts of Wanchese and unicorporated Manteo.

Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

**Table 22.** Roanoke Island Planning Area **Present Vulnerability Assessment:** AE Flood Zone

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| Type of Development | Existing Number of Buildings (parcels) | Current Assessed Improvement Value | Current Assessed Total Value | Current Number of People | Projected Number of Buildings (If developed under existing policies) | Projected Assessed Improvement Value | Projected Assessed Total Value | Projected Number of People (If developed under existing policies) |
| Residential | 1185 | 193,573,000 | 339,135,600 | 2,761 | 1,268 | 207,123,110 | 362,875,092 | 2,954 |
| Residential-Mobile Home | 307 | 7,610,100 | 28,025,500 | 715 | 313 | 7,762,302 | 28,586,010 | 730 |
| Multi-Family Residential | 3 | 1,156,700 | 1,479,200 | 18 | 3 | 1,237,669 | 1,582,744 | 19 |
| Commercial | 73 | 14,533,800 | 29,710,700 | 170 | 77 | 15,260,490 | 31,196,235 | 179 |
| Manufacturing | 9 | 2,894,700 | 4,569,100 | 21 | 9 | 2,981,541 | 4,706,173 | 22 |
| Miscellaneous Improvements | 44 | 410,500 | 4,902,400 | - | 45 | 422,815 | 5,049,472 | - |
| **SubTotal** | **1,621** | **220,178,800** | **407,822,500** | **3,685** | **1,716** | **234,787,927** | **433,995,726** | **3,903** |
| | | | | | | | | |
| Public Buildings & Utilities | 19 | 57,510,900 | 84,105,200 | 152 | 20 | 59,236,227 | 86,628,356 | 157 |
| Other Exempt Improvements | 25 | 6,994,400 | 11,395,600 | 58 | 26 | 7,204,232 | 11,737,468 | 60 |
| **SubTotal** | **44** | **64,505,300** | **95,500,800** | **210** | **45** | **66,440,459** | **98,365,824** | **217** |
| **Total** | **1,665** | **284,684,100** | **503,323,300** | **3,896** | **1,761** | **301,228,386** | **532,361,550** | **4,120** |

**Table 23.** Roanoke Island Planning Area **Present Vulnerability Assessment: VE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings (parcels)** | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings (If developed under existing policies)** | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People (If developed under existing policies)** |
| Residential | 102 | 28,141,800 | 70,925,500 | 238 | 109 | 30,111,726 | 75,890,285 | 254 |
| Residential-Mobile Home | 0 | - | - | - | - | - | - | - |
| Multi-Family Residential | 0 | - | - | - | - | - | - | - |
| Commercial | 16 | 4,397,800 | 5,342,300 | 37 | 17 | 4,617,690 | 5,609,415 | 39 |
| Manufacturing | 9 | 3,236,600 | 3,394,400 | 21 | 9 | 3,333,698 | 3,496,232 | 22 |
| Miscellaneous Improvements | 8 | 110,500 | 2,133,800 | - | 8 | 113,815 | 2,197,814 | - |
| **SubTotal** | **135** | **35,886,700** | **81,796,000** | **296** | **143** | **38,176,929** | **87,193,746** | **315** |
| | | | | | | | | |
| Public Buildings & Utilities | 8 | 5,235,000 | 26,414,400 | 64 | 8 | 5,392,050 | 27,206,832 | 66 |
| Other Exempt Improvements | 2 | 1,824,700 | 7,184,500 | 5 | 2 | 1,879,441 | 7,400,035 | 5 |
| **SubTotal** | **10** | **7,059,700** | **33,598,900** | **69** | **10** | **7,271,491** | **34,606,867** | **71** |
| **Total** | **145** | **42,946,400** | **115,394,900** | **365** | **154** | **45,448,420** | **121,800,613** | **386** |

Table 24. North Area Present Vulnerability Assessment

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| *100 Year Floodplain* | | | | | | | | |
| AE | 1,273.05 | 2,683.59 | 3,956.64 | 3,200 | 456,270,800 | 20,120,600 | 545,118,500 | 1,021,509,900 |
| VE | - | - | - | - | 0 | 0 | 0 | - |
| **Subtotal** | **1,273.05** | **2,683.59** | **3,956.64** | **3,200** | **456,270,800** | **20,120,600** | **545,118,500** | **1,021,509,900** |
| X Zone | 13.94 | 46.02 | 59.96 | 303 | 30,215,100 | 305,600 | 25,604,800 | 56,125,500 |
| **Total** | **1,286.99** | **2,729.61** | **4,016.60** | **3,503** | **486,485,900** | **20,426,200** | **570,723,300** | **1,077,635,400** |

Note:
Includes the districts of Colington, unincorporated Kill Devil Hills, and Martin's Point.

Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

Table 25. North Planning Area **Present Vulnerability Assessment: AE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings (parcels)** | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings (If developed under existing policies)** | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People (If developed under existing policies)** |
| Residential | 2196 | 455,269,600 | 833,850,300 | 5,117 | 2,350 | 487,138,472 | 892,219,821 | 5,475 |
| Residential-Mobile Home | 130 | 3,113,800 | 15,044,300 | 303 | 133 | 3,176,076 | 15,345,186 | 309 |
| Multi-Family Residential | 1 | 3,868,500 | 5,313,400 | 6 | 1 | 4,139,295 | 5,685,338 | 6 |
| Commercial | 40 | 9,217,000 | 21,236,000 | 93 | 42 | 9,677,850 | 22,297,800 | 98 |
| Manufacturing | 1 | 32,300 | 216,700 | 2 | 1 | 33,269 | 223,201 | 2 |
| Miscellaneous Improvements | 43 | 376,500 | 7,672,500 | - | 44 | 387,795 | 7,902,675 | - |
| **SubTotal** | **2,411** | **471,877,700** | **883,333,200** | **5,521** | **2,571** | **504,552,757** | **943,674,021** | **5,890** |
| | | | | | | | | |
| Public Buildings & Utilities | 4 | 976,200 | 1,687,700 | 32 | 4 | 1,005,486 | 1,738,331 | 33 |
| Other Exempt Improvements | 17 | 3,410,300 | 11,485,800 | 40 | 18 | 3,512,609 | 11,830,374 | 41 |
| **SubTotal** | **21** | **4,386,500** | **13,173,500** | **72** | **22** | **4,518,095** | **13,568,705** | **74** |
| **Total** | **2,432** | **476,264,200** | **896,506,700** | **5,593** | **2,592** | **509,070,852** | **957,242,726** | **5,964** |

Table 26. North Planning Area **Present Vulnerability Assessment: VE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings** (parcels) | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings** (If developed under existing policies) | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People** (If developed under existing policies) |
| Residential | 0 | - | - | - | - | - | - | - |
| Residential-Mobile Home | 0 | - | - | - | - | - | - | - |
| Multi-Family Residential | 0 | - | - | - | - | - | - | - |
| Commercial | 0 | - | - | - | - | - | - | - |
| Manufacturing | 0 | - | - | - | - | - | - | - |
| Miscellaneous Improvements | 0 | - | - | - | - | - | - | - |
| **SubTotal** | - | - | - | - | - | - | - | - |
| | | | | | | | | |
| Public Buildings & Utilities | 0 | - | - | - | - | - | - | - |
| Other Exempt Improvements | 0 | - | - | - | - | - | - | - |
| **SubTotal** | 0 | - | - | - | - | - | - | - |
| **Total** | - | - | - | - | - | - | - | - |

Table 27. South Planning Area **Present Vulnerability Assessment**

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| ***100 Year Floodplain*** | | | | | | | | |
| AE | 5,336.55 | 3,367.16 | 8,703.71 | 5,690 | 758,589,500 | 35,649,500 | 1,258,753,200 | 2,052,992,200 |
| VE | 3,390.24 | 29,907.38 | 33,297.62 | 3,026 | 512,583,400 | 29,750,100 | 945,783,100 | 1,488,116,600 |
| **Subtotal** | **8,726.79** | **33,274.54** | **42,001.33** | **8,716** | **1,271,172,900** | **65,399,600** | **2,204,536,300** | **3,541,108,800** |
| X Zone | 14.36 | 29.32 | 43.68 | 106 | 9,120,800 | 205,300 | 11,444,600 | 20,770,700 |
| **Total** | **8,741.15** | **33,303.86** | **42,045.01** | **8,822** | **1,280,293,700** | **65,604,900** | **2,215,980,900** | **3,561,879,500** |

Note:
Includes the districts of Rodanthe, Waves, Salvo, Avon, Buxton, Frisco, and Hatteras.

Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

**Table 28.** South Planning Area **Present Vulnerability Assessment:** AE Flood Zone

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings** (parcels) | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings** (If developed under existing policies) | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People** (If developed under existing policies) |
| Residential | 3289 | 679,326,300 | 1,434,750,200 | 7,663 | 3,519 | 726,879,141 | 1,535,182,714 | 8,200 |
| Residential-Mobile Home | 351 | 10,167,800 | 55,838,500 | 818 | 358 | 10,371,156 | 56,955,270 | 834 |
| Multi-Family Residential | 8 | 1,762,900 | 3,610,000 | 48 | 9 | 1,886,303 | 3,862,700 | 51 |
| Commercial | 237 | 76,571,700 | 169,198,700 | 552 | 249 | 80,400,285 | 177,658,635 | 580 |
| Manufacturing | 4 | 387,500 | 1,026,500 | 9 | 4 | 399,125 | 1,057,295 | 10 |
| Miscellaneous Improvements | 89 | 3,499,300 | 12,285,600 | - | 92 | 3,604,279 | 12,654,168 | - |
| **SubTotal** | **3,978** | **771,715,500** | **1,676,709,500** | **9,091** | **4,230** | **823,540,289** | **1,787,370,782** | **9,675** |
| | | | | | | | | |
| Public Buildings & Utilities | 52 | 25,526,800 | 44,155,400 | 416 | 54 | 26,292,604 | 45,480,062 | 428 |
| Other Exempt Improvements | 60 | 4,510,900 | 11,184,400 | 140 | 62 | 4,646,227 | 11,519,932 | 144 |
| **SubTotal** | **112** | **30,037,700** | **55,339,800** | **556** | **115** | **30,938,831** | **56,999,994** | **572** |
| **Total** | **4,090** | **801,753,200** | **1,732,049,300** | **9,647** | **4,346** | **854,479,120** | **1,844,370,776** | **10,247** |

**Table 29.** South Planning Area **Present Vulnerability Assessment:** **VE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| Type of Development | Existing Number of Buildings (parcels) | Current Assessed Improvement Value | Current Assessed Total Value | Current Number of People | Projected Number of Buildings (If developed under existing policies) | Projected Assessed Improvement Value | Projected Assessed Total Value | Projected Number of People (If developed under existing policies) |
| Residential | 1816 | 470,481,400 | 1,079,928,600 | 4,231 | 1,943 | 503,415,098 | 1,155,523,602 | 4,527 |
| Residential-Mobile Home | 60 | 1,959,300 | 10,711,100 | 140 | 61 | 1,998,486 | 10,925,322 | 143 |
| Multi-Family Residential | 1 | 227,500 | 985,600 | 6 | 1 | 243,425 | 1,054,592 | 6 |
| Commercial | 95 | 39,441,600 | 110,699,800 | 221 | 100 | 41,413,680 | 116,234,790 | 232 |
| Manufacturing | 1 | 144,700 | 556,200 | 2 | 1 | 149,041 | 572,886 | 2 |
| Miscellaneous Improvements | 101 | 2,731,000 | 15,317,700 | - | 104 | 2,812,930 | 15,777,231 | - |
| **SubTotal** | **2,074** | **514,985,500** | **1,218,199,000** | **4,601** | **2,210** | **550,032,660** | **1,300,088,423** | **4,911** |
| | | | | | | | | |
| Public Buildings & Utilities | 28 | 39,549,300 | 1,576,104,400 | 224 | 29 | 40,735,779 | 1,623,387,532 | 231 |
| Other Exempt Improvements | 24 | 2,801,700 | 7,520,600 | 56 | 25 | 2,885,751 | 7,746,218 | 58 |
| **SubTotal** | **52** | **42,351,000** | **1,583,625,000** | **280** | **54** | **43,621,530** | **1,631,133,750** | **288** |
| **Total** | **2,126** | **557,336,500** | **2,801,824,000** | **4,881** | **2,264** | **593,654,190** | **2,931,222,173** | **5,200** |

**Table 30.** Town of Manteo **Present Vulnerability Assessment**

| | Vacant Acres | Developed Acres | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|---|
| *100 Year Floodplain* | | | | | | | | |
| AE | 253.59 | 1,990.73 | 2,244.32 | 1,530 | 298,422,300 | 16,235,900 | 331,882,200 | 646,540,400 |
| VE | 405.78 | 2,791.58 | 3,197.36 | 383 | 52,567,500 | 16,881,400 | 55,469,000 | 124,917,900 |
| **Subtotal** | **659.37** | **4,782.31** | **5,441.68** | **1,913** | **350,989,800** | **33,117,300** | **387,351,200** | **771,458,300** |
| | | | | | | | | |
| X Zone | - | 0.22 | 0.22 | 1 | - | 300 | 163,300 | 163,600 |
| | | | | | | | | |
| **Total** | **659.37** | **4,782.53** | **5,441.90** | **1,914** | **350,989,800** | **33,117,600** | **387,514,500** | **771,621,900** |

Note:
Properties within more than one flood zone were categorized in acreage and value totals as follows:
If any portion was in VE, AE, and or X, it was included in VE.
If any portion was in AE and X it was included in AE.

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

**Table 31.** Town of Manteo Planning Area **Present Vulnerability Assessment:** **AE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings** (parcels) | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings** (If developed under existing policies) | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People** (If developed under existing policies) |
| Residential | 883 | 183,692,100 | 340,874,400 | 2,057 | 945 | 196,550,547 | 364,735,608 | 2,201 |
| Residential-Mobile Home | 28 | 471,500 | 2,281,100 | 65 | 29 | 480,930 | 2,326,722 | 67 |
| Multi-Family Residential | 5 | 3,044,700 | 4,727,000 | 30 | 5 | 3,257,829 | 5,057,890 | 32 |
| Commercial | 121 | 51,752,500 | 105,801,100 | 282 | 127 | 54,340,125 | 111,091,155 | 296 |
| Manufacturing | 0 | - | - | - | - | - | - | - |
| Miscellaneous Improvements | 153 | 8,291,100 | 14,355,900 | - | 158 | 8,539,833 | 14,786,577 | - |
| **SubTotal** | **1,190** | **247,251,900** | **468,039,500** | **2,435** | **1,263** | **263,169,264** | **497,997,952** | **2,596** |
| | | | | | | | | |
| Public Buildings & Utilities | 37 | 57,301,400 | 107,808,100 | 296 | 38 | 59,020,442 | 111,042,343 | 305 |
| Other Exempt Improvements | 24 | 10,088,200 | 23,307,900 | 56 | 25 | 10,390,846 | 24,007,137 | 58 |
| **SubTotal** | **61** | **67,389,600** | **131,116,000** | **352** | **63** | **69,411,288** | **135,049,480** | **362** |
| **Total** | **1,251** | **314,641,500** | **599,155,500** | **2,786** | **1,326** | **332,580,552** | **633,047,432** | **2,959** |

**Table 32.** Town of Manteo Planning Area **Present Vulnerability Assessment: VE Flood Zone**

| | Current Conditions | | | | Potential Future Conditions (Five Year Projection) | | | |
|---|---|---|---|---|---|---|---|---|
| **Type of Development** | **Existing Number of Buildings** (parcels) | **Current Assessed Improvement Value** | **Current Assessed Total Value** | **Current Number of People** | **Projected Number of Buildings** (If developed under existing policies) | **Projected Assessed Improvement Value** | **Projected Assessed Total Value** | **Projected Number of People** (If developed under existing policies) |
| Residential | 176 | 53,745,400 | 105,984,800 | 410 | 188 | 57,507,578 | 113,403,736 | 439 |
| Residential-Mobile Home | 0 | - | - | - | - | - | - | - |
| Multi-Family Residential | 0 | - | - | - | - | - | - | - |
| Commercial | 0 | - | - | - | - | - | - | - |
| Manufacturing | 0 | - | - | - | - | - | - | - |
| Miscellaneous Improvements | 196 | 15,703,500 | 16,177,800 | - | 202 | 16,174,605 | 16,663,134 | - |
| **SubTotal** | **372** | **69,448,900** | **122,162,600** | **410** | **390** | **73,682,183** | **130,066,870** | **439** |
| | | | | | | | | |
| Public Buildings & Utilities | 0 | - | - | - | - | - | - | - |
| Other Exempt Improvements | 0 | - | - | - | - | - | - | - |
| **SubTotal** | - | - | - | - | - | - | - | - |
| **Total** | **372** | **69,448,900** | **122,162,600** | **410** | **390** | **73,682,183** | **130,066,870** | **439** |

**Table 33.** Dare County **Present Vulnerability Assessment** - Data By District

| Planning Area | District Name | Total Acres | Number of Parcels | Assessed Building Value | Assessed Misc Structure Value | Assessed Land Value | Assessed Total Value |
|---|---|---|---|---|---|---|---|
| Mainland Planning Area | East Lake | 113,760.46 | 168 | 3,401,700 | 426,800 | 5,659,700 | 9,488,200 |
| Mainland Planning Area | Manns Harbor | 5,670.05 | 473 | 33,814,600 | 2,691,300 | 54,195,700 | 90,701,600 |
| Mainland Planning Area | Mashoes | 2,284.43 | 54 | 1,882,600 | 99,300 | 5,246,300 | 7,228,200 |
| Mainland Planning Area | Stumpy Point | 5,844.64 | 247 | 11,742,700 | 787,500 | 18,409,600 | 30,938,800 |
| North Planning Area | Colington | 3,342.12 | 2,949 | 324,760,300 | 11,307,500 | 400,754,100 | 736,821,900 |
| North Planning Area | Kill Devil Hills Out | 246.55 | 182 | 27,322,200 | 1,336,600 | 26,110,400 | 54,769,200 |
| North Planning Area | Martin's Point | 427.93 | 372 | 134,403,400 | 7,782,100 | 143,858,800 | 286,044,300 |
| Roanoke Island Planning Area | Manteo Out | 7,448.94 | 2,968 | 381,550,200 | 16,243,300 | 461,232,300 | 859,025,800 |
| Roanoke Island Planning Area | Wanchese | 100,855.15 | 1,087 | 76,381,100 | 5,002,800 | 88,228,400 | 169,612,300 |
| South Planning Area | Avon | 2,596.94 | 2,224 | 346,135,000 | 14,131,400 | 586,305,500 | 946,571,900 |
| South Planning Area | Buxton | 9,721.19 | 1,242 | 159,324,500 | 6,220,100 | 257,376,400 | 422,921,000 |
| South Planning Area | Frisco | 25,337.49 | 1,670 | 183,064,700 | 7,252,100 | 343,082,600 | 533,399,400 |
| South Planning Area | Hatteras | 2,151.37 | 1,431 | 213,753,100 | 14,731,000 | 360,547,000 | 589,031,100 |
| South Planning Area | Rodanthe | 965.88 | 865 | 131,956,900 | 9,017,000 | 215,159,300 | 356,133,200 |
| South Planning Area | Salvo | 764.41 | 910 | 155,416,100 | 8,190,900 | 299,946,300 | 463,553,300 |
| South Planning Area | Waves | 507.73 | 480 | 90,643,400 | 6,062,400 | 153,563,800 | 250,269,600 |
| | **Totals** | **281,925.28** | **17,322** | **2,275,552,500** | **111,282,100** | **3,419,676,200** | **5,806,509,800** |

Note:

Federally owned parcels were not included in acreage or value totals, however other tax exempt parcels are included.

Values are based on January 1, 2009 assessed value which is reflective of the January 2005 market value.

DARE COUNTY HURRICANE RECOVERY HAZARD MITIGATION PROJECTS

| Project Name | | Funding Source | Year Project Began | Year Project Completed | Number of residential Structures | Type of Mitigation | Costs of Project |
|---|---|---|---|---|---|---|---|
| Hurricane Bonnie | | 75% Fed/25% State | 1999 | 2002 | 10 | Elevation _ HMGP | $978,000.00 |
| Hurricane Floyd Recovery | | 100% State | 2001 | 2002 | 5 | 3 Replacements ★<br>1 Rehabilitation ★<br>1 Repair | $350,000.00 |
| 2002 Scattered Site Housing<br>NC Dept of Commerce<br>Division of Community Assistance | | 100% Fed. | 2002 | 2004 | 3 | 3 Replacements ★ | $360,000.00 |
| 2005 Scattered Site Housing<br>NC Dept of Commerce<br>Division of Community Assistance | | 100% Fed. | 2005 | 2008 | 1 | Rehabilitation ★ | $125,000.00 |
| Hurricane Isabel | Pt. 1 | 75% Fed / 25% State | 2005 | 2007 | 8 | Elevation HMGP | $642,300.00 |
| Hurricane Isabel | Pt.2 | 75% Fed / 25% State | 2006 | 2008 | 13 | Elevation HMGP | $1,010,063.00 |
| Hurricane Ophelia | | 75% Fed / 25% State | 2007 | 2009 | 2 | Elevation HMGP | $168,700.00 |
| | | | | | 42 total | ★ = includes elevation | |

All elevation s are a min. of 1 foot above current base flood levels based on adopted flood maps of 9/20/06
All rehabilitations include elevations of a min. of 1 foot above base flood levels based on adopted flood maps of 9/20/06
All replacements are placed on new foundations that are a min. of 1 foot above base flood levels based on adopted flood maps of 9/20/06

All HMGP elevation projects are only for the elevation of a primary residential structure that is below base flood and approved by FEMA to be cost effective. No rehabilitation of the struture is included other than steps, decks and other means of access and items that must by code be placed above base flood levels. Not income based. The structure is the only thing that is weighed in the cost benefits. Must be full time residential owner.

Scattered Site Housing Grants follow completely differently guidleines which include low income, home ownership and depending on the current condition of the structure, rehabilitation or replacement can occur.

Hurricane Floyd Recovery was a NC State sponsored project for low income and a victim of the storm. Each qualifying homeowner had different circumstances that were approved by the North Carolina Dept. of Commerce, Community Assistance Div under the Floyd Project

# Mitigation In Action - Historic Island Communities Find Up Is the Best Way Out

Release Date: November 20, 2003
Release Number: FNF-03-18

» More Information on North Carolina Hurricane Isabel

» 2003 Region IV News Releases

North Carolina: **Mitigation In Action**
**2nd in a 3-part series from FEMA.gov**

» Part 1 - Belhaven
» Part 2 - Coastal Carolina
» Part 3 - Mitigation Education

All along the North Carolina coast, individual homeowners and whole communities have increasingly realized the persistent threat to life and property posed by major storms and hurricanes. Weather forecasters began to realize that this region has come through several decades of relatively calm weather, and the future may bring damaging storms more frequently than seen in recent history.

Jenny Jones, in charge of mitigation projects for Dare County, walks by one of 10 homes which received a FEMA and state elevation grants and had no damage from Hurricane Isabel. Photo: Cynthia Hunter/ FEMA News Photo

Background
As the automobile and highways began to reach out across America, once-remote areas became highly desirable places to live. North Carolina's Outer Banks, a thin line of barrier islands 25 miles or more from the mainland in places, began to be built up as never before. Historic Kitty Hawk, where the Wright brothers achieved the first powered flight, and Roanoke Island, where Sir Walter Raleigh once planted the first English colony in the New World, saw populations boom. Many structures were built before flood maps had been defined, or even thought of.

Then as major storms began to roll in, especially in the last decade, the growing population saw how vulnerable they were to the forces of both the ocean on one side and Pamlico and Albemarle sounds on the other.

People who lived in houses that flooded with every major storm began to live with dresser drawers piled on top of the dressers.

Bob Parker received a FEMA and state grant which elevated his home after repeated flooding. His home suffered no damage during Hurricane Isabel. Photo: Cynthia Hunter/ FEMA News Photo

Mickey and Linda Daniels' home in Wanchese, on Roanoke Island, was flooded in the "Storm of the Century" in March 1993. Every year after that, the arrival of hurricane season would make Mickey acutely aware of the weather reports, especially when tropical storms began brewing far out in the Atlantic. "Every time I looked off that African coast, I started getting nervous," he recalls.

Not far away, Boyd and June Basnight discovered that the half mile between their Wanchese home and the harbor meant nothing to an ill wind and a storm-driven sea. Thirteen inches of floodwater surged through

the house in 1993, damaging or destroying all in its path and leaving behind a lingering uncertainty. In the following years, an approaching storm would send the couple into a frantic scramble to raise furniture onto blocks and boxes.

Some 15 miles north, in Kitty Hawk on the Outer Banks, Lou and Helen Hoppe lived in a large and stately historic home built in the 1890s. But after the "Storm of the Century," and then Hurricane Fran in 1996, they were ready to move.

"I don't care if you get two inches or three feet, it's a mess," Low says. "If you've ever been flooded once, it's something you never want to go through again."

Taking Action
Roanoke Island and much of the Outer Banks are part of Dare County-named for Virginia Dare, the first English child born in the New World, on Sir Raleigh's ill-fated colony.

After Hurricane Bonnie hit in 1998, Dare County was ready to participate in a mitigation project for the first time. Jenny Gray Jones, a seventh-generation resident of the Outer Banks and project manager for the county's hurricane recovery mitigation projects, recalls that 400 families showed up for a town meeting on an elevation project. Three hundred applied for the project. The process eventually winnowed the ten that would get the $719,000 in funding, which was split between FEMA (75 percent) and the state of North Carolina (25 percent).

The project took time. Engineering drawings were required, then contractors hired-and the contractors capable of such projects were booked up to two years in advance.

But the homes were elevated before Isabel struck this year on September 18.

The Result
The test was not long in coming.

The whole Outer Banks were under evacuation orders when Isabel cam ashore.

Mickey and Linda Daniels have lived in their home for 32 years. During the elevation of their home, the couple lived in a church trailer for more than three months. The temporary inconvenience proved worthwhile. When Isabel roared through town, the storm surge covered their yard, and the garage took five inches of floodwater. But the house stayed high and dry. "I'm not under pressure as I was before," Mickey says. "I don't have that sense of dread that the water will come in."

The Basnights also found Hurricane Isabel less threatening to their property. Floodwaters entered their yard-but not their home. "I didn't have to find someone to move my furniture up in the air," recalls Boyd Basnight.

The Hoppes, too, found their home was indeed above the reach of Isabel's floodwaters. "We don't have to worry any more about being flooded," Low Hoppe says.

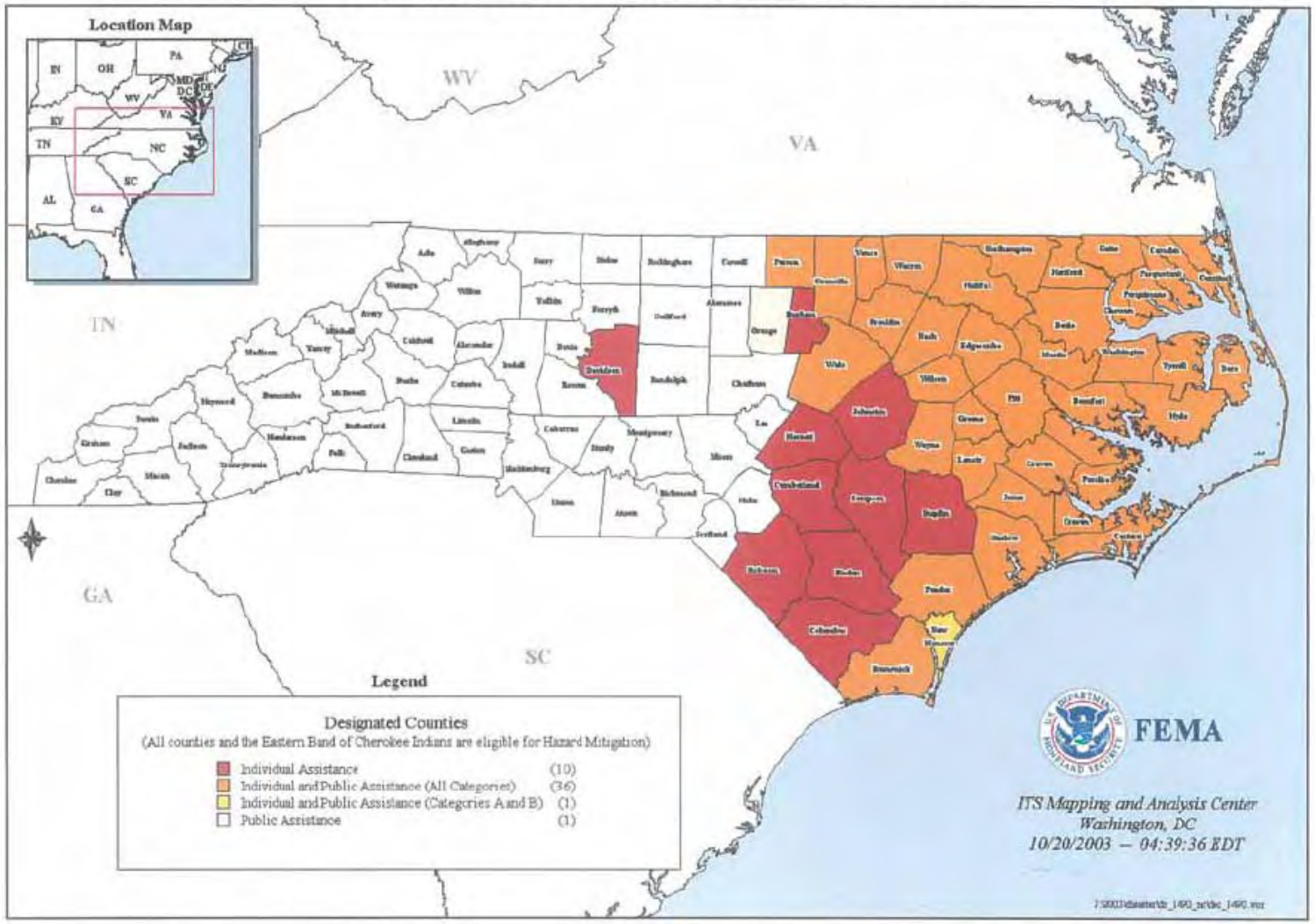
They saved tens or thousands of dollars in damages from this storm alone.

They saved untold grief and labor and heartache.

They showed that up is the way to go.

Last Modified: Tuesday, 20-Jan-2004 13:56:08

# FEMA - 1490 - DR, North Carolina
# Disaster Declaration as of 10/20/2003



# FEMA-1608-DR, North Carolina
## Disaster Declaration as of 10/07/2005

**Location Map**

**Legend**

**Designated Counties**

- Public Assistance
- No Designation

All counties in the State of North Carolina are eligible to apply for assistance under the Hazard Mitigation Grant Program.

FEMA

*ITS Mapping & Analysis Center*
*Washington, DC*
*10/08/05 -- 10:30:00 EDT*

MapID

# Federal Emergency Management Agency
# Community Status Book Report
## NORTH CAROLINA
### Communities Participating in the National Flood Program

| CID | Community Name | County | Init FHBM Identified | Init FIRM Identified | Curr Eff Map Date | Reg-Emer Date | Tribal |
|---|---|---|---|---|---|---|---|
| 370059# | CHEROKEE COUNTY * | CHEROKEE COUNTY | 06/16/78 | 02/02/89 | 02/18/09 | 02/02/89 | No |
| 370455# | CHERRYVILLE, CITY OF | GASTON COUNTY | | 07/15/88 | 03/02/09 | 05/15/07 | No |
| 370487# | CHIMNEY ROCK, VILLAGE OF | RUTHERFORD COUNTY | 01/10/75 | 06/01/87 | 09/03/08 | 02/14/97 | No |
| | THE VILLAGE OF CHIMNEY ROCK HAS ADOPTED THE RUTHERFORD COUNTY [370217] FIRM DATED 6-1-87. | | | | | | |
| 370210# | CHINA GROVE, TOWN OF | ROWAN COUNTY | 01/09/74 | 03/29/78 | 09/29/78 | 12/21/78 | No |
| 370289# | CHOCOWINITY, TOWN OF | BEAUFORT COUNTY | | 05/15/03 | 05/16/08 | 06/30/97 | No |
| 370301# | CHOWAN COUNTY * | CHOWAN COUNTY | 01/27/78 | 07/03/85 | 02/04/09 | 07/03/85 | No |
| 370557# | CLAREMONT, CITY OF | CATAWBA COUNTY | | 09/05/07 | 03/18/08 | 09/05/07 | No |
| 370021# | CLARKTON, TOWN OF | BLADEN COUNTY | 12/07/73 | 07/03/86 | 02/16/07 | 07/03/86 | No |
| 370063# | CLAY COUNTY* | CLAY COUNTY | 07/17/81 | 04/01/99 | 05/04/09(>) | 04/01/99 | No |
| 370139# | CLAYTON, TOWN OF | JOHNSTON COUNTY | 12/28/73 | 04/01/82 | 01/05/07 | 04/01/82 | No |
| 370531# | CLEMMONS, VILLAGE OF | FORSYTH COUNTY | | 01/02/09 | 03/16/09(>) | 06/27/00 | No |
| | USE FORSYTH COUNTY FIRM PANEL 37067C 242H | | | | | | |
| 370302# | CLEVELAND COUNTY* | CLEVELAND COUNTY | 06/16/78 | 07/02/91 | 07/02/08 | 10/23/95 | No |
| 370263# | CLINTON, CITY OF | SAMPSON COUNTY | 12/06/74 | 01/01/87 | 02/16/07 | 07/02/75 | No |
| 370122# | CLYDE, TOWN OF | HAYWOOD COUNTY | 06/14/74 | 12/01/83 | 12/01/83 | 12/01/83 | No |
| 370409# | COFIELD, VILLAGE OF | HERTFORD COUNTY | 03/07/80 | | 03/07/80 | 08/07/01 (E) | No |
| 370233# | COLUMBIA, TOWN OF | TYRRELL COUNTY | 02/08/74 | 08/05/85 | 09/19/07 | 08/05/85 | No |
| 370305# | COLUMBUS COUNTY * | COLUMBUS COUNTY | 06/16/78 | 06/03/91 | 02/16/07 | 06/03/91 | No |
| 370662# | COMO, TOWN OF | HERTFORD COUNTY | | 11/01/99 | 11/01/99 | 12/12/07 | No |
| 370037# | CONCORD, CITY OF | CABARRUS COUNTY | 12/21/73 | 03/04/80 | 03/02/09 | 03/04/80 | No |
| 370089# | CONETOE, TOWN OF | EDGECOMBE COUNTY | 01/09/74 | 11/03/04 | 09/19/07 | 04/04/00 | No |
| 370600# | CONNELLY SPRINGS, TOWN OF | BURKE COUNTY | | 09/05/07 | 12/02/08 | 02/20/08 | No |
| 370053# | CONOVER, TOWN OF | CATAWBA COUNTY | 06/21/74 | 09/03/80 | 03/18/08 | 09/03/80 | No |
| 370174# | CONWAY, TOWN OF | NORTHAMPTON COUNTY | 11/22/74 | 08/01/87 | 02/04/09 | 08/01/87 | No |
| 370498# | CORNELIUS, TOWN OF | MECKLENBURG COUNTY | 10/22/76 | 06/01/86 | 03/02/09 | 09/30/97 | No |
| | THE TOWN OF CORNELIUS HAS ADOPTED THE MECKLENBURG COUNTY (370158) FIRM DATED 2/3/93 PANELS 0005, 0015, 0020. | | | | | | |
| 370601# | COVE CITY, TOWN OF | CRAVEN COUNTY | | 07/16/04 | (NSFHA) | 07/02/04 | No |
| 370321# | CRAMERTON, TOWN OF | GASTON COUNTY | 07/11/75 | 03/04/80 | 03/02/09 | 05/21/92 | No |
| 370072# | CRAVEN COUNTY* | CRAVEN COUNTY | 12/20/74 | 05/04/87 | 05/16/08 | 05/04/87 | No |
| 370107# | CREEDMOOR, CITY OF | GRANVILLE COUNTY | 06/28/74 | 06/25/76 | 06/04/07 | 06/25/76 | No |
| 370443# | CRESWELL, TOWN OF | WASHINGTON COUNTY | 08/19/85 | 08/19/85 | 02/04/09 | 08/19/85 | No |
| 370287# | CROSSNORE, TOWN OF | AVERY COUNTY | 08/05/77 | 08/19/86 | 02/04/09(M) | 08/19/86 | No |
| 370076# | CUMBERLAND COUNTY * | CUMBERLAND COUNTY | 12/13/74 | 02/17/82 | 12/18/07 | 02/17/82 | No |
| 370078# | CURRITUCK COUNTY * | CURRITUCK COUNTY | 01/31/75 | 11/01/84 | 09/20/06 | 11/01/84 | No |
| 370322# | DALLAS, TOWN OF | GASTON COUNTY | 06/27/75 | 05/01/94 | 03/02/09 | 05/01/94 | No |
| 370363# | DANBURY, TOWN OF | STOKES COUNTY | 04/01/77 | 07/16/87 | 07/03/07 | 07/16/87 | No |
| 375348# | DARE COUNTY* | DARE COUNTY | 04/09/71 | 10/06/78 | 09/20/06 | 10/06/78 | No |
| 370307# | DAVIDSON COUNTY * | DAVIDSON COUNTY | 06/17/77 | 05/01/80 | 03/16/09(>) | 05/01/80 | No |
| 370503# | DAVIDSON, TOWN OF | IREDELL COUNTY/MECKLENBURG COUNTY | 10/22/76 | 06/01/86 | 03/02/09 | 10/16/97 | No |
| | THE TOWN OF DAVIDSON HAS ADOPTED THE MECKLENBURG COUNTY (370158) FIRM DATED 2-3-93 PANELS 10, 20, 25 | | | | | | |
| 370308# | DAVIE COUNTY * | DAVIE COUNTY | 04/21/78 | 03/21/80 | 03/16/09(>) | 03/21/80 | No |
| 370136# | DILLSBORO, TOWN OF | JACKSON COUNTY | 03/08/74 | 05/15/86 | 02/06/91 | 05/15/86 | No |
| 370652# | DORTCHES, TOWN OF | NASH COUNTY | | 11/03/04 | 07/03/07 | 12/29/05 | No |

## Appendix D. Number of Repetitive Loss Properties in FEMA's Target Group Special Direct Facility, By State

(As of December 31, 2004)

| State | Number of Properties | Total Premium ($) |
|---|---|---|
| Alabama | 208 | 303,652 |
| Alaska | 2 | 1,083 |
| Arizona | 6 | $3,871 |
| Arkansas | 24 | 23,917 |
| California | 298 | 255,664 |
| Colorado | 1 | 1,047 |
| Connecticut | 156 | 181,811 |
| Delaware | 39 | 86,233 |
| District Columbia | 2 | 7,113 |
| Florida | 921 | 953,389 |
| Georgia | 79 | 55,362 |
| Hawaii | 31 | 43,371 |
| Idaho | 1 | 435 |
| Illinois | 179 | 136,327 |
| Indiana | 58 | 37,635 |
| Iowa | 32 | 29,543 |
| Kansas | 22 | 35,901 |
| Kentucky | 204 | 173,950 |
| Louisiana | 3,208 | 2,311,476 |
| Maine | 12 | 16,573 |
| Maryland | 43 | 56,001 |
| Massachusetts | 359 | 427,018 |
| Michigan | 15 | 14,874 |
| Minnesota | 16 | 14,176 |
| Mississippi | 336 | 182,259 |
| Missouri | 400 | 351,772 |
| Montana | 0 | 0 |
| Nebraska | 15 | 7,793 |
| Nevada | 2 | 910 |
| New Hampshire | 4 | 2,834 |
| New Jersey | 1,034 | 1,039,831 |
| New Mexico | 1 | 193 |
| New York | 554 | 564,101 |
| North Carolina | 790 | 747,259 |
| North Dakota | 1 | 624 |
| Ohio | 98 | 88,021 |
| Oklahoma | 69 | 39,939 |
| Oregon | 32 | 28,987 |
| Pennsylvania | 214 | 207,249 |
| Puerto Rico | 58 | 69,933 |
| Rhode Island | 22 | 60,105 |
| South Carolina | 111 | 113,250 |
| South Dakota | 3 | 3,375 |
| Tennessee | 78 | 61,785 |
| Texas | 1,573 | 1,177,550 |
| Utah | 0 | 0 |
| Vermont | 5 | 6,187 |
| Virgin Islands | 15 | 42,960 |

| State Name | Total Number of Repetitive Loss Properties Total | Total Number of Repetitive Loss Properties Insured | Total Number of Repetitive Loss Claims Total | Total Number of Repetitive Loss Claims Insured | Total $ Losses for RLPs | Total $ Losses for Insured RLPs |
|---|---|---|---|---|---|---|
| Nebraska | 316 | 51 | 775 | 128 | 8,333,876 | 1,536,710 |
| Nevada | 35 | 12 | 85 | 28 | 2,465,832 | 827,427 |
| New Hampshire | 107 | 45 | 258 | 119 | 2,945,926 | 1,813,318 |
| New Jersey | 6,565 | 3,639 | 19,626 | 11,253 | 281,925,863 | 166,908,438 |
| New Mexico | 25 | 8 | 60 | 20 | 646,089 | 205,115 |
| New York | 7,141 | 2,758 | 18,714 | 7,475 | 200,576,210 | 104,003,561 |
| North Carolina | 6,871 | 4,622 | 18,024 | 12,357 | 334,416,748 | 216,283,723 |
| North Dakota | 211 | 28 | 470 | 62 | 10,555,394 | 1,497,568 |
| Ohio | 1,203 | 493 | 3,216 | 1,441 | 43,188,190 | 24,486,050 |
| Oklahoma | 829 | 225 | 2,395 | 717 | 36,008,920 | 13,115,020 |
| Oregon | 282 | 160 | 682 | 386 | 14,946,487 | 9,549,119 |
| Pennsylvania | 2,877 | 1,152 | 7,702 | 3,198 | 145,112,550 | 71,296,107 |
| Puerto Rico | 1,871 | 327 | 5,352 | 958 | 46,479,279 | 14,909,992 |
| Rhode Island | 169 | 75 | 488 | 235 | 9,930,123 | 4,980,642 |
| South Carolina | 1,396 | 650 | 3,389 | 1,669 | 78,687,781 | 34,262,502 |
| South Dakota | 80 | 23 | 170 | 53 | 2,460,619 | 989,248 |
| Tennessee | 702 | 318 | 1,965 | 876 | 25,984,223 | 14,890,963 |
| Texas | 17,129 | 5,894 | 49,263 | 17,611 | 1,155,911,731 | 509,918,097 |
| Utah | 23 | 3 | 58 | 7 | 1,087,641 | 150,394 |
| Vermont | 51 | 22 | 118 | 56 | 1,467,482 | 875,499 |
| Virgin Islands | 194 | 88 | 508 | 238 | 21,882,015 | 12,701,456 |
| Virginia | 2,076 | 1,248 | 5,262 | 3,134 | 114,998,842 | 66,915,302 |
| Washington | 796 | 370 | 2,129 | 1,000 | 43,494,636 | 21,396,822 |
| West Virginia | 2,158 | 1,001 | 5,463 | 2,613 | 85,591,219 | 44,698,828 |
| Wisconsin | 422 | 219 | 949 | 499 | 13,126,470 | 6,490,184 |
| Wyoming | 9 | 2 | 22 | 4 | 237,301 | 33,971 |
| **TOTAL** | **112,540** | **50,644** | **314,640** | **145,740** | **$5,174,222,683** | **$2,686,779,107** |

Source: Data provided by Federal Emergency Management Agency's Office of Legislative Affairs.

# APPENDIX F: INFORMATION DISTRIBUTION

**Introduction**

The Dare County Public Information Department provides the capability to distribute the latest information from State and Federal agencies to inform the public interest in matters concerning hazard mitigation plans, policies and programs. Utilizing local media outlets and local government television access channels, combined with input from the departmental agencies directly involved, our public information office is able to deliver accurate and timely information to all citizens.

Also, the department assists in developing written materials, in conjunction with State / Federal guidelines that define on-going programs available to Dare County citizens, combining to make hazard mitigation an important part of Dare Counties continuing effort to reduce property damage from disasters.

**Dare County Emergency Management**
**Joint Information Section Plan**

When an emergency situation, such as a hurricane, threatens the Outer Banks, media and public information interest can quickly escalate to a national or even international level. It is important that the Dare County Control Group, in support of the towns and unincorporated villages, provide a coordinated, rapid, and quality communications response to meet public information needs, both locally and beyond, during emergency events. In 2004, the Dare County Control Group established the Joint Information Section (JIS) to meet this need.

The JIS is comprised of public information representatives from each of the Dare County Control Group member organizations. Goals of the JIS are to provide: 1) extended public information resources and operations to each participating agency through pooled assets; 2) rapid dissemination of information to the public and the media; and 3) coordinated release of public information, reducing conflicting statements which confuse the public and may lead to frustration and even avoidable life-threatening situations. The Dare County Emergency Operations Support Group will play a critical role in the successful achievement of these goals.

Although the JIS public information representatives remain working employees of their respective agencies, during emergencies they will also work cooperatively as the Joint Information Coordination Group through the consultative JIS structure. Coordination Group members will represent their agency in the JIS, providing the most updated information available and coordinating release of this information within the JIS structure. To ensure best advantage of the JIS, all Coordination Group members should be stationed at the Joint Information Center (JIC), located at the Dare County Emergency Operations Center, during the event. Advance planning, preparation, and active information sharing by Coordination Group members will be key components to an effective emergency public information program.

The JIS utilizes three working units under the Coordination Group: the Information Production Unit, Information Dissemination Unit, and Information Administration Unit. These units work out of the JIC and will be staffed mainly by Dare County employees. If necessary, an On-site Information Representative will be stationed at severely damaged or isolated areas/incidents to serve as the Coordination Group information link.

The Dare County Public Information Officer serves in the position of Joint Information Section Chief, providing management with overall policy direction of the JIS. The JIS Chief will insure that all media releases have been cleared through the Coordination Group. The Coordination Group will make summaries of news conferences, press releases, and fact sheets available to all organizations involved in response and recovery.

All Coordination Group members should speak from one platform at all media briefings, with any conflict of information or opinion identified, discussed, and resolved prior to the media briefings. Media inquires at the JIC and during media briefings, conferences will be referred to the appropriate Coordination Group member

representing that jurisdiction. Generally, Coordination Group members will limit public statements to the jurisdiction that they serve.

It is understood that, at times, some members of the Coordination Group may not be able to be physically stationed at the JIC and will need to operate remotely. In cases such as this, the following principles will be followed, to the extent practical.

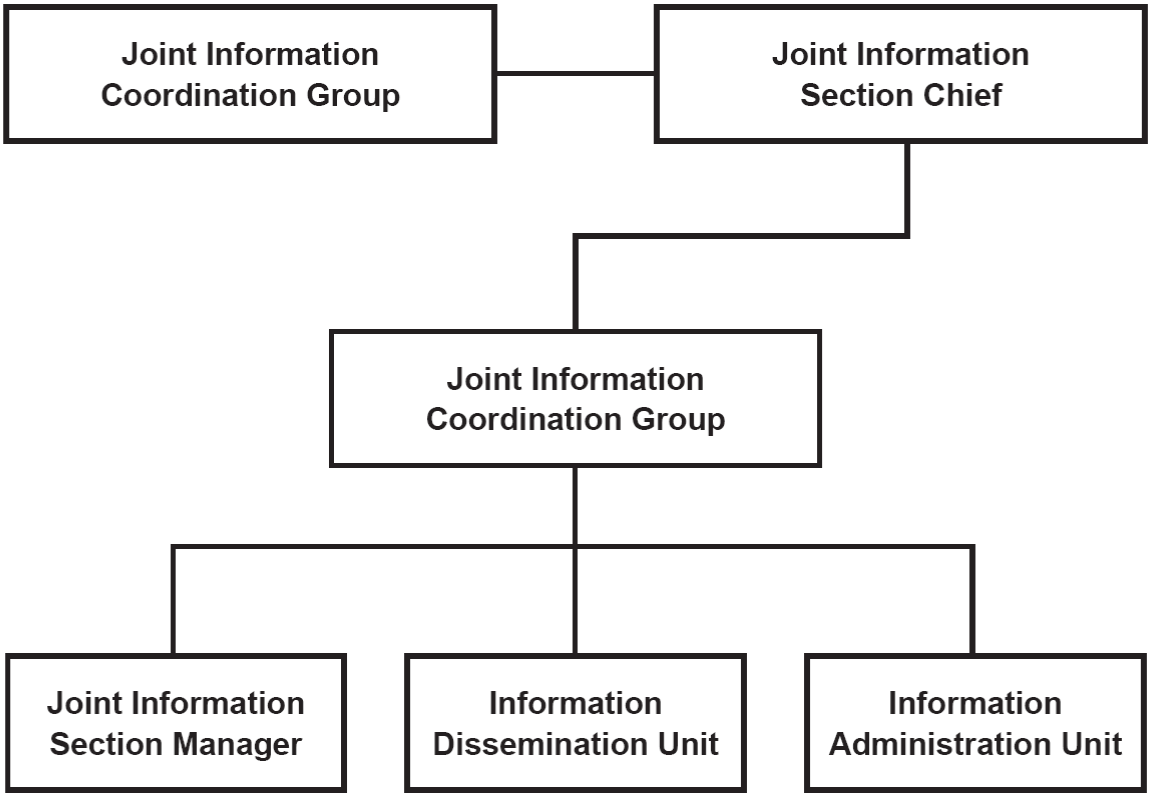
A Joint news conferences and briefings are preferred; however, in the event that this is not possible, scheduling of remote conferences and briefings will be coordinated with the JIS group so as to avoid conflicts of scheduling and information.

B Hard-copy releases and broadcast scripts will be exchanged whenever possible prior to release to provide all Coordination Group members opportunity to comment.

C The JIS will make available to the media all emergency print and broadcast releases received from remote Coordination Group members.

It is also understood that the need to protect public health and safety may require that an agency immediately disseminate information prior to coordination with the Coordination Group. In such cases, the agency who releases the information directly should provide the JIS group with a copy of the release when it is distributed to the public/media.

## Joint Information Section (JIS)
## Functional Organization Chart




**Organizational Overview**

**Dare County Control Group –** The Dare County Control Group is responsible for approving policies and strategies pertinent to the emergency / disaster situation and providing leadership and decision making for implementation by the Support Group. The Control Group consists of the Chairperson or the Dare County Board of Commissioners; the six municipal mayors (The Towns of Manteo, Nags Head, Kill Devil Hills, Kitty Hawk, Southern Shores, and Duck); the Superintendent, National Park Service Outer Banks Group; and the Dare County Sheriff. The Control Group works under the direction of the Chairperson of the Dare County Board of Commissioners, or his/her designee.

**Joint Information Section –** The JIS is responsible for the accurate and timely gathering, production, and dissemination of emergency information to the media and general public during emergency situations in which the Control Group is activated. The JIS is dually managed by the Joint Information Coordination Group and the Joint Information Section Chief. The JIS works under the direction of the Control Group. The Dare County Public Information Officer will recommend to the Control Group the need to activate the JIS during emergency situations.

**Joint Information Coordination Group –** The Joint Information Coordination Group is responsible for the overall coordination of timely and accurate emergency information from all entities represented on the Coordination Group. The Coordination Group is comprised of public information representatives from all Coordination Group entities. The Coordination Group works under the direction of the Control Group and works in coordination with the Joint Information Section Chief.

**Joint Information Section Chief** – The Joint Information Section Chief is responsible for providing management of the overall policy and function of the gathering, production, approval, and dissemination of emergency information. The Dare County Public Information Officer serves as the JIS Chief and reports to the Control Group. The JIS Chief works in coordination with the Control Group. The JIS Chief will ensure close liaison with the Coordination Group members who are unable to locate at the JIC for the event.

**On-Site Information Representatives** – The On-Site Information Representative is responsible for gathering and providing accurate and timely emergency information to the JIS from a severely damaged or isolated area of the emergency incident. The On-Site Representative is stationed at the damaged/isolated area and must have ability to access emergency information at the site, represents the JIS at the site, and maintains communications with the JIS Chief at all times. Manages on-site media tours. This position will be particularly important in the unincorporated areas. The On-Site Representative reports to the JIS Chief.

**Joint Information Center (JIC)** – The JIC is the operational facility of the JIS and is the primary location for the gathering, production, and dissemination of emergency information. The JIC also serves as the primary physical point of contact for news media emergency information dissemination. Conditions will warrant the operating hours of the JIC. In all cases, JIC shifts will overlap adequately to permit sufficient crossover of staff and briefing of the incoming shift.

**Joint Information Section Manager** – The Joint Information Section Manager is responsible for overseeing operations of the JIC, including the Information Production Unit, Information Dissemination Unit and the Information Administration Unit. The JIS Manager reports to the JISC.

**Information Production Unit** – The Information Production Unit, located at the JIC, is responsible for gathering, production, and release approval of accurate emergency information received from the Coordination Group, Support Group, On-Site Representative, and other organizations and locations as needed. This includes preparation of news releases, fact sheets, briefing/conference materials, and talking points. The Production Unit is responsible for updating Channel 20, the Dare County website, sending releases out to the email distribution lists, and sending releases to the fax distribution contractor. No information will be released from the Production Unit without the approval of the JIS Chief. The Production Unit is led by the Update Editor and is under the direction of the JIS Manager.

**Information Dissemination Unit** – The Information Dissemination Unit, located at the JIC, is responsible for distribution of emergency information. This includes answering questions from media and public; handing out fact sheets, press releases, and other materials; notifying the media of press conferences; making physical arrangements (with Administrative Section) for news conferences, tours, and interviews; handling special requests for film, tape, photography, or information; and staff at the Dare County Administrative Building. To provide quality control, the Dissemination Unit only releases information that has been issued by the Production Unit. The Dissemination Unit is led by the Dissemination Leader and is under the direction of the JIS Manager. The Dissemination Unit will also staff and emergency information dissemination site (secondary to the JIC) for the news media at the Ramada Inn in Kill Devil Hills.

**Information Administration Unit** – The Information Administration Unit, located at the JIC, is responsible for providing logistical, administrative and clerical support. This includes coordination of purchases, leases, rentals, and borrowing of resources needed at the JIC. The Administration Unit also is responsible for security at the JIC – ensuring that the JIC is locked and unlocked as necessary depending on operating schedule. The Administration Unit is under the direction of the JIS Manager.

**ANNEX I**

***Dare County Hazard Mitigation Plan***

**Description**

To approve the updated Draft Hazard Mitigation Plan

**Board Action Requested**

Approval

APPROVED 6/1/09 CLERK

# THE DARE COUNTY BOARD OF COMMISSIONERS MEETING

June 1, 2009—9:00 A.M.
Dare County Administrative Building
PO Box 1000, Manteo, North Carolina 27954

***Commissioners Present:***
Chairman Warren Judge, Dist. 3; Vice-Chairman Burrus, Dist. 4; Virginia Tillett, Dist. 1; Richard Johnson, Dist. 1; Max Dutton, Dist. 2; Jack Shea, Dist. 5; Mike Johnson, Dist. 2

***Commissioners Absent:*** None

***Others Present:***
County Manager Terry Wheeler, County Attorney Bobby Outten, Katie Smith—Clerk to the Board

***Action:***
APPROVAL OF AMENDED AGENDA (Addition of Item 4A—US Census Bureau Presentation and Removal of Item 10—FF&E RISC) — ***Approved***
EMPLOYEE OF THE MONTH (MAY) — ***Presented to Debra Romaley***
EMPLOYEE OF THE MONTH (JUNE) — ***Presented to Millie Barkley***
DARE COUNTY HAZARD MITIGATION PLAN — ***Approved***
RECOMMENDED 2010-2014 COUNTY & WATER CAPITAL IMPROVEMENTS PLANS — ***Public Hearing Scheduled for June 15, 2009 at 5:30 P.M.***
DISASTER MANAGEMENT & RECOVERY PROFESSIONAL CONSULTING SERVICES CONTRACT WITH BECK DISASTER RECOVERY, INC. — ***Approved***
PUBLIC HEARING: BRADFORD MARX—WENDY WEBB REZONING REQUEST — ***Held and Approved***
PUBLIC HEARING: ZONING ORDINANCE SECTION 22-58.3 FAMILY HOUSING INCENTIVE STANDARDS TEXT AMENDMENT REQUEST — ***Held and Amendment Approved***
PUBLIC HEARING: FY'09-'10 BUDGET — ***Held***
ORV COMMITTEE APPOINTMENTS — ***Appointed (Edgar Govan, Gail Hutchison, Allen Poole, Ivy Johnson with Commissioner Mike Johnson as Chairman, and Commissioners Tillett and Shea)***
CONSENT AGENDA — ***Approved***

- Approval Of Amended Minutes (5.18.09)
- Budget Amendment—Occupancy Tax Legal Expenses
- Annual Participation Agreements for NCACC Insurance Pools
- VOIP Two-year Maintenance Contract

BOARD APPOINTMENTS

- College of the Albemarle—Board of Trustees — ***Reappointed (Fletcher Willey)***
- Fessenden Center Advisory Committee — ***Appointed (Cheryl Austin and Danny Couch)***
- Hatteras Community Center Board — ***Reappointed (Ernie Foster, Jr., Geraldine Farrow, Ricki Shepherd)***
- Health Board — ***Reappointed (Brant Murray)***
- Land Transfer Tax Appeals Board — ***Reappointed (Robert Rollason, Jr., Barbara Connery, June Neri, Emilie Klutz)***
- Manns Harbor Community Center Board — ***Reappointed (Rodney Balance, Harry Carter Mann, Vickie Craddock)***
- Oregon Inlet and Waterways Commission — ***Reappointed (Robin Mann, David May, Arvin Midgett, Fletcher Willey)***
- Roanoke Island Community Center Board — ***Reappointed (Roland Bowser, Betty Selby, Beulah Charity Ashby, Willie Brickhouse)***
- Rodanthe-Waves-Salvo Community Center Board — ***Reappointed (Susan Gray, JW Kierzkowski, Louie Midgett, Claude Howard)***
- Extra Territorial Jurisdiction (JTC) District — ***Reappointed (Ed Overton)***

**ITEM 5 – SINGLE FAMILY REHABILITATION GRANT NC HOUSING FINANCE AGENCY**
Jenny Jones, Administrator Project Manager Dare County Grants and Waterways, updated the Board on potential opportunities from an SFR grant. She stated Dare County's involvement with this grant began last October through the Albemarle Commission. She explained the funding for the grant is from the North Carolina Housing Finance Agency. After speaking with the Finance Agency and the Albemarle Commission, they found any agency could obtain assistance for citizens of Dare County; however, the funding would be between the Albemarle Commission and the Finance Agency. Because Dare County is not a viable party in this grant, they would have no control over how the funding is handled. She explained many stipulations attached to the funds that may actually make the grant more of a burden than assistance for the recipient and their families. Commissioner Richard Johnson clarified the Albemarle Commission also cannot control the regulations and stipulations placed on the grant money by the Finance Agency. Chairman Judge encouraged people who are interested in finding out more information regarding available funding to contact Ms. Jones or the Albemarle Commission. Commissioner Tillett thanked Ms. Jones for putting so much time and energy into researching this grant, and she thanked Commissioner Richard Johnson for bringing this information to the Board's attention.

**ITEM 6 – DARE COUNTY HAZARD MITIGATION PLAN (Att. 1)**
Sandy Sanderson, Emergency Management Director, presented the updated Draft Hazard Mitigation Plan. He explained every five years the County is required to update this plan which is now before the Commissioners for approval. Once this draft is approved, he would return in six (6) months for a Public Hearing and approval of the final plan.

**MOTION**
Vice-Chairman Burrus motioned to approve the updated Dare County Draft Hazard Mitigation Plan. Commissioner Shea seconded the motion.
VOTE: AYES unanimous

***MOVE TO ITEM 8***

**ITEM 7 – RECOMMENDED 2010-2014 COUNTY AND WATER CAPITAL IMPROVEMENTS PLANS (Att. 2)**
Mr. David Clawson, Finance Director, presented the Recommended 2010-2014 County and Water Capital Improvements Plans. He explained the Capital Improvements Plan is funded by realty transfer tax which has seen a severe decrease in the last three (3) years. He shared details of the plan and emphasized the use of fund balances, but noted necessary adjustments will be made based on improvements of the economy. He shared the three (3) year history of projects and what is recommended for the coming years. He stressed the list of projects that were requested but not included which totaled $48, 360,824. After further detailing recommended projects, he requested input from the Board, the scheduling of a Public Hearing to receive input from the community, and the scheduling of the CIP adoption to coincide with the budget adoption. Commissioner Mike Johnson asked if C&D cell five (5) would be located between existing cells one (1) and two (2). Mr. Outten stated while the permits are not in hand, the plan is to place cell five (5) between existing cells.

**MOTION**
Commissioner Shea motioned to schedule a public hearing for the Capital Improvements Plan for 5:30 p.m. on June 15, 2009 and requested the CIP adoption coincide with the budget adoption.

(SEAL)

Respectfully submitted,

By: _____
Katie Smith, Clerk

APPROVED:

By: _____
Warren C. Judge, Chairman
Dare County Board of Commissioners

ATTACHMENT 2 - 8/17/09

*Revision of the Dare County Hazard Mitigation Plan*

**Description**

Adoption of the Resolution of the Town of Duck's Hazard Mitigation Plan and the Town of Manteo's Hazard Mitigation Plan to merge and participate with Dare County's Hazard Mitigation Plan.

**Board Action Requested**

Approval

APPROVED. 8/17/09 , CLERK

**EXTRACTS FROM MINUTES OF THE BOARD OF COMMISSIONERS**

A regular meeting of the Board of Commissioners of the County of Dare, North Carolina, was duly held on August 17, 2009 at 5:00 p.m. in the County Board of Commissioners' Meeting Room, Commissioners Administration Building, 954 Marshall C. Collins Drive, Manteo, North Carolina. Chairman Warren Judge presiding.

The following members were present:
Chairman Warren Judge, Vice-Chairman Allen Burrus, Commissioners Mike Johnson, Max Dutton, Virginia Tillett, Jack Shea, and Richard Johnson.

The following members were absent:

* * * * *

On motion of Commissioner Shea seconded by Vice-Chairman Burrus and Commissioner Dutton, the adoption of the Resolution of the Town of Duck's Hazard Mitigation Plan and the Town of Manteo's Hazard Mitigation Plan to merge and participate with Dare County's Hazard Mitigation Plan was duly adopted by the following vote:

AYES: UNANIMOUS

NAYS:

*PASSED, ADOPTED AND APPROVED* this 17th day of August, 2009.

(SEAL)

KATIE V. SMITH
Clerk to the Board of Commissioners
County of Dare, North Carolina

WARREN JUDGE
Board of Commissioners Chairman
County of Dare, North Carolina

PPAB 1579402v1

HANDLED UNDER COUNTY MGR'S BUSINESS
11/16/09

***Town Inclusion in Dare County Hazard Mitigation Plan***

**Description**

The Towns of Nags Head, Kill Devil Hills, Kitty Hawk and Southern Shores have asked to be included in Dare County's Hazard Mitigation Plan.

**Item Presenter**

County Manager Bobby Outten

**Board Action Requested**

To approve and authorize the inclusion of the Towns of Nags Head, Kill Devil Hills, Kitty Hawk and Southern Shores in the Dare County Hazard Mitigation Plan.

APPROVED. , CLERK

## HAZARD MITIGATION PLAN UPDATE

## SCHEDULE OF MEETINGS

**7-31-08** ATTEND WORKSHOP IN KINSTON ON MITIGATION PLAN

**9-09-08** FIRST MEETING OF PLANNING COMMITTEE

**10-09-08** PLANNING COMMITTEE SCOPE OF WORK ASSIGNED

**12-01-08** MEETING OF COMMUNITY LEADERS REQUESTING INPUT

**2-03-09** PLANNING COMMITTEE NOTICE FOR REVIEW OF FIRST DRAFT

**2-13-09** FIRST DRAFT SENT TO NCEM, ALYSSA YOUNG

**3-09-09** PLANNING COMMITTEE RECEIVES COPY OF DRAFT FOR REVIEW

**4-12-09** COPY OF DRAFT DISTRIBUTED FOR PUBLIC COMMENT

ALL LIBRARIES (3), BAUM CENTER, FESSENDEN CENTER,

COMMISSIONERS OFFICE, PLANNING DEPARTMENT

**4-15-09** DRAFT PLACED ON DARE COUNTY WEB FOR PUBLIC REVIEW

**5-28-09** PUBLIC MEETING TO REVIEW DRAFT PLAN

**6-01-09** BOARD OF COMMISSIONERS APPROVAL

**6-04-09** DRAFT PLAN TO STATE EMERGENCY MANAGEMENT FORE REVIEW

**NEXT ACTIONS**

**PLAN REVIEW BY STATE, CORRECTIONS MADE OR SENT TO FEMA REVIEW**

**FEMA REVIEW, CORRECTIONS MADE OR SENT TO COUNTY FOR PUBLIC HEARING**

**BOARD OF COMMISSIONERS APPROVAL**

APRIL 10 '09

# Hazard plan available for review

The Dare County Department of Emergency Management has made updates to the Dare County Hazard Mitigation Plan for 2009.

It is necessary for the County to plan for and to carry out disaster response and short-term recovery operations utilizing local resources. The plan provides guidance to local officials in all phases of emergency response in situations such as a hurricane, nor'easter, or other large scale emergency event. This plan is reviewed on an annual basis and revisions are made as necessary to comply with local, state and federal guidelines.

Updates to the plan are available for public review at the following locations:

— Dare County Library locations on Mustian Street in Kill Devil Hills, U.S. 64/264 in Manteo and Highway 12 in Hatteras Village.

— Dare County Administration Buildings at 954 Marshal Collins Drive in Manteo and 50347 Highway 12 in Frisco.

— Dare County Office of Emergency Management at 1044 Driftwood Drive in Manteo.

— Dare County Planning Department at 954 Marshal Collins Drive in Manteo.

— Dare County website www.darenc.com under Emergency Management.

Please refer comments to darecoem@darenc.com.

# Hospital board to meet Friday

A meeting of the board of directors of the Outer Banks Hospital has been scheduled for Friday, April 24 at 1:30 p.m. The meeting will be held in the board room at the hospital.

The purpose is to discuss operational and business matters and go into closed session, if necessary.

MAY 5 '09

# Dare's draft hazard mitigation plan now available for review

A draft update of the Dare County Hazard Mitigation Plan is now available for review.

Updates to the plan were made by the county's department of Emergency Management.

The plan provides guidance to local officials in all phases of emergency response to large-scale emergencies like hurricanes and nor'easters. This plan is reviewed on an annual basis and revisions are made as necessary to comply with local, state and Federal guidelines.

The plans are available for public review at the following locations:

- Dare County Libraries on Mustian Street in Kill Devil Hills, Hwy 64/264 in Manteo and N.C. 12 in Hatteras village;
- Dare County Administration Buildings in the planning department at 954 Marshal Collins Drive in Manteo and 50347 N.C. 12 in Frisco; and
- Dare County Office of Emergency Management at 1044 Driftwood Drive in Manteo.

The 203-page draft plan is also available on-line at the county's website, www.darenc.com, under the department of Emergency Management. Click on the Hazard Mitigation Plan button.

Public comments are requested by e-mail to darecoem@darenc.com.

MAY 17 '09

# Legal Advertisements

ADDITIONAL LEGALS
PAGE 7C

**NOTICE OF A PUBLIC MEETING**

The Dare County Emergency Operations will hold a Public Meeting to review the Draft Hazard Mitigation Plan. The meeting will be held on Thursday May 28th, 2009 at 7:00 pm at the Emergency Operations Center located at 1044, Driftwood Drive. The Public is invited to attend. For more information contact N.H. (Sandy) Sanderson at 252-475-5856.

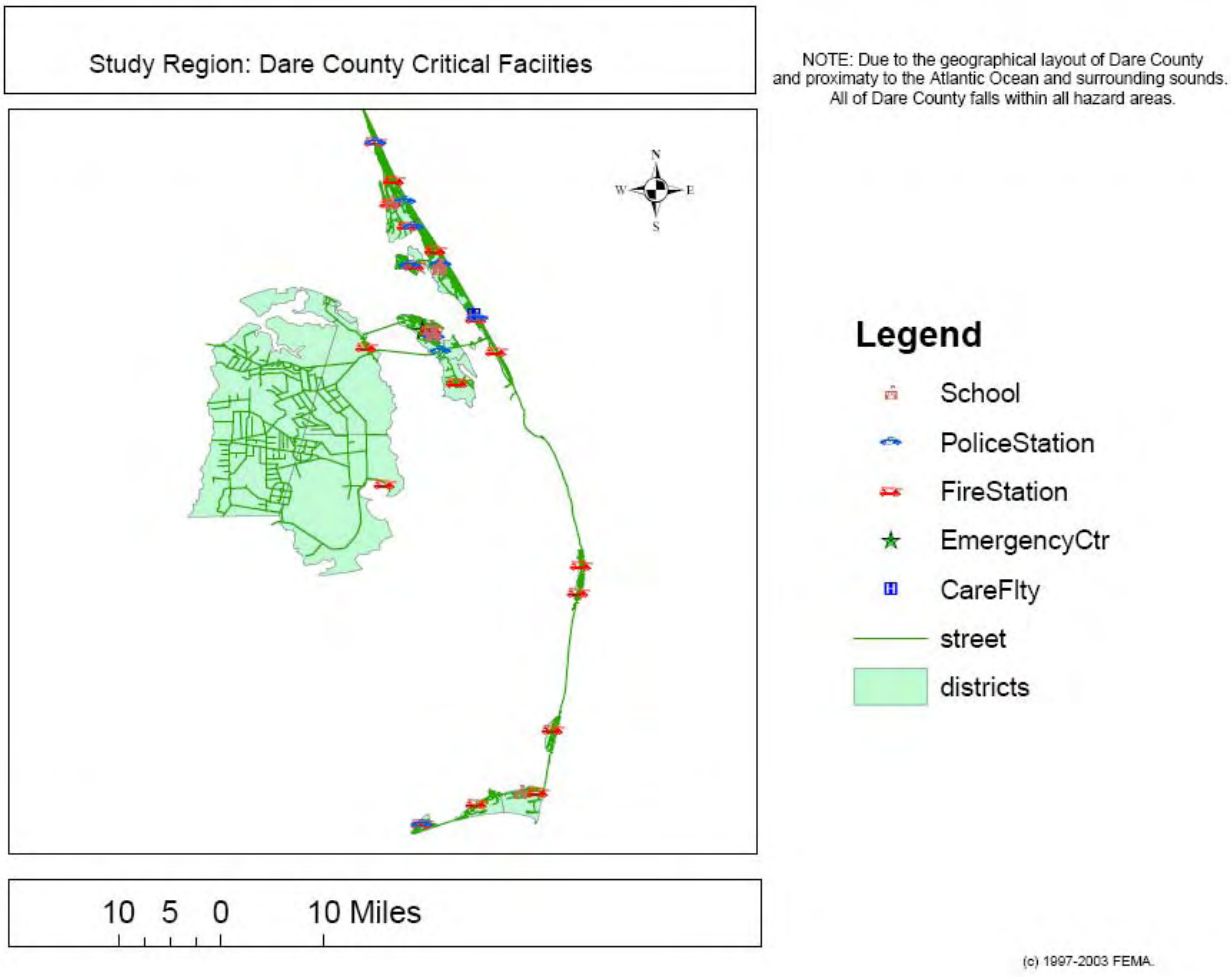
5-17c

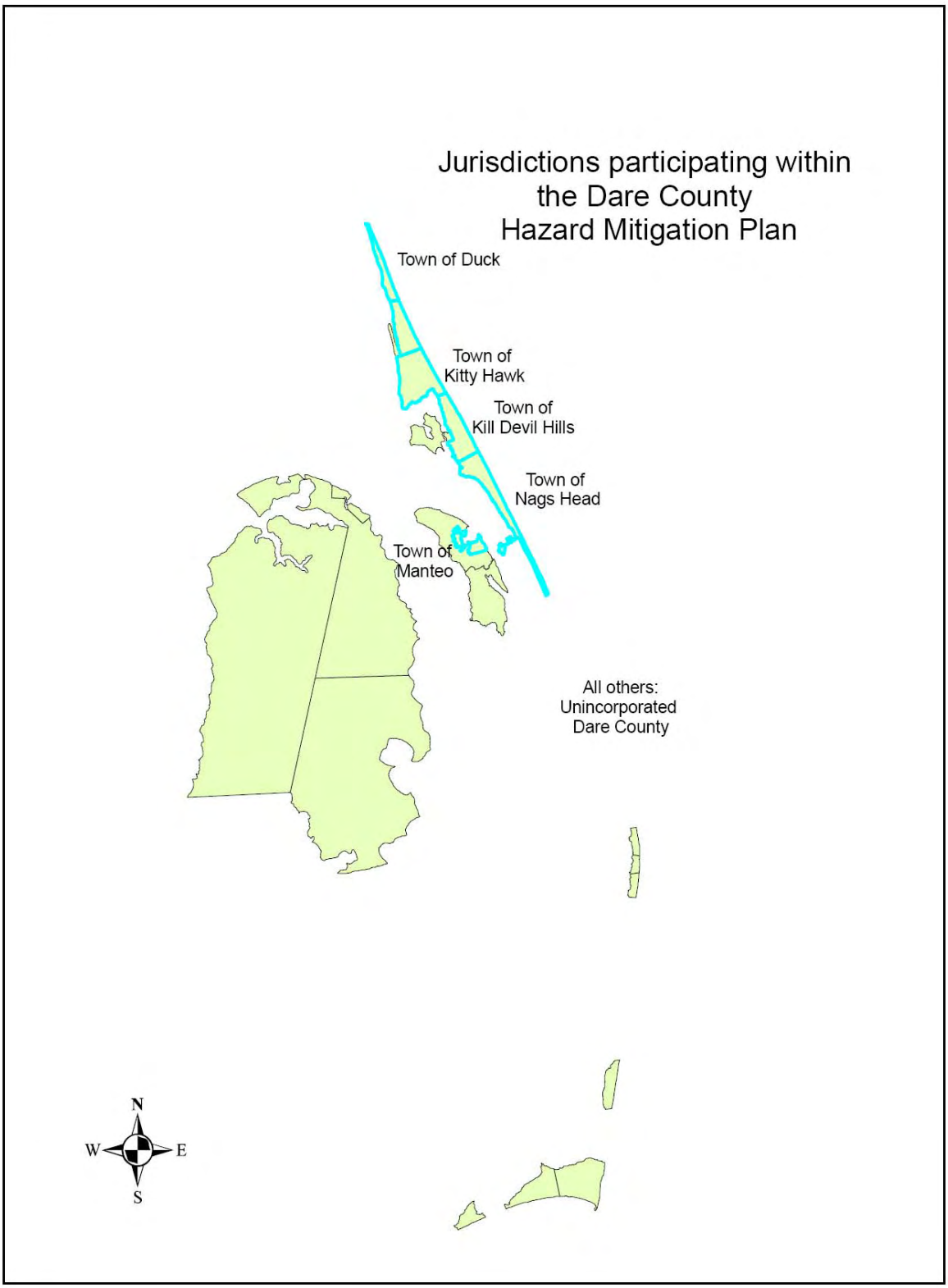
HMP REVIEW W/ TOWNS OF NAGSHEAD, MANTEO, KITTY HAWK, DUCK and COUNTY OF DARE

9/30/09

| NAME AND AGENCY | PHONE NUMBER | PAGER AND E-MAIL | OTHER / FAX |
|---|---|---|---|
| Angela Welsh Nags Head | 441-7016 | | |
| Andy Garman Duck | 255.1234 | | |
| Maureen O'Shea Kitty Hawk | 261.3552 | moshea@kittyhawktown.net. | |
| Erin Trebisacci | 473-2133 | trebisacci@townofmanteo.com | 252-473-2135 |
| Cliff Ogburn Town of NH | 449-2010 | ogburn@townofnagshead.net | |
| JESSICA PHILLIPS DARE Co. EM | 252 475.5655 | jessicap@darenc.com | |
| | | | |
| | | | |

## MAPS


Study Region: Dare County Critical Facilities
NOTE: Due to the geographical layout of Dare County and proximaty to the Atlantic Ocean and surrounding sounds. All of Dare County falls within all hazard areas.
N
W
E
S
Legend
School
PoliceStation
FireStation
EmergencyCtr
CareFlty
street
districts
10 5 0 10 Miles
(c) 1997-2003 FEMA.


Jurisdictions participating within
the Dare County
Hazard Mitigation Plan
Town of Duck
Town of
Kitty Hawk
Town of
Kill Devil Hills
Town of
Nags Head
Town of
Manteo
All others:
Unincorporated
Dare County
N
W
E
S

## SUPPORT GROUP MEMBERS

## Dare County Departments

County Manager
Public Relations
Dare County Sheriff's Office
Dare County Regional Airport
Department of Social Services
Dare County Health Department
Dare County Emergency Medical Services
Dare County Fire Marshal
Dare County Schools
Dare County Water Department
Dare County Tax Department
Dare County Finance Department
Dare County Public Works
Dare County Planning Department
Dare County Human Resources
Dare County Animal Control – S.P.C.A.

## Outside Agencies

Outer Banks Visitors Bureau
Chamber of Commerce
Association of Realtors
NC State Highway Patrol
Civil Air Patrol
Embarq
Dominion Power
Cape Hatteras Electric Co-op
Albemarle Mental Health
NC Department of Transportation
U.S. Fish and Wildlife
Amateur Radio
Dare Forestry
Outer Banks Hospital
American Red Cross

# COMMUNITY RATING SYSTEM ANNUAL RECERTIFICATION

Section 1. Community Data

If there are any changes or corrections to the information in this section, please line out the old item and write in the correction.

Community: DARE COUNTY State: NC NFIP Number: 375348

Recertification Date: 10/01/09

Chief Executive Officer:

Name: Mr. Robert L. Outten Title: County Manager

Address: P.O. Box 1000, Manteo, NC 27954

CRS Coordinator:

Name: Mr. Hannon Fry Title: Floodplain Manager

Address: P.O. Box 1000, Manteo, NC 27954

Coordinator's Phone: (252) 475-5874 Fax: (252)-449-0207

e-mail address: hannonf@darenc.com

We are maintaining, to the best of my knowledge, to enforce all flood insurance policies that have been required of us as a condition of federal financial assistance for insurable buildings owned by us and located in the Special Flood Hazard Area shown on our Flood Insurance Rate Map.

Section 2. Certification

I hereby certify that this community is continuing to implement the activities noted below as credited under the Community Rating System and described in our original application and subsequent modifications.

Signed: _____ Date: 9/25/09
Mr. Robert L. Outten, County Manager

## COMMUNITY RATING SYSTEM ANNUAL RECERTIFICATION

Section 3. Community Activities

Your community has been verified as currently receiving CRS credit for the following activities. If your community is still implementing the listed activities, the CRS Coordinator should confirm by placing his/her initials in the blank. Some activities require documentation to be returned with the Annual Recertification form. (The numbers to the left of each statement refer to activity numbers as outlined in the *CRS Coordinator's Manual*)

WHF 310 We are maintaining Elevation Certificates on all new and substantially improved buildings in our Special Flood Hazard Area.

WHF 310 We have issued 28 (insert number) permits for new construction and substantial improvements in the Special Flood Hazard Area in the last year.

WHF 310 Attached are 5 Elevation Certificates for new or substantially improved structures that have been completed in the last year.

WHF 320 We are providing Flood Insurance Rate Map information upon request and information on the flood insurance purchase requirement. This service is publicized to local lenders, real estate agents and insurance agents annually and we maintain a log, letters or other records of this service.

WHF 330 **Attached** is a copy of this year's annual outreach project to all residents in the county.

WHF 330 **Attached** is a copy of our annual Progress Report on our Outreach Project Strategy (OPS).

WHF 340 People looking to purchase floodprone property are being advised of the flood hazard through our credited hazard disclosure measures.

WHF 350 Our public library continues to maintain flood protection materials.

WHF 360 We continue to provide flood protection assistance to inquirers, publicize the availability of this service and maintain a log, letters or other record of the assistance provided.

WHF 410 We continue to use our additional regulatory flood data before a new development can proceed in our floodplain.

WHF 420 We continue to preserve our open space in the floodplain.

WHF 430 We continue to enforce the floodplain mangement provisions of our zoning, subdivision and building code ordinances. [____ Initial here if you have amended your floodplain regulations. **Attach** a copy of the amendment.]

## COMMUNITY RATING SYSTEM ANNUAL RECERTIFICATION

WAF 430 We continue to keep track of building improvements and repairs. Before a new permit is issued, we check the permit record and count the projects' dollar value cumulatively to determine if a nonconforming building should be brought up to our standards for new construction. We no longer do this on a cumulative basis.

WAF 440 We continue to maintain our erosion data maintenance system.

WAF 440 We continue to use and update our flood data maintenance system.

WAF 450 We continue to enforce regulations pertaining to soil and erosion control

WAF 502 **Attached** is a copy of our outreach explaining property protection, financial assistance and flood insurance that we have sent/will send to our repetitive loss areas. [___ Initial here if there are no repetitive loss properties in your community]

WAF 510 **Attached** is an annual progress report for our adopted Floodplain Management/Hazard Mitigation Plan.

WAF 530 We continue to encourage property owners interested in retrofitting their buildings to protect them from flood damage.

WAF 540 We continue to enforce a regulation prohibiting dumping in the drainage system.

WAF 610 We have maintained and tested our flood threat recognition and our warning dissemination equipment within the past year. In addition,

WAF We have conducted at least one exercise of our flood response plan within the past year.

or

____ **Attached** is an Evaluation Report describing how our flood warning program worked during the flood(s) we had during the past year. (Note: Evaluation Report required if flood event damaged more than 10 buildings, caused more than $50,000 in property damage or caused the death of one or more persons.)

√ 630 All North Carolina communities currently receive 58 points for a state dam safety program which has been accepted by FEMA for CRS credits.

____ We have submitted our Biennial Report to FEMA. [___] Initial here if you have not submitted the Biennial Report to FEMA, and attach a copy.

***Reminder: Your community is scheduled for a cycle verification visit in 2010.***

NFIP Number: 375348

**APPENDIX G**

# Town of Manteo
# Hazard Mitigation Plan

# Outline for the Town of Manteo Hazard Mitigation Plan


I. Introduction

A. The Town of Manteo 2

Table Showing a Profile of General Demographic Characteristics 2

Table Showing Profile of Select Housing Characteristics 4

B. Rational for the Hazard Mitigation Plan 6

C. Explanation of Planning Format 7

D. The Planning Process 7

E. Hazard Identification 7

F. Vulnerability Assessment 7

G. Hazard Mitigation Goals 7

H. Community Capability Assessment 8

I. Mitigation Efforts in Place 8

J. Implementation Strategies for Manteo 9

K. Prioritizing the Implementation Strategies 11

1. Table Displaying the Proposed Strategy, What Hazards the Strategy is Meant to Address, the Responsible Party for the Strategy and the Priority Ranking for the Strategy 11

L. Review Process for Hazard Mitigation Plan 12

I. Introduction

A. The Town of Manteo

The Town of Manteo has a long and interesting history. Sir Walter Raleigh organized an expedition from England, which led to the discovery of Roanoke Island by the English. One of the Native Americans ~~he~~ encountered on this expedition, an Algonquain, named Chief Manteo; is the Town's namesake. Manteo was named the County seat in 1870 when Dare County was designated by the State of North Carolina. The growth of the town is restricted because of its island location. Currently, Manteo has a year round population of 1,052 (Census 2000).

Some of the housing characteristics that are important to consider with this plan are the 924 housing units within the Town's 1.79 square miles. Of those 924 units 515 are in use year round and 409 are vacant units, 308 are for "seasonal, recreational, or occasional use." These seasonal units can be attributed to the Pirates Cove and Shallow Bag Bay Club developments. Most of the 308 units are used by individuals on vacation, sometimes they are renting them by the week and other times it is the owner who may be staying for the winter or the summer. According to the housing statistics from the U.S. Census Bureau the largest majority of the housing units in the Town were built between 1980 and 1989. More than half of the owner occupied units are valued at $50,000 and $149,000. Please see the table below for complete facts and figures concerning the population and housing characteristics for the Town of Manteo.

## Table Showing a Profile of General Demographic Characteristics

Source: Table DP-1 of the Data set: Census 2000 Summary File 1 (SF-1) 100-Percent Data

| | | |
|---|---|---|
| **Total population** | **1,052** | **100.0** |
| | | |
| **SEX AND AGE** | | |
| Male | 492 | 46.8 |
| Female | 560 | 53.2 |
| | | |
| Under 5 years | 58 | 5.5 |
| 5 to 9 years | 57 | 5.4 |
| 10 to 14 years | 64 | 6.1 |
| 15 to 19 years | 58 | 5.5 |
| 20 to 24 years | 45 | 4.3 |
| 25 to 34 years | 157 | 14.9 |
| 35 to 44 years | 145 | 13.8 |
| 45 to 54 years | 153 | 14.5 |
| 55 to 59 years | 83 | 7.9 |
| 60 to 64 years | 51 | 4.8 |
| 65 to 74 years | 93 | 8.8 |
| 75 to 84 years | 60 | 5.7 |
| 85 years and over | 28 | 2.7 |
| | | |
| Median age (years) | 41.2 | (X) |
| | | |
| 18 years and over | 844 | 80.2 |
| Male | 389 | 37.0 |
| Female | 455 | 43.3 |
| 21 years and over | 808 | 76.8 |
| 62 years and over | 208 | 19.8 |
| 65 years and over | 181 | 17.2 |
| Male | 66 | 6.3 |
| Female | 115 | 10.9 |
| | | |

| | | |
|---|---|---|
| **RACE** | | |
| One race | 1,036 | 98.5 |
| White | 908 | 86.3 |
| Black or African American | 106 | 10.1 |
| American Indian and Alaska Native | 6 | 0.6 |
| Asian | 1 | 0.1 |
| Asian Indian | 0 | 0.0 |
| Chinese | 0 | 0.0 |
| Filipino | 1 | 0.1 |
| Japanese | 0 | 0.0 |
| Korean | 0 | 0.0 |
| Vietnamese | 0 | 0.0 |
| Other Asian [1] | 0 | 0.0 |
| Native Hawaiian and Other Pacific Islander | 0 | 0.0 |
| Native Hawaiian | 0 | 0.0 |
| Guamanian or Chamorro | 0 | 0.0 |
| Samoan | 0 | 0.0 |
| Other Pacific Islander [2] | 0 | 0.0 |
| Some other race | 15 | 1.4 |
| Two or more races | 16 | 1.5 |
| | | |
| ***Race alone or in combination with one or more other races*** [3] | | |
| White | 922 | 87.6 |
| Black or African American | 111 | 10.6 |
| American Indian and Alaska Native | 14 | 1.3 |
| Asian | 2 | 0.2 |
| Native Hawaiian and Other Pacific Islander | 0 | 0.0 |
| Some other race | 21 | 2.0 |
| | | |
| **HISPANIC OR LATINO AND RACE** | | |
| **Total population** | **1,052** | **100.0** |
| Hispanic or Latino (of any race) | 27 | 2.6 |
| Mexican | 8 | 0.8 |
| Puerto Rican | 0 | 0.0 |
| Cuban | 1 | 0.1 |
| Other Hispanic or Latino | 18 | 1.7 |
| Not Hispanic or Latino | 1,025 | 97.4 |
| White alone | 899 | 85.5 |
| | | |
| **RELATIONSHIP** | | |
| **Total population** | **1,052** | **100.0** |
| In households | 1,044 | 99.2 |
| Householder | 515 | 49.0 |
| Spouse | 200 | 19.0 |
| Child | 237 | 22.5 |
| Own child under 18 years | 191 | 18.2 |
| Other relatives | 34 | 3.2 |
| Under 18 years | 13 | 1.2 |
| Nonrelatives | 58 | 5.5 |
| Unmarried partner | 27 | 2.6 |
| In group quarters | 8 | 0.8 |
| Institutionalized population | 0 | 0.0 |
| Noninstitutionalized population | 8 | 0.8 |
| | | |
| **HOUSEHOLDS BY TYPE** | | |
| **Total households** | **515** | **100.0** |
| Family households (families) | 288 | 55.9 |
| With own children under 18 years | 121 | 23.5 |

| | | |
|---|---|---|
| Married-couple family | 200 | 38.8 |
| With own children under 18 years | 59 | 11.5 |

| | | |
|---|---|---|
| Female householder, no husband present | 63 | 12.2 |
| With own children under 18 years | 49 | 9.5 |
| Nonfamily households | 227 | 44.1 |
| Householder living alone | 198 | 38.4 |
| Householder 65 years and over | 94 | 18.3 |
| | | |
| Households with individuals under 18 years | 131 | 25.4 |
| Households with individuals 65 years and over | 148 | 28.7 |
| | | |
| Average household size | 2.03 | (X) |
| Average family size | 2.64 | (X) |
| | | |
| **HOUSING OCCUPANCY** | | |
| **Total housing units** | **924** | **100.0** |
| Occupied housing units | 515 | 55.7 |
| Vacant housing units | 409 | 44.3 |
| For seasonal, recreational, or occasional use | 308 | 33.3 |
| | | |
| Homeowner vacancy rate (percent) | 6.9 | (X) |
| Rental vacancy rate (percent) | 18.0 | (X) |
| | | |
| **HOUSING TENURE** | | |
| **Occupied housing units** | **515** | **100.0** |
| Owner-occupied housing units | 256 | 49.7 |
| Renter-occupied housing units | 259 | 50.3 |
| | | |
| Average household size of owner-occupied unit | 2.12 | (X) |
| Average household size of renter-occupied unit | 1.94 | (X) |

## Table Showing Profile of Select Housing Characteristics

Source: Table DP-4 of the Data Set: Census 2000 Summary File3 (SF-3) Sample Data

| | | |
|---|---|---|
| **Total housing units** | **901** | **100.0** |
| **UNITS IN STRUCTURE** | | |
| 1-unit, detached | 424 | 47.1 |
| 1-unit, attached | 59 | 6.5 |
| 2 units | 14 | 1.6 |
| 3 or 4 units | 85 | 9.4 |
| 5 to 9 units | 45 | 5.0 |
| 10 to 19 units | 197 | 21.9 |
| 20 or more units | 36 | 4.0 |
| Mobile home | 41 | 4.6 |
| Boat, RV, van, etc. | 0 | 0.0 |
| | | |
| **YEAR STRUCTURE BUILT** | | |
| 1999 to March 2000 | 26 | 2.9 |
| 1995 to 1998 | 94 | 10.4 |
| 1990 to 1994 | 99 | 11.0 |
| 1980 to 1989 | 363 | 40.3 |
| 1970 to 1979 | 56 | 6.2 |
| 1960 to 1969 | 50 | 5.5 |
| 1940 to 1959 | 88 | 9.8 |
| 1939 or earlier | 125 | 13.9 |

| | | |
|---|---|---|
| **ROOMS** | | |
| 1 room | 6 | 0.7 |
| 2 rooms | 18 | 2.0 |
| 3 rooms | 101 | 11.2 |
| 4 rooms | 237 | 26.3 |
| 5 rooms | 214 | 23.8 |
| 5 rooms | 214 | 23.8 |
| 6 rooms | 154 | 17.1 |
| 7 rooms | 62 | 6.9 |
| 8 rooms | 66 | 7.3 |
| 9 or more rooms | 43 | 4.8 |
| Median (rooms) | 4.9 | (X) |
| | | |
| **Occupied Housing Units** | **496** | **100.0** |
| **YEAR HOUSEHOLDER MOVED INTO UNIT** | | |
| 1999 to March 2000 | 106 | 21.4 |
| 1995 to 1998 | 193 | 38.9 |
| 1990 to 1994 | 82 | 16.5 |
| 1980 to 1989 | 46 | 9.3 |
| 1970 to 1979 | 26 | 5.2 |
| 1969 or earlier | 43 | 8.7 |
| | | |
| **VEHICLES AVAILABLE** | | |
| None | 41 | 8.3 |
| 1 | 235 | 47.4 |
| 2 | 175 | 35.3 |
| 3 or more | 45 | 9.1 |
| | | |
| **HOUSE HEATING FUEL** | | |
| Utility gas | 3 | 0.6 |
| Bottled, tank, or LP gas | 73 | 14.7 |
| Electricity | 389 | 78.4 |
| Fuel oil, kerosene, etc. | 27 | 5.4 |
| Coal or coke | 0 | 0.0 |
| Wood | 2 | 0.4 |
| Solar energy | 0 | 0.0 |
| Other fuel | 0 | 0.0 |
| No fuel used | 2 | 0.4 |
| | | |
| **SELECTED CHARACTERISTICS** | | |
| Lacking complete plumbing facilities | 0 | 0.0 |
| Lacking complete kitchen facilities | 4 | 0.8 |
| No telephone service | 10 | 2.0 |
| | | |
| **OCCUPANTS PER ROOM** | | |
| **Occupied housing units** | **496** | **100.0** |
| 1.00 or less | 494 | 99.6 |
| 1.01 to 1.50 | 0 | 0.0 |
| 1.51 or more | 2 | 0.4 |
| | | |
| **Specified owner-occupied units** | **195** | **100.0** |
| **VALUE** | | |
| Less than $50,000 | 12 | 6.2 |
| $50,000 to $99,999 | 72 | 36.9 |
| $100,000 to $149,999 | 42 | 21.5 |
| $150,000 to $199,999 | 9 | 4.6 |
| $200,000 to $299,999 | 13 | 6.7 |

| | | |
|---|---|---|
| $300,000 to $499,999 | 33 | 16.9 |
| $500,000 to $999,999 | 10 | 5.1 |
| $1,000,000 or more | 4 | 2.1 |
| Median (dollars) | 116,100 | (X) |
| | | |
| **MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS** | | |
| With a mortgage | 106 | 54.4 |
| Less than $300 | 0 | 0.0 |
| $300 to $499 | 7 | 3.6 |
| $500 to $699 | 13 | 6.7 |

| | | |
|---|---|---|
| $500 to $699 | 13 | 6.7 |
| $700 to $999 | 21 | 10.8 |
| $1,000 to $1,499 | 32 | 16.4 |
| $1,500 to $1,999 | 9 | 4.6 |
| $2,000 or more | 24 | 12.3 |
| Median (dollars) | 1,120 | (X) |
| Not mortgaged | 89 | 45.6 |
| Median (dollars) | 281 | (X) |
| | | |
| **SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999** | | |
| Less than 15 percent | 83 | 42.6 |
| 15 to 19 percent | 29 | 14.9 |
| 20 to 24 percent | 33 | 16.9 |
| 25 to 29 percent | 12 | 6.2 |
| 30 to 34 percent | 6 | 3.1 |
| 35 percent or more | 32 | 16.4 |
| Not computed | 0 | 0.0 |
| | | |
| **Specified renter-occupied units** | **230** | **100.0** |
| **GROSS RENT** | | |
| Less than $200 | 16 | 7.0 |
| $200 to $299 | 13 | 5.7 |
| $300 to $499 | 71 | 30.9 |
| $500 to $749 | 93 | 40.4 |
| $750 to $999 | 21 | 9.1 |
| $1,000 to $1,499 | 3 | 1.3 |
| $1,500 or more | 3 | 1.3 |
| No cash rent | 10 | 4.3 |
| Median (dollars) | 521 | (X) |
| | | |
| **GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999** | | |
| Less than 15 percent | 30 | 13.0 |
| 15 to 19 percent | 32 | 13.9 |
| 20 to 24 percent | 27 | 11.7 |
| 25 to 29 percent | 27 | 11.7 |
| 30 to 34 percent | 26 | 11.3 |
| 35 percent or more | 74 | 32.2 |
| Not computed | 14 | 6.1 |

These facts are meant to show that even though Manteo covers a very small area there are many residents and possible visitors that would be affected by a natural or man-made disaster.

## B. Rational for the Hazard Mitigation Plan

The preceding discussion and an analysis of the Manteo flood plain map, included in the Dare County portion of this plan, indicate that Manteo is particularly vulnerable to flooding and storm surge inundation. This confirms the need for Manteo to prepare this Hazard Mitigation Plan. Although we have already taken some steps to address flooding in the Town, additional mitigation is necessary to prevent future losses.

Manteo will benefit from the preparation and implementation of this plan in many ways. The following provides a summary list of the local benefits of implementing hazard mitigation.

- Saving lives and reducing injuries
- Preventing or reducing property damage
- Reducing economic losses
- Minimizing social dislocation and stress
- Protecting and maintaining critical facilities
- Providing positive consequences for government action
- Reducing the Community Rating Service (CRS) rating and thereby directly reducing National Flood Insurance Premiums

## C. Explanation of Planning Format

This Hazard Mitigation Plan has been formatted to correspond with the Dare County Hazard Mitigation Plan. For all of the background information, except that which is otherwise specified, the Dare County plan's appendices should be referenced. This greatly reduces the size of this document without sacrificing the detail necessary to make it complete. The format of this plan is useful, not only to the Town's policy makers, but also to the County's policy makers who are already familiar with the County's Plan.

## D. The Planning Process

This plan was initiated in 2008 with the Mitigation Advisory Committee, comprised of the Town of Manteo Planning Board. One meeting was held on June 9, 2009 in which the committee approved and adopted the draft and it was made available to the public. Those members that were present include Chairman Bill Parker, Member Beth Storie, Member Phil Scarborough, Member Bebe Woody and Member Grizelle Fearing. Also present at the meeting were Erin Trebisacci and Becky Breiholz.

Subsequent to the 2008 meeting the revisions made in 2009 the draft was submitted to the Town Board of Commissioners for resolution and adoption. It is then to be sent to the County to be incorporated into the Dare County Hazard Mitigation Plan.

## E. Hazard Identification

The Town of Manteo is susceptible to many different natural hazards. These include:

- Hurricanes
- Severe Thunderstorms
- Tornadoes
- Flooding
- Severe Winter Storms
- Nor'easters

The Town accepts and acknowledges the hazards identified by the county, the description of such hazards, and risk/vulnerability assessments that the County deems appropriate.

## F. Vulnerability Assessment

The Town of Manteo acknowledges and accepts the vulnerability assessment performed by Dare County.

## G. Hazard Mitigation Goals

The Town of Manteo views the Hazard Mitigation Plan as an opportunity to protect its citizens and the local economy. The Mitigation Advisory Committee set forth specific goals as a way to grasp this opportunity. They are as follows:

1. Reduce loss of life and personal injury from natural hazards
2. Minimize the damage to public infrastructure resulting from natural and manmade hazards
3. Manage future development so that vulnerability of private property to natural and manmade hazards is reduced
4. Expedite post-disaster clean-up, repair, and construction
5. Protect the fragile natural and scenic areas located along our shoreline
6. To preserve and protect key facilities and services from the threat of terrorists or others wishing to damage, destroy or contaminate public assets.

## H. Community Capability Assessment

The Town has a very small staff and therefore is limited in its capabilities. The mitigation strategies chosen are financially feasible and appropriate to meet the needs and capabilities of the Town.

Participation in the National Flood Insurance Program's (NFIP) Community Rating System (CRS) has been occurring from the programs inception in 1973. The Town has achieved a class ~~7~~ 8 rating. This has been accomplished by continuing the Town's commitment to reduce property damage and save lives while facilitating development of our Town in accordance with local, state, and Federal regulations.

In addition to the Town's CRS program there are some existing and proposed policies, programs and ordinances that may affect the Town's vulnerability to hazards. The following documents were identified:

- Town of Manteo Subdivision Ordinance
- Town of Manteo Zoning and Ordinance
- Dare County Comprehensive Plan
- Town of Manteo Flood Damage Prevention Ordinance

## I. Mitigation Efforts in Place

A summary of existing policies used by the Town is as follows:

<u>Rising Water</u>

1. The National Weather Service monitors and reports rainfall and stream gauges to predict flooding
2. Local TV stations have state-of-the-art equipment to predict and accurately report weather. They are able to pinpoint specific geographic areas. There is a special audible alert that precedes weather advisories.
3. Manteo joins with Dare County in lobbying the state to update the FIRMS.
4. Manteo participates in the CRS program and is taken measures to improve the class 8 rating.

5. Manteo's zoning ordinances Article 26 establishes specifications for construction in flood hazard areas to minimize flood damage.
6. Property owners are provided advice through site visits to property to review flooding, drainage and related problems.
7. Homeowners are advised on retrofitting techniques.
8. State buffer rules are enforced to improve the quality of storm water runoff.
9. Town removes debris as soon as possible after flood event.

Winds

1. The National Weather Service monitors and reports wind speeds and storm conditions.
2. Local TV Stations have state-of-the-art equipment to predict and accurately report weather. They are able to pinpoint specific geographic areas. There is special audible alert that precedes weather advisories.
3. The Town removes debris as soon as possible after the event. The town has a contingency contract for expeditious removal of storm debris.
4. Manufactured homes must meet Category 3 hurricane standards.

Winter Storms

1. The National Weather Service monitors and reports winter storms.
2. Local TV Stations have state-of-the-art equipment to predict and accurately report weather. They are able to pinpoint specific geographic areas. There is a special audible alert that precedes weather advisories.

Terrorism

1. Lock all facilities when staff is not present
2. Alarms are in place to monitor sewage and water facilities
3. Manteo Police Department is linked to the Dare County Law Enforcement System
4. Manteo Police have attended in-service training and are current in terrorist training.

## J. Implementation Strategies for Manteo

As this plan was formed it was reliant on a few main strategies that the county already employs. Those strategies are as follows:

1. The County's Emergency Operations Plan. This plan includes evacuation procedures and response to hazards included in this plan and those listed in Dare County's Plan.
2. Its storm hazard mitigation policies provided in the most recent Dare County Coastal Management Act (CAMA) Land Use Plan and in the 2007 Manteo CAMA Land Use Plan.
3. Maintain elevation certificate information in hard copy format to be provided by Manteo upon request.

The Town of Manteo also has some implementation strategies that it wishes to use. These include:

A. Making use of Dare County's floodplain, parcel data, and aerial photographs in digital format. The County should be capable of overlaying this coverage's on its Geographic Information System (GIS)

B. Ensure that Manteo maintains documents about flood insurance, flood protection, floodplain management, and the natural and beneficial functions of floodplains.

C. Assist local real estate agents with information handouts that will advise potential buyers to investigate the flood hazard for the property they are considering purchasing.

D. Send a flood protection flyer to all property owners in Manteo through a community newsletter, utility bill or other document. The flyer would include general identification of the local flood hazard, flood safety, flood insurance, property protection, floodplain development permit requirements, and drainage system maintenance.

E. Continue to stay current with all Community Rating System reporting requirements to ensure continued program participation.

F. Continue our policy controlling the development of critical public facilities in the 100-year flood plain in cases where viable alternatives exist.

G. Continue to actively pursue state and federal grant funds to assist in the hazard mitigation recommendations included in the plan.

H. Continue to encourage projects undertaken by the Manteo Police Department, Fire-Rescue-EMS, Public Works, and Planning Departments that will lessen the vulnerability of the Town and its residents to natural hazards. When projects are found to address hazard mitigation, the availability of state and federal grant funds should be investigated that may assist the Town with the cost.

I. Mayor and other council members to participate in Dare County's Emergency Management training sessions.

J. Continue to acquire and maintain back-up generators for lift stations and to supply electricity to critical Town facilities during periods of power outage.

K. Continue to maintain ditching along streets to facilitate drainage.

L. Continue to update and use the existing Manteo Police Emergency Plan

M. The Town Planner to file for grant applications.

N. Building Inspector / Planner to enforce Town codified ordinances which include NFIP approved Flood Ordinance

O. Public Works Director to have regularly scheduled maintenance of storm water system.

P. The Town Planner will actively research and identify mitigation initiatives for grant applications and establish target dates for completion.

These implementation strategies are further discussed in the table below.

## K. Prioritizing the Implementation Strategies

Each one of the strategies stated above is a high priority for the Town. However, there must be some order in which these priorities are addressed. Seeing that some strategies are just as important as others, it was deemed appropriate, not to number but to assign symbols that can show the equal importance among the strategies. The following rating system was applied:

Most important = ✶✶✶
Moderately Important = ✶✶
Important = ✶

**Table Displaying the Proposed Strategy, What Hazards the Strategy is Meant to Address, the Responsible Party for the Strategy and the Priority Ranking for the Strategy.**

| Strategy | Hazard to be Addressed* | Responsible Party | Funding Source | Cost | Priority |
|---|---|---|---|---|---|
| **1** | All those not explicitly stated, including terrorism | Dare County and Town of Manteo | Dare County | Low | ✶✶ |
| **2** | ⚐ ☂ ♦ ≋ | Dare County and Town of Manteo | Dare County | Low | ✶✶ |
| **3** | ⚐ ☂ ♦ ≋ | Dare County and Town of Manteo | Dare County | Low | ✶✶✶ |
| **A** | ⚐ ☂ ♦ ≋ | Town Planner | Town of Manteo | Low | ✶✶✶ |
| **B** | ⚐ ☂ ♦ ≋ | Town Planner | FEMA | Low | ✶✶ |
| **C** | ⚐ ☂ ♦ ≋ | Town Planner | Town of Manteo | Low | ✶✶✶ |
| **D** | ⚐ ☂ ♦ ≋ | Public Works | Town of Manteo | Low | ✶✶✶ |
| **E** | ⚐ ☂ ♦ ≋ | Town Planner and Assistant Town Manager | Town of Manteo | Low | ✶✶✶ |
| **F** | ⚐ ☂ ♦ ≋ | Town Planner | Town of Manteo | Low | ✶ |
| **G** | ⚐ ☂ ☂ ♦ ❄ ≋ | Town Planner and Assistant Town Manger | Town of Manteo | Low | ✶✶ |
| **H** | ⚐ ☂ ☂ ♦ ❄ ≋ | Police, Fire-Rescue-EMS, Public Works, Planning Departments | Federal Grants, State of North Carolina, and Town of Manteo | Low | ✶✶ |
| **I** | ⚐ ☂ ☂ ♦ ❄ ≋ | Mayor, Council | Town of Manteo and Dare County | Low | ✶✶ |
| **J** | ⚐ ☂ ☂ ♦ ❄ ≋ | Public Works | Town of Manteo | High | ✶ |
| **K** | ⚐ ☂ ♦ ≋ | Public Works | Town of Manteo | Low | ✶ |
| **L** | ⚐ ☂ ☂ ♦ ❄ ≋ | Police Department | Town of Manteo | Low | ✶ |
| **M** | ⚐ ☂ ☂ ♦ ❄ ≋ | Assistant Town Manager | Town of Manteo | Low | ✶✶ |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **N** | ⚐ ☂ ♦ ≋ | Building Inspector and Town Planner | Town of Manteo | Low | ✶ |
| **O** | ⚐ ☂ ♦ ≋ | Public Works Director | Town of Manteo | Low | ✶ |
| **P** | ⚐ ☂ ☁ ♦ ❄ ≋ | Town Planner | Town of Manteo | Low | ✶✶ |

* Symbols used to represent hazards are as follows: Hurricanes = ⚐, Severe Thunderstorms = ☂, Tornadoes = ☁, Flooding = ♦, Severe Winter Storms = ❄, Nor'easter = ≋

## L. Review Process for Hazard Mitigation Plan

The Hazard Mitigation Committee will reconvene during the first week of June each year to receive a presentation on the progress of the plan. The Hazard Mitigation Committee will prepare an annual evaluation report that will be submitted, along with the Floodplain Administrator's report, to the Town Commissioners. Revisions to the plan require a public hearing and adoption by the Town of Manteo Commissioners.

# ANNEX 2

## RESOLUTION OF ADOPTION
2009-08
**Dare County**
**Multi Jurisdictional**
**Hazard Mitigation Plan**
**(Town of Manteo Appendix)**

WHEREAS, the citizens and property within the Town of Manteo are subject to the effects of natural hazards and man-made hazard events that pose threats to lives and cause damages to property, and with the knowledge and experience that certain areas, i.e., flood hazard areas, are particularly susceptible to flood hazard events; and

WHEREAS, the Town desires to seek ways to mitigate situations that may aggravate such circumstances; and

WHEREAS, the Legislature of the State of North Carolina has in Part 6, Article 21 of Chapter 143; Parts 3, 5, and 8 of Article 19 of Chapter 160A; and Article 8 of Chapter 160A of the North Carolina General Statutes, delegated to local governmental units the responsibility to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry; and

WHEREAS, the Legislature of the State of North Carolina has in Section 1 Part 166A of the North Carolina General Statutes (adopted in Session Law 2001-214—Senate Bill 300 effective July 1, 2001), states in Item (a) (2) "For a state of disaster proclaimed pursuant to G.S. 166A-6(a) after November 1, 2004, the eligible entity shall have a hazard mitigation plan approved pursuant to the Stafford Act"; and

WEREAS, Section 322 of the Federal Disaster Mitigation Act of 2000 states that local government must develop an All-Hazards Mitigation Plan in order to receive future Hazard Mitigation Grant Program Funds, and

WHEREAS, it is the intent of the Board of Commissioners of Manteo to fulfill this obligation in order that the Town will be eligible for state assistance in the event that a state of disaster is declared for a hazard event affecting the Town;

NOW, therefore, be it resolved, that the Board of Commissioners of Manteo hereby:

1. Adopts the Dare County Multi Jurisdictional Hazard Mitigation Plan; and

2. Vests the Town Manager with the responsibility, authority, and the means to:

   (a) Inform all concerned parties of this action.

   (b) Cooperate with Federal, State and local agencies and private firms which undertake to study, survey, map, and identify floodplain or flood-related erosion areas, and cooperate with neighboring communities with respect to management of adjoining floodplain and/or flood-related erosion areas in order to prevent aggravation of existing hazards.

(c) Adjust the boundaries of County and municipal planning jurisdictions whenever a municipal annexation or extraterritorial jurisdiction revision results in a change whereby a municipality assumes or relinquishes the authority to adopt and enforce floodplain management regulations for a particular area in order that all Flood Hazard Boundary Maps (FHBMs) and Flood Insurance Rate Maps (FIRMs) accurately represent the planning jurisdiction boundaries. Provide notification of boundary revisions along with a map suitable for reproduction, clearly delineating municipal corporate limits and extraterritorial jurisdiction boundaries to all concerned parties.

3. Appoints the Town Manager to assure that the Hazard Mitigation Plan is reviewed annually and in greater detail at least once every five years to assure that the Plan is in compliance with all State and Federal regulations and that any needed revisions or amendments to the Plan are developed and presented to the Manteo Town Council for consideration.

4. Agrees to take such other official action as may be reasonably necessary to carry out the objectives of the Hazard Mitigation Plan.

Adopted on 6-18-2009

Mayor
Town of Manteo

Attest:

Clerk to the Board of Commissioners

SEAL
TOWN OF MANTEO
CORPORATED
SEAL
1899
NORTH CAROLINA

**APPENDIX H**

# Dare County
# Multi-Jurisdictional
# Hazard Mitigation Plan

## TOWN OF DUCK

## Update 2009

Adopted by the Duck Town Council:

_____, 2009

**Town of Duck Hazard Mitigation Plan**

*Adopted by the Duck Town Council*
*_____, 2009*

## Duck Town Council

Neil Morrison, Mayor
Monica Thibodeau
Nancy Caviness
Bart Smith
David Wessel
Don Kingston – Elect
Chuck Burdick - Elect

Duck Town Manager

Christopher Layton

## 2009 Duck Hazard Mitigation Planning Committee

Jon Britt
Joe Blakaitis
Ron Forlano
John Fricker
Don Kingston
David Wessel
Donna Black
Chris Layton
Andy Garman

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# *Town of Duck*

# *Hazard Mitigation Plan*
# (2009 Plan Year Update)

## Introduction

Natural hazards, such as floods, hurricanes, tornadoes, winter storms, earthquakes, wildfires, and other hazardous natural events occur every year and are an essential component of the earth's natural systems. These events damage the ecological environment, but the natural environment possesses remarkable recuperative capabilities, restoring plant and animal habitat in a short time.

The built, or manmade, environment does not possess these recuperative capabilities. When these natural hazards interact with the built environment, disasters occur. The frequency of disasters is increasing, not necessarily because natural hazards are occurring more frequently, but as a result of more people choosing to live, work, and visit locations where the risks of natural hazards are greater. Since the 1960's, increasing numbers of people are choosing to live and work in areas at risk from coastal storms and repetitive flooding. By 2010, the number of people living in hurricane-prone counties will likely double (*Local Hazard Mitigation Planning* Manual. 1998. NC Division of Emergency Management, p. 1). This realization makes it imperative that coastal and riverine communities undertake floodplain management and hazard mitigation.

The Town of Duck, North Carolina incorporated on May 1, 2002 and has since undertaken a significant number of planning activities. These include adoption of the Town's first Land Use Plan, revisions to the Town's land use regulations including the zoning and subdivision ordinances, adoption of the Town's first Flood Damage Prevention Ordinance, and, with the assistance of the North Carolina Division of Community Assistance, development of the Town's first Hazard Mitigation Plan in August of 2004. The initial effort to prepare the Town of Duck Hazard Mitigation Plan established a stand-alone Hazard Mitigation Plan which was approved by the Federal Emergency Management Agency and the North Carolina Division of Emergency Management to meet the hazard mitigation planning requirements of the Federal Disaster Mitigation Act of 2000 (DMA2K) and North Carolina Senate Bill 300.

The Town of Duck has now prepared a five-year update to this plan, which has been designed to be incorporated into the Dare County Multi-Jurisdictional Hazard Mitigation Plan. The Town continues to benefit from the significant efforts that were undertaken to develop the original plan; and, many of the hazard mitigation planning goals, objectives, and action items established in that original plan have not changed. However, the Town recognizes the obvious geographic similarities between the communities located within Dare County and the benefits of hazard mitigation planning on a County-wide scale. Emergency management activities are often coordinated by Dare County; the communities within Dare County must make collective decisions and provide mutual aid to respond during events which have the potential to impact life and property throughout the entire Outer Banks. For this reason, the Town of Duck wishes to incorporate the first five-year update to its Hazard Mitigation Plan into the Dare County Multi-jurisdictional Plan.

The Dare County Multi-Jurisdictional Hazard Mitigation Plan provides a detailed overview of the purpose of the Hazard Mitigation Plan and hazard mitigation planning as well as the hazards (see Appendix A – Hazard Descriptions and Intensity Scales) that have the potential to impact communities within Dare County. The Town of Duck portion of the Plan will provide more specific information relative to the Duck Community including the following:

- Updated 2009 Town of Duck Demographic Profile including Population and Housing Characteristics
- Overview of the Planning Process used to Prepare the Town of Duck portion of the Multi-Jurisdictional Hazard Mitigation Plan 2009 Update
- Updated Goals and Values for the Town of Duck Hazard Mitigation Plan Update

- 2009 Revisions to the Action Plan that was included in the original Hazard Mitigation Plan for the Town of Duck
- 2009 update to the Vulnerability Analysis for the Town of Duck

***Geography and the Environment***

Duck consists of approximately 2.32 square miles (1,486 acres) and is approximately 6 miles in length. It is the northernmost community in Dare County located on the northern Outer Banks. The Currituck County line is to the north of Duck and Southern Shores is located to the south. Access to Duck is possible only by accessing Highway 12. The town is bounded on the east by the Atlantic Ocean and the west by the Currituck Sound. Duck has a reputation as a cottage community, with a seasonal population of nearly 25,000 persons and a permanent population of about 500 residents.

***Topography***

Rising gradually toward the north and west, the Town varies in elevation between sea level and about 25 feet. The Outer Banks have a mean elevation of about six feet, but a few of the dunes rise substantially above the average elevation. Less than ten percent of the Town's area occurs in gradients of more than two percent.

***Source of Water***

The dominant source of flooding in Duck is storm surge generated in the Atlantic Ocean by tropical storms and hurricanes. In addition, this surge propagates into Albemarle Sound and further propagates into the North River and Currituck Sound where high winds associated with tropical storms can produce high waves. The wave action associated with tropical storms can be much more damaging than the higher water level. Not all storms which pass close to the study area produce extremely high tides. Similarly, storms which produce flooding conditions in one area may not necessarily produce flooding conditions in other parts of the study area.

Duck is a newly incorporated municipality. The North Carolina General Assembly voted to grant Duck's charter in the 2001 session, and the effective date of incorporation was May 1, 2002.

***Demographic Profile***

Because Duck was incorporated in 2002, there is no census profile for the area within the corporate limits of the Town of Duck. However, census tract and block data from Dare County can be used to determine some population characteristics. The Census 2000 data available estimated Duck's population to be 448 people. There were 233 females and 215 males. Duck's population consisted of 438 white persons, 5 African Americans, 4 American Indians, and 1 Pacific Islander.

The State estimates Duck's population in 2007 grew by 77 people, for a total of 515 persons. The most recent population estimate provided by the North Carolina State Demographer for July 1, 2008 identified a total of 499 residents for the Town of Duck. Table 1 illustrates the change in permanent population that has occurred during the last ten years.

## Table 1. Permanent Population Trends

| 2000 | 2007* | 2008* |
|---|---|---|
| 448 | 515 | 499 |

*Based on estimates provided by North Carolina State Demographer

The permanent population of Dare County, according to the Census 2000, is 29,967. The seasonal population peak is approximately 200,000. Duck's portion of this figure could be more than 20,000 people.

The Census 2000 noted 2,068 total housing units in Duck. According to the Dare County tax database in January 2003, there were 2,423 housing properties in Duck (this includes single-family and multi-family structures but does not include hotels or bed and breakfast inns). There were 1,960 single family detached residential structures, of which as many as 1,750 may be vacation homes. There were 463 units in multi-family developments (condominiums, townhouses, timeshares, and co-ownership properties) in Town, 122 units at The Sanderling, and 8 rooms at bed and breakfast businesses. (Source: Duck 2003-2004 CAMA Land Use Plan) As of August 2009, it is estimated that there are approximately 2,553 housing properties in Duck (see Table 3). There was no estimated change in multi-family units or hotel motel structures during this time frame. Table 3 does indicate a slight decrease in multi-family units from 2003 to 2009. However, this could be attributed to a difference in the method used to extract the number of units each time the analysis was performed.

## Table 2. Estimated Peak Seasonal Population - 2003

| Type of Accommodation | Estimated Number of Units | Average Number of Persons Per Unit | Total Peak Population |
|---|---|---|---|
| Single family detached residential structures | 1,960 | 6.5 | 12,740 |
| Multi-family developments | 463 | 3.5 | 1,621 |
| The Sanderling | 122 | -- | 254 |
| Inns and Bed and Breakfasts | 8 | 2 | 16 |
| TOTAL | 2,553 | -- | 14,631 |

Source: Town of Duck Land Use Plan Committee

## Table 3. Estimated Peak Seasonal Population - 2009

| Type of Accommodation | Estimated Number of Units | Total Number of Bedrooms | Total Peak Population *(est. 2 persons per bedroom)* |
|---|---|---|---|
| Single family detached residential structures | 2,101 | 9,655 | 19,310 |
| Multi-family Units | 449 | 1,060 | 2,120 |
| The Sanderling | 122 | -- | 254 |
| Inns and Bed and Breakfasts | 2 | 10 | 20 |
| TOTAL | 2,674 | -- | **21,704** |

*Analysis performed using current Dare County Tax Data

***Housing Profile***
The primary land use in Duck is single family detached residential structures that are generally not the principal residences of the owners. The Census 2000 noted a total of 2,068 housing units in Duck, of which 1,852 (90%) were vacant, while 215 (10%) were occupied. Vacation homes are often made available for short-term rental during the summer months. As noted above in Table 3, the number of housing units has increased over the last nine years. Based on the increase in permanent population vs. the increase in total housing units, it is estimated that the percentage owner occupied structures relative the total housing units remains approximately the same.

The number of total households in Duck in 2000 was also reported to be 215. The average household size was 2.1 persons. There were 137 married couple families in Duck in 2000. Twenty (20) of these were households with (own) children under 18 years of age present. The balance of married couple households (117) were households with no (own) children under 18 years of age present.

***Statement of the Problem***

For a Detailed Problem Statement, Refer to Dare County Plan Multi-Jurisdictional Plan Section I. A.

***Purpose of the Plan***

This hazard mitigation plan makes an assessment of our current natural hazard risk and sets forth goals and schedules for the current five-year planning horizon (2009) and beyond to eliminate, reduce, and mitigate this risk. After conducting a few meetings, the committee developed a problem statement, or purpose for the plan. The purpose of this plan is:

Duck, through hazard mitigation planning, seeks to maintain or lower the community's flood insurance rating, qualify for future disaster funding, identify potential problems, minimize repetitive losses, and educate the public on Duck's vulnerability to natural hazards.

This document is Duck's portion of the Dare County Multi-Jurisdictional Hazard Mitigation Plan. It is prepared to guide policy in the Town's vulnerable areas and to assist state and federal funding efforts.

At the time the original 2004 Town of Duck Hazard Mitigation Plan was adopted, Duck property owners participated in the NFIP through Dare County's Flood Damage and Prevention Ordinance. On September 3, 2003, the Town of Duck Town Council adopted Ordinance 03-13 which was the Town's first Flood Damage Prevention Ordinance. These items were subsequently forwarded to the North Carolina Division of Emergency Management along with the Town's application for participation in the NFIP. The Town was formally accepted into the NFIP and began administering its own Flood Damage Prevention Ordinance shortly after the Town's first Hazard Mitigation Plan was adopted. On August 2, 2006 the Town adopted a revised Flood Damage Prevention Ordinance in conjunction with statewide revisions to the National Flood Insurance Rate Maps for North Carolina. Revised Flood Insurance Rate Maps for the Town of Duck went into effect on September 20, 2006. In the summer of 2008 the Town initiated the process to apply for participation in the Community Rating System program. As the first step in this process, staff from the North Carolina Division of Emergency Management conducted a Community Assistance Visit in August, 2008 in order to verify compliance with the minimum standards of the NFIP. The Town of Duck is currently awaiting the outcome of this process.

The NFIP provides federally supported flood insurance in communities that regulate development in their floodplains. The CRS reduces flood insurance premiums in those communities that do more than implement the minimum regulatory requirements. The Town has developed this plan in order to limit life and property losses due to a major flood.

The benefits of hazard mitigation planning are:

- *Saves lives and property* – Duck can save lives and reduce property damage from natural hazards through mitigation actions, such as moving families and their homes out of harm's way.
- *Reduces vulnerability to future hazards* – By having a mitigation plan in place, Duck is prepared to take steps that will permanently reduce the risk of future losses. This opportunity is often lost when we build

communities without regard to natural hazards or when we rebuild them after a disaster "just like they were before."

- *Saves money* – Duck will experience cost savings by not having to provide emergency services, rescue operations, or recovery measures to areas that are dangerous to people in the event of a hazard.
- *Facilitates post-disaster funding* – By identifying and ranking projects before the next disaster, Duck is in a better position to obtain post-disaster funding because much of the background work necessary for applying for federal and state aid will already be done.
- *Speeds recovery* – By developing a mitigation plan, Duck can identify post-disaster mitigation opportunities in advance of a disaster. By having this strategy in advance, Duck can be ready to respond quickly after a disaster.
- *Demonstrates commitment to improving community health and safety* – A mitigation strategy demonstrates a community's commitment to safeguarding its citizens and protecting its economic, social, and environmental well-being.

## Planning Process

The following section describes the process to prepare the original Town of Duck Hazard Mitigation Plan which was adopted in August of 2004. Following this section is a description of the process that was undertaken to prepare the first five-year update to the plan.

***Preparation of the Initial Plan - 2004***

The North Carolina Division of Community Assistance provided the Town with a professional planner to draft the original Town of Duck Hazard Mitigation plan, with input from an 8 member planning committee, the Hazard Mitigation Plan Committee, established by the Town Council. The Hazard Mitigation Plan Committee membership included:

- Neil Morrison, Town Council
- Linda Nave, citizen
- Donna Black, citizen
- Chris Layton, Town Manager
- Gene Schwarz, Mayor
- Suzanne Cotellessa, Planning Director
- Jack Hughes, citizen
- John Jenkins, citizen

The Committee held a public meeting during the preparation of the plan. Additionally, it held five working sessions that focused on hazard assessment, problem identification, mitigation goals, review of possible activities and work elements to be included in the proposed plan. The draft plan assembled by the Hazard Mitigation Plan Committee was submitted to the Duck Planning Board in July of 2004 for review.

The Hazard Mitigation Plan Committee met initially on June 17, 2002 to develop a plan that met the requirements of S.B. 300. This committee later met on March 10, 2004 and developed a plan to include public participation in the planning process, to meet the requirements of the Disaster Mitigation Act of 2000. Elements of the public participation plan included:

- Copies of the Draft Hazard Mitigation Plan were made available at the Duck Town Hall for public review on January 31, 2004;
- On April 12, 2004, a public meeting was held on the Draft Hazard Mitigation Plan prepared by the Committee;
- On May 21, 2004, a Hazard Mitigation Plan Committee meeting was held; and
- On August 4, 2004, a public hearing was held by the Town Council prior to adoption.

The public meetings were advertised in the local newspaper. In addition to public meetings and making information available to the public, the committee itself consisted of 4 citizens representing the community. The citizens participated in the committee meetings and provided lively discussion and a fresh perspective to the planning process.

Additionally, outside agencies were invited to participate in the planning process. There are two reasons to involve agencies and private organizations in planning efforts. First, they may be implementing or planning to implement activities that can affect flood damage or some of the other interests and concerns. The Committee wanted to make sure that their efforts were not going to be in conflict with a government program or duplicate the efforts of another organization. Second, the Committee wanted to involve other agencies to see if they could assist their efforts. Help may be in the form of flood hazard data, technical information on various measures, guidance on regulatory requirements, advice and assistance in the planning effort, implementation of a recommended measure, and financial assistance to help implement a recommended measure.

During the initial research period at the beginning of the planning process, a list of outside agencies that could help Duck in the preparation of this document was created:

- Currituck County
- Charter Communications
- Dominion Power
- Sprint
- US Corps of Engineers
- Waste Management
- NC Division of Coastal Management
- NC Division of Emergency Management
- Duck Land Use Plan liaison
- Duck Police Department
- Duck Fire Department
- Ocean Rescue
- Homeowners Association
- Turnpike Properties
- Coast Guard
- Dr. Nancy White
- Local business group
- Tourism Bureau
- Dare County Board of Education
- US Army Corps of Engineers
- Dare County Emergency Management
- Town of Kitty Hawk
- Town of Kill Devil Hills
- Town of Nags Head
- Town of Southern Shores
- Town of Manteo
- Soil and Water Conservation District
- Outer Banks Association of Realtors
- Outer Banks Homebuilders Association
- Association of Insurance Agents
- Build the Bridge Committee
- Outer Banks Chamber of Commerce
- Regional Medical Center
- Outer Banks Hospital
- Dare County Sheriff
- NC Department of Transportation

These parties were made aware of Duck's public meetings and they were invited to attend and participate.

***Five-Year Hazard Mitigation Plan Update - 2009***

Prior to beginning this five-year plan update, Town staff had several discussions with the North Carolina Division of Emergency Management (NCEM) regarding the process for preparing the plan update. During these discussions,

staff was encouraged to explore the process to participate in a multi-jurisdictional plan update with Dare County. As noted by staff from NCEM, this would reduce the number of hazard mitigation plans that are being prepared statewide and limits redundancy of documentation among jurisdictions that are similarly situated geographically and that share the same general risks and vulnerability. Upon request by the Town, NCEM provided guidance to initiate the process to join the Dare County Plan. At the August 5, 2009 regular meeting, the Town of Duck Town Council adopted resolution 09-07, which was a request to join the Multi-Jurisdictional Hazard Mitigation Plan for Dare County (See Attachment A). This resolution was forwarded to the Dare County Board of Commissioners as a formal request to join the Multi-Jurisdictional Plan update. The Dare County Board of Commissioners subsequently approved the request, and both resolutions were forwarded to NCEM along with a formal request to prepare the five-year update to the Town of Duck Hazard Mitigation Plan as part of the Dare County Multi-Jurisdictional Hazard Mitigation Plan.

The Town of Duck Town Council also established a Hazard Mitigation Planning Committee to oversee the preparation of the five-year plan update. This Committee included the following members:

- Jon Britt, Planning Board (Chair)
- Joe Blakaitis, Planning Board (Vice-Chair)
- Ron Forlano, Planning Board
- John Fricker, Planning Board
- Don Kingston, Planning Board
- Dave Wessel, Town Council
- Christopher Layton, Town Manager
- Donna Black, Fire Chief
- Andy Garman, Director of Community Development

Town staff had several initial discussions with staff from the Dare County Department of Emergency Management to coordinate the process to merge the Town of Duck Plan with the Multi-Jurisdictional Plan. It was agreed that the Town of Duck would prepare an addendum to the Dare County Plan which would provide the following information:

- Updated 2009 Town of Duck Demographic Profile including Population and Housing Characteristics
- Overview of the Planning Process used to Prepare the Town of Duck portion of the Multi-Jurisdictional Hazard Mitigation Plan 2009 Update
- Updated Goals and Values for the Town of Duck Hazard Mitigation Plan Update
- 2009 Revisions to the Action Plan that was included in the original Hazard Mitigation Plan for the Town of Duck
- 2009 update to the Vulnerability Analysis for the Town of Duck

The Town of Duck update would eliminate information that is redundant in the Dare County Plan such as the detailed Hazard Descriptions and Intensity Scales. Once the Town of Duck completed a draft of its plan update, it was provided to Mr. Sandy Sanderson and Ms. Jessica Phillips of the Dare County Department of Emergency Management to be compiled with the remainder of the Plan. Dare County staff would handle coordination with the State regarding the review of the plan as well as circulation to other stakeholders.

The Town of Duck Hazard Mitigation Planning Committee conducted two meetings during the fall of 2009 to review the plan. A summary of the meetings is included below:

*First Meeting – August 12, 2009*

- An overview of the planning process
- A discussion of the major events or policy changes that have occurred since the 2004 plan update that would impact plan goals, objectives, or action items
- A review of the implementation status of the action items included in the 2004 plan

*Second Meeting – October 14, 2009*

- A review of revised goals, objectives, and action items prepared by Town staff in response to the discussion from the first meeting
- An overview of the updated demographic profile and vulnerability assessment for the Town as prepared by staff

***Incorporation with Existing Plans, Studies, and Reports***

The hazard mitigation plan incorporated existing plans, studies, and reports into the document. The existing plans that were reviewed were:

- Duck CAMA Land Use Plan
- Duck Zoning Ordinance
- Dare County Flood Insurance Study

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

***Adoption***

The Committee held a public meeting during the preparation of the plan. Additionally, it held a working session that focused on hazard assessment, problem identification, mitigation goals, review of possible activities and work elements to be included in the proposed plan. The draft plan assembled by the Hazard Mitigation Plan Committee was submitted to the Duck Planning Board in June for review. Copies of the Draft Hazard Mitigation Plan were made available at the Duck Building Inspections office for public review on March 29, 2004.

After a recommendation to approve the plan was forwarded to the Town Council by the Planning Board, a public hearing was held in July and the Town Council subsequently adopted the plan on August 4, 2004.
For the five-year plan update, several public meetings were held during the fall of 2009 to discuss revisions to the Hazard Mitigation Plan. A Hazard Mitigation Planning Committee was established to prepare the draft plan with the assistance of Town staff. The Town Council approved all revisions to the five-year plan update along with the remainder of the Dare County Multi-Jurisdictional Hazard Mitigation Plan at their _____ meeting.

The Town of Duck Town Council reviewed the final version of the Town of Duck Five-Year Hazard Mitigation Plan Update on _____. This was subsequently adopted on _____.

## *Basis for Hazard Mitigation Planning*

Planning is one of the best ways to correct shortcomings associated with natural hazards. The objective of planning is to produce a program of activities that will best tackle the community's flood problem and meet other community needs. A well-prepared plan will guide a community's flood, stormwater, and hazard mitigation activities so that they are implemented more economically and in ways more attuned to the needs and objectives of the community and its residents. A well-prepared plan will result in lower hazard losses and improved protection of the floodplain's natural and beneficial functions. This will benefit both the community and the NFIP.

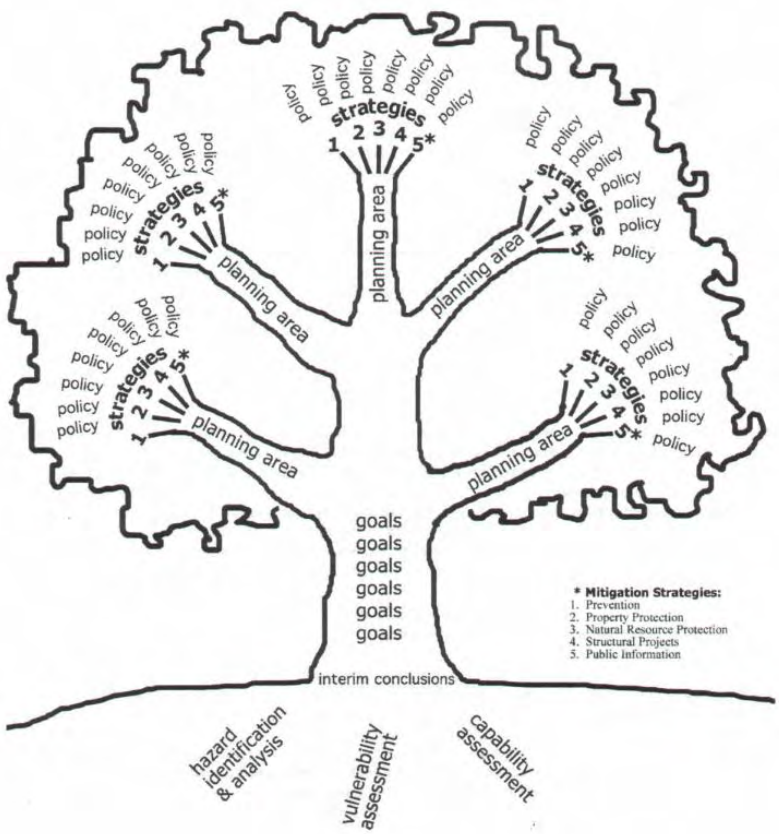
A hazard mitigation plan, one that is carefully researched to reflect local needs and conditions, can provide many benefits to a community. This is especially true of plans that are prepared in advance of a hazard event, not in the aftermath of a disaster. Many communities have engaged in mitigation activities on a project-by project basis by incorporating such projects into the context of a comprehensive plan that considers multiple aspects of the community. A local government can avoid the often inconsistent and uncoordinated results of this ad hoc approach to mitigation by developing a mitigation plan. A local hazard mitigation plan can be effective for establishing the community's commitment to mitigation goals, objectives, policies and programs. By articulating what the

community hopes to achieve, the plan can serve to establish an important connection between the public interest and mitigation measures to be employed.

***Hazard Mitigation Planning Steps***

In order to help the reader visualize the nature of the planning process, a "mitigation planning tree" is used. By comparing the planning process to a living, growing being, emphasis is placed on the interrelationships between each step and the dynamism of the final plan itself. Each step is designed to be supported by the previous step, and in turn, provides support for the next. Some of the steps in the planning process are "root" steps. These are essential analytical steps that will provide the necessary background data and justification for the action part of the plan. Next, the "ground" level steps will be pursued, followed by the "branch" steps, or actions and policies.

**Figure 1. Planning Tree**




*This hazard mitigation plan follows the guidelines endorsed by the North Carolina Division of Emergency Management that meet the requirements of Senate Bill 300. The essential planning steps are:*

1. *Identify the hazards* - The first of the "root" steps requires the community to identify the natural hazards that affect the area and analyze them in terms of likelihood, magnitude, and potential impact.

2. *Assess vulnerability of people and property* – The next "root" step is made up of multiple tasks, or sub-steps, that helps the community to assess the vulnerability to the hazards identified in Step 1. During the vulnerability assessment, the areas within the community where the hazards are likely to occur will be identified.

3. *Assess community capability* – The final "root" step asks Duck to assess the community's current mitigation practices, as well as its potential to engage in mitigation activities. While few communities in North Carolina have a dedicated mitigation strategy, most do have policies that affect construction and land-use in hazard-prone areas.

4. *Form interim conclusions* – At this level, the Town has established a strong root system that identifies the problems Duck faces, where those problems are located, and the tools at the Town's disposal to address them. Step 4 gives the community an opportunity to look at these background analyses and determine whether or not it should move forward with the planning process.

5. *Establish values and goals* – Duck now determines how mitigation fits into the community's vision of its future, and formulates goal statements to express that vision. Picture the goal statements as forming the "trunk" of the Mitigation Planning Tree. The goals and values are the central supporting element of the entire plan – they shape and determine all the mitigation policies that will be created as a result of the plan.

6. *Set policy selection criteria* – Current and potential policies will be examined by: 1) Effectiveness; and 2) Cost. Effectiveness will be determined by the perception of the Hazard Mitigation Plan Committee as High, Medium, or Low. Cost will be determined by the Committee and rated as High, Medium, or Low. The cost will be the expense of implementation and administration to the community.

7. *Formulate mitigation strategies and policies* – Step 7 is where all the previous steps have been leading up to. The mitigation policies are the "branches" of the Mitigation Planning Tree. The policies will put into action the goals established for reducing vulnerability.

8. *Preparation of the final plan* – The draft plan will meet all minimum requirements of Senate Bill 300 and keep Duck eligible for state public assistance funds, effective for state-declared disasters after August 1, 2002.

9. *Assign implementation responsibilities* – Each action step outlined in the plan will be assigned to an individual or a Town department. A 5-year implementation schedule is included for every action step.

10. *Establish procedures for monitoring, evaluation, and reporting progress* – 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.

11. *Establish procedures for revisions and updates* – This step calls for establishing procedures to see that the annual evaluation report results in revisions and updates of the plan, when warranted.

## Town of Duck Hazard Mitigation Plan

***Goals and Values***

During the development of the initial Town of Duck Hazard Mitigation Plan, the Hazard Mitigation Plan Committee developed a series of goals to mitigate hazards in Duck. These goals were developed for the following five (5) types of mitigation strategies: 1) prevention; 2) property protection; 3) natural resource protection; 4) structural projects; and 5) public information. These goals were reviewed and revised during the five-year update to reflect changes in Town policies or to address new issues or situations that occurred between 2004 and 2009. The following is the revised list of Town hazard mitigation planning goals the Town has adopted as part of the 2009 five-year plan update:

Town of Duck Hazard Mitigation Planning Goals:

- Continue enforcement of current hazard mitigation regulations
- Locate a regional debris removal area
- Improve stormwater drainage in vulnerable areas
- Preserve, protect, and enhance the Atlantic Ocean and Currituck Sound shorelines and ensure future generations are able to enjoy its beauty and bounty and can continue to use the beach and water for active and passive recreation and leisure activities
- Reduce loss of life, property, and resources due to wildland/urban interface fires
- Educate property owners on dune maintenance effectiveness
- Develop policies and educate property owners on proper siting and coastal construction techniques
- Encourage and promote through various methods the proper installation, use, and storage of propane
- Mitigate ocean overwash and sound erosion
- Develop and dedicate more open space
- Support the continued management of oceanfront shoreline development to protect and preserve the natural and recreational resources along the oceanfront
- Re-nourish and maintain the ocean beach

- Build the Mid-County Bridge
- Address localized drainage problems on NC 12
- Develop an emergency communications network
- Develop effective public information regarding natural hazards and disseminate to citizens
- Communicate hurricane information to tourists
- Improve methods to communicate with property owners in areas most vulnerable to storm damage
- Improve Ocean and Beach Safety through public education efforts and continued training of Ocean Rescue Personnel

The Committee also evaluated the Town's current programs and policies, along with potential programs and policies that could reduce Duck's susceptibility to natural hazards.

The plan *goals* describe the overall direction that Duck can take to minimize the impacts of natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations that are outlined in the action items.

The *action items* are a listing of activities in which the town and the citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation.

The mitigation plan identifies action items developed through data collection and research, surveys, and the public participation process. Mitigation plan activities may be considered for funding through federal and state grant programs, and when other funds are made available. To help insure activity implementation, each action item includes information on the timeline and the responsible party. Upon implementation, the responsible person(s) may look to partner organizations for resources and technical assistance.

- **Responsible Person.** The responsible person(s) is the person or entity that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Responsible person(s) may include local, county, or regional agencies that are capable of or responsible for implementing activities and programs.
- **Deadline.** Each action item includes an estimate of the timeline for implementation.
- **Funding.** Each action item will include a possible source of funding. Implementation ideas may include grant programs or human resources.
- **Prioritization.** Each action item is prioritized. The selection criteria used to analyze and prioritize each action step are: 1) cost effective; 2) environmentally sound; and 3) technically feasible. If an action item meets all three criteria, it is given a **High** priority; if it meets two criteria, it is given a **Medium** priority; and if it meets one criterion, it is given a **Low** priority. There is an explicit emphasis on cost effectiveness, in light of its possible use in environmental reviews for HMGP, FMA, and other federal hazard mitigation projects.

Based on the review of the five categories of possible activities, it is recommended that the Town implement the following action plan:

***Mitigation Action Steps***

Each action step outlined in the action plan is assigned to an individual or a Town position. Additionally, the major hazards addressed by the action steps are hurricanes, nor'easters, thunderstorms, and coastal erosion. A 5-year implementation schedule is included for every action step.

***Implementation Status***

For the five-year Hazard Mitigation Plan Update (2009), a column has been added to the Action Plan to indicate the Town's progress in implementing each of the action items. Action items have also been added to address the new goals recommended by the Committee.

## Table 4. Duck Hazard Mitigation Action Plan

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| **Preventive Goals:**<br>1. Continue enforcement of current hazard mitigation regulations<br>2. Locate a regional debris removal area<br>3. Improve stormwater drainage in vulnerable areas<br>4. Preserve, protect, and enhance the Atlantic Ocean and Currituck Sound shorelines and ensure future generations are able to enjoy its beauty and bounty and can continue to use the beach and water for active and passive recreation and leisure activities<br>5. Reduce loss of life, property, and resources due to wildland/urban interface fires | | | | | | | |
| 1 a | Continue to provide funding for enforcement positions | Hurricane s, Nor'easte rs | General Fund | Town Council | Ongoing | High | Ongoing/met |
| 2 a | Meet with Currituck County and Southern Shores to discuss possible locations for a debris removal area | Hurricane s, Nor'easte rs, Thunders torms | General Fund | Town Manage r | January 2005 | High | Completed (Identification of the Newbern property) |
| 3 a | Identify areas vulnerable to stormwater problems | Hurricane s, Nor'easte rs, Thunders torms | General Fund | Plannin g Board | January 2006 | High | Completed - NCDOT drainage study completed – January 2006 |
| 3 b | Coordinate town roles and state roles in stormwater management problems | Hurricane s, Nor'easte rs, Thunders torms | General Fund | Plannin g Board | January 2006 | High | Same as above |
| 3 c | Provide funding for stormwater improvements | Hurricane s, Nor'easte rs, Thunders torms | General Fund | Town Council | January 2006 | Medium (environm entally sound and technicall y feasible) | Ongoing - Town has provided funding in CIP for engineering of South Duck Drainage Project – NCDOT is funding construction; Sound-Sea Village Drainage project has been partially funded in CIP |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 4 a | Adopt and apply development policies that balance protection of natural resources and fragile areas with residential and economic development | Hurricane s, Nor'easte rs, Thunders torms, Wildfire, Flooding | N/A | Town Council | Ongoing | Medium (environm entally sound and technicall y feasible) | Ongoing – Adopted Town Code amendments including Tree and Vegetation Preservation, Land Disturbing Activities, Beach and Dune Management, Ocean and Sound Overlay, Parking, Lot Coverage, etc. |
| 4 b | Develop policies that minimize threats to life, property, and natural resources resulting from development located in or adjacent to hazard areas, such as those subject to erosion, high winds, storm surge, flooding, or sea level rise | Hurricane s, Nor'easte rs, Thunders torms, Wildfire, Flooding | N/A | Town Council | Ongoing | Medium (environm entally sound and technicall y feasible) | Ongoing – Adoption of revised Flood Insurance Rate Maps and Flood Damage Prevention Ordinance, Local Participation in CAMA LPO program, Pursuing enrollment in FEMA Community Rating System, Enforcement of NC State Building Code Revisions and Amendments including Wind-Borne Debris Provisions |
| 4 c | Develop location, density, and intensity criteria for new, existing development and redevelopment including public facilities and infrastructure so that they can better avoid or withstand natural hazards | Hurricane s, Nor'easte rs, Thunders torms, Wildfire, Flooding | N/A | Town Council | Ongoing | Medium (environm entally sound and technicall y feasible) | Ongoing – Town Code revisions including lot coverage regulations, limitations on residential dwelling size (ratio of number of bedrooms to lot area), increased setbacks for accessory structures, additional elevation requirements for V-Zone structures. |
| 5 a | Identify areas most at risk and investigate strategies to reduce risk from wildland/urban interface fires | Wildland/ urban interface fires | N/A | Fire Departm ent/ Town Staff | Ongoing | Medium (environm entally sound and technicall y feasible) | *New Action Item* |
| 5 b | Investigate how the Town of Duck can become a Firewise Community | Wildland/ urban interface fires | N/A | Fire Departm ent/ Town Council | Ongoing | Medium (environm entally sound and technicall y feasible) | *New Action Item* |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 5 c | Collaborate with DVFD and the Town of Duck to educate the homeowners, developers and landscapers on designing fire safe communities. | Wildland/ urban interface fires | N/A | Fire Departm ent/ Town Council | Ongoing | Medium (environm entally sound and technicall y feasible) | *New Action Item* |
| **Property Protection Goals:**<br>6. Educate property owners on dune maintenance effectiveness<br>7. Develop policies and educate property owners on proper siting and coastal construction techniques<br>8. Encourage and promote through various methods the proper installation, use, and storage of propane | | | | | | | |
| 6 a | Develop dune maintenance education materials | Hurricane s, Nor'easte rs, Coastal Erosion | General Fund / CAMA grants | Consulta nt / NC Division of Coastal Manage ment/Se a Grant | Ongoing | High | Ongoing – Town distributes information regarding proper sand fence installation techniques and native vegetation information; the Town also provides copies of the NC Seagrant Publication "The Dune Book" upon request. |
| 6 b | Make education materials available on-line | Hurricane s, Nor'easte rs, Coastal Erosion | General Fund | Duck Webmas ter | July 2005 | High | Partially Complete – Town maintains links to FEMA and Division of Coastal Management websites regarding NFIP and CAMA. Additional information needs to be provided regarding coastal construction techniques, retrofitting, and anchoring of underground storage tanks. |
| 7 a | Provide information on good construction techniques for coastal communities | Hurricane s, Nor'easte rs | General Fund | Duck Webmas ter/Tow n Staff | January 2007 | High | Not Complete – Need to provide FEMA/NC Department of Insurance publications/ resources as mentioned above. |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 7 b | Develop good construction materials information | Hurricane s, Nor'easte rs | General Fund | Planning Board | January 2007 | High | Not Complete – New strategy would be to provide existing FEMA publications to the general public via the internet and maintain an in-house library of these materials. |
| 7 c | Enroll in the FEMA Community Rating System and take advantage of the various mitigation strategies promoted by this program | Hurricane s, Nor'easte rs, Flooding | General Fund | Town Council/ Departm ent of Commu nity Develop ment | January 2010 | High | *New Action Item* |
| 8 a | Research the use and storage of propane | Hurricane s, Nor'easte rs, Flooding | General Fund | Fire Departm ent / Planning Board | July 2005 | High | Completed |
| 8 b | Draft a "propane" ordinance | Hurricane s, Nor'easte rs, Flooding | General Fund | Planning Board | July 2005 | High | Not Complete – The Town needs to investigate the legal authority to regulate underground storage tanks since they are under the control of the NC Dept. of Agriculture. |

**Natural Resource Protection Goals:**

9. Mitigate ocean overwash and sound erosion
10. Develop and dedicate more open space
11. Support the continued management of oceanfront shoreline development to protect and preserve the natural and recreational resources along the oceanfront
12. Re-nourish and maintain the ocean beach

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 9 a | Identify vulnerable areas and conditions | Hurricane s, Nor'easte rs, Coastal Erosion | General Fund | Town Council | January 2006 | High | Ongoing – The Town has been monitoring high oceanfront erosion areas by documenting storm damage and taking photos/video. The Town has used GIS information provided by Dare County and the North Carolina Division of Coastal Management to monitor movement of the oceanfront shoreline. NCDOT in conjunction with the Towns of Duck and Southern Shores conducted a drainage study on NC 12 to determine areas vulnerable to flooding. The Town needs to develop a method to track soundside erosion. |
| 9 b | Develop public information about the uses of sand, grasses, and fences | Hurricane s, Nor'easte rs, Coastal Erosion | General Fund | Town Council | January 2006 | High | Completed – The Town distributes information regarding proper sand fence installation techniques and native vegetation information; the Town also provides copies of the NC Seagrant Publication, "The Dune Book", upon request |
| 9 c | Disseminate the public information | Hurricane s, Nor'easte rs, Coastal Erosion | General Fund | Town Council | January 2006 | High | Completed. |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 10a | Identify available property for open space | Hurricanes, Nor'easters, Coastal Erosion, Wildfire | General Fund | Town Council | Ongoing | High | Ongoing – The Town has purchased an 11-acre park in the center of the Village Commercial area which is partially maintained as open space. The Town is 90 percent developed and there are few other areas available to purchase and maintain as open space. Town funds for this activity are limited. Future activities in this area will largely depend on the success of the Town in acquiring property with available grants. |
| 10b | Acquire the property through donation and purchase or dedication of easements | Hurricanes, Nor'easters, Coastal Erosion, Wildfire | General Fund | Town Council | Ongoing | Medium (environmentally sound and technically feasible) | Ongoing. The Town is in the process of acquiring easements to construct an elevated soundside boardwalk. No other projects are being considered at this time. |
| 10c | Develop and maintain the open space | Hurricanes, Nor'easters, Coastal Erosion, Wildfire | General Fund | Town Council | Ongoing | Medium (environmentally sound and technically feasible) | Ongoing. The Town drafted a Municipal Property Master Plan in 2004 in order to develop the Town Park property. This is currently being implemented in phases. The park is partially maintained as open space. |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 11a | Support programs and initiatives to annually assess shoreline changes (erosion and accretion) | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Town Council | Ongoing | High | Ongoing. The Town has been monitoring high oceanfront erosion areas by documenting storm damage and taking photos/video. The Town has used GIS information provided by Dare County and the North Carolina Division of Coastal Management to monitor movement of the oceanfront shoreline. The Town has held several meetings with the staff at the USACOE Field Research Facility to understand their research and theories regarding localized beach erosion in Duck and along the Outer Banks. |
| 11b | Develop policies to deal with encroaching development on the Town beaches. | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Town Council/ Town Manager | January 2011 | High | *New Action Item* |
| 11c | Develop policies to preserve native dune plants and vegetation within the Town's Dune System | Hurricanes, Nor'easters, Coastal Erosion | N/A | Town Council | Ongoing | High | *New Action Item* |
| 12a | Stay informed and involved relative to Federal, State, and/or regional studies and initiatives concerning beach re-nourishment and maintenance | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Town Council | Ongoing | High | Ongoing. The Town participates in the annual program established by the Dare County Shoreline Commission to provide funds for beach maintenance. The Town has provided comments to the State of North Carolina regarding the NC Beach and Inlet Management Plan that was to be completed in the Spring of 2009. |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 12b | Work with and support efforts by CAMA concerning beach re-nourishment and maintenance | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Town Council | Ongoing | High | Ongoing. The Town participates in the CAMA LPO program and issues permits for regulated beach activities. The Town has adopted a Beach and Dune Management ordinance to protect dunes and dune vegetation. The Town is not currently pursuing a strategy to nourish the beach. |
| 12c | Seek ways to ensure residents receive information and links to technical assistance from the Division of Coastal Management concerning beach re-nourishment and maintenance activities and options such as sand fencing | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Town Council | Ongoing | High | Ongoing. The Town provides information and issues CAMA permits to oceanfront property owners seeking to maintain their primary and frontal dunes. The Town website is used to provide this information as well. |
| **Structural Project Goals:**<br>13. Build the Mid-County Bridge<br>14. Address localized drainage problems on NC 12 | | | | | | | |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 13a | Lobby the NC Board of Transportation and the NC Department of Transportation and NC Turnpike Authority (resolution and letter to staff members regarding environmental studies, attendance at meetings./public hearings | Hurricanes | NC DOT | Town Council | Ongoing | High | Ongoing. The Town Council has issued several resolutions to support the construction of the Mid-Currituck Bridge and to identify the Town's preferred design alternative for the project. The Town has sent letters to NCDOT and NC Turnpike Authority Staff providing comments on the project studies that have been underway for several years. The Town frequently discusses the project at regular Town Council meetings and is kept informed of the status of the project by Town staff and residents who serve on a local committee to support construction of the bridge. |
| 14a | Lobby the NC Board of Transportation and the NC Department of Transportation | Hurricanes | NC DOT | Town Council | Ongoing | High | Ongoing. The Town has worked with NCDOT to develop solutions to localized drainage problems on NC 12. NCDOT is beginning a project to raise NC 12 in the southern portion of Town to address a flooding issue. |
| 14b | Identify capital projects to address drainage issues on NC 12 | Hurricanes, Nor'easters, Flooding | General Fund | Town Council | Ongoing | High | *New Action Item* |

**Public Information Goals:**

15. Develop an emergency communications network
16. Develop effective public information regarding natural hazards and disseminate to citizens
17. Communicate hurricane information to tourists
18. Improve methods to communicate with property owners in areas most vulnerable to storm damage
19. Improve Ocean and Beach Safety through public education efforts and continued training of Ocean Rescue Personnel

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 15a | Maintain a roster of business owners and homeowners associations | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | January 2005 | High | Completed. |
| 15b | Continue to research methods to disseminate information | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | January 2006 | High | Ongoing. |
| 16a | Continue to identify who needs natural hazards information | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | Ongoing | High | Ongoing |
| 16b | Continue to develop/disseminate the information (dune protection, wind, erosion) | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | Ongoing | High | Ongoing. |
| 16c | Continue to research methods to get the information to citizens | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council/ Town Manager | Ongoing | High | Ongoing. |
| 17a | Develop/disseminate hurricane information to provide to tourists | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | Ongoing | High | Ongoing. |
| 17b | Continue to disseminate the information through realtors and businesses | Hurricanes, Nor'easters, Tornadoes | General Fund | Town Council | Ongoing | High | Ongoing. |
| 18a | Develop and maintain a database of contact information for oceanfront property owners where storm damage is likely to occur | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Department of Community Development | Ongoing | High | *New Action Item* |

| Goals and Actions | | Hazard | Funding Sources | Respon sibility | Target Completion Date | Priority | Implementation Status |
|---|---|---|---|---|---|---|---|
| 18b | Develop a method to post storm damage information on the Town website including property specific damage information | Hurricanes, Nor'easters, Coastal Erosion | General Fund | Department of Community Development | Ongoing | High | *New Action Item* |
| 19a | Develop public education materials to educate beachgoers on beach safety (rip currents, beach holes, beach fires, etc.) | Rip Currents | General fund | Town Manager/ PIO/ Ocean Rescue | Ongoing | High | *New Action Item* |

***Implementation and Monitoring***
Implementation of the activities recommended by this plan will be monitored so the deadlines will be met. The Floodplain Administrator will be responsible for tracking the activities outlined in this plan. Each person assigned a responsibility in this plan shall report to the Floodplain Administrator once each year (May 1st).

The activities listed in this plan should be incorporated into other planning documents of the town, such as land use plans, capital improvement plans, thoroughfare plans, and any other planning documents that have a hazard mitigation component.

***Evaluating and Reporting Progress***
Beyond checking whether the policies of the plan are being implemented on time, an evaluation of the plan's effectiveness should be undertaken each year. Evaluation includes gauging the effectiveness of individual policies, as well as evaluating the level of vulnerability of the community as a whole.

The Floodplain Administrator will report to the Duck Town Council once each year, on the first week of hurricane season (June 1st). The report should review progress and recommend changes as needed.

***Revisions and Updates***
In addition, the Hazard Mitigation Plan Committee will reconvene during the first week of June each year to receive a presentation on the progress of the plan. The Hazard Mitigation Plan Committee will prepare an annual evaluation report that will be submitted, along with the Floodplain Administrator's report, to the Town Council. Revisions to the plan are required every five years and require a public hearing and adoption by the Duck Town Council.

Continued public involvement will include making the plan and subsequent updates available at Town Hall and available on the town's website. This document will remain open to public comment to ensure that the public's voice is heard in the ongoing mitigation process. In addition, newspaper advertisements and e-mail announcements will be used to further public participation during the plan updates.

During the five year update process, the following questions can be used as criteria for assessing the effectiveness and appropriateness of the plan:

- Do the goals and actions 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 the agencies and other partners participate in the plan and planning process as proposed?

## Hazard Descriptions and Intensity Scales

For a detailed description of hazards and intensity scales for the Town of Duck and the remainder of Dare County, please refer to Appendix A of the Dare County Multi-Jurisdictional Hazard Mitigation Plan.

## Hazard Index/Assessment

Duck is located along the northern Outer Banks; the Currituck Sound forms the Town's western boundary; the Atlantic Ocean lies to the east; and Southern Shores to the south.

Duck is vulnerable to several natural hazards. The committee identified and analyzed specific hazards by:

1- the type of natural hazards that threaten the community;
2- the likelihood of occurrence of the hazards;
3- the location of the community that are most vulnerable;
4- the impact of the hazard; and
5- the strength of the hazard, scored by a Hazard Index.

The Hazard Index is a subjective value obtained by combining how much impact and how frequently a hazard affects the community. Table 5 represents the Hazard Identification and Analysis matrix and the corresponding Hazard Index scores. The most threatening natural hazards to Duck are identified in **bold**.

The Committee identified nor'easters as the biggest natural threat to the Town. Hurricanes and flooding scored high on the hazard index as well. This plan will focus attention and efforts on these three natural hazards.

## Table 5. Duck Hazard Identification and Analysis

| *Hazard* | Likelihood of Occurrence[1] (ex. Highly Likely, Likely, Possible, Unlikely) | Location[2] (ex. Small, Medium, Large) | Impacts[3] (ex. Catastrophic, Critical, Limited, Negligible) | Hazard Index (i.e. scored by combining how much impact and how frequently this hazard affects the community |
|---|---|---|---|---|
| Earthquake / Tsunami | Unlikely | Large | Catastrophic | 1 |
| Landslide | Unlikely | Small | Negligible | 1 |
| **Hurricane** | **Likely** | **Large** | **Critical** | **5** |
| **Nor'easter** | **Highly Likely** | **Medium** | **Limited** | **5** |
| Thunderstorm | Highly Likely | Small | Limited | 1 |
| Tornado / Waterspout | Likely | Small | Limited | 3 |
| Coastal Erosion | Highly Likely | Medium | Negligible | 3 |
| Severe Winter Storm | Possible | Large | Limited | 1 |
| **Flooding** | **Highly Likely** | **Small** | **Limited** | **5** |
| Wildfire | Possible | Small | Negligible | 1 |
| Heat Wave/Drought | Possible | Large | Negligible | 1 |
| Dam/levee Failure | Unlikely | N/A | N/A | 1 |
| Volcano | Unlikely | N/A | N/A | 1 |
| Rip Currents | Highly Likely | High | Limited | 3 |
| Terrorism Event | Unlikely | Low | Negligible | 1 |
| Pandemic Event | Unlikely | Moderate | Catastrophic | 1 |

[1] **Likelihood of Occurrence** – estimates the likelihood of each type of hazard occurring in Duck.

Highly Likely = near 100% probability in the next year

Likely = between 10% and 100% probability in the next year

Possible = between 1% and 10% probability in the next year

Unlikely = less than 1% probability in the next year

[2] **Location -** the hazard covers a small, medium, or large proportion of the community

[3] **Impacts** – a combination of the severity of the event, its magnitude, and the density of human activity in the affected area

**Catastrophic** = >50% magnitude, multiple deaths, complete shutdown of critical facilities for >30 days, >50% of property is severely damaged

**Critical** = 25% to 50% magnitude, multiple severe injuries, complete shutdown of critical facilities for >14 days, >25% of property is severely damaged

**Limited** = 10 % to 25% magnitude, some injuries, complete shutdown of critical facilities for >7 days, >10% of property is severely damaged

**Negligible** = <10% magnitude, minor injuries, shutdown of critical facilities for <24 hours, <10% of property is severely damaged

Table 6 is provided below to comparatively illustrate the historical trends of hazards in Dare County as a basis for the assumptions used in the Hazard Identification and Analysis Matrix.

**Table 6. Summary of Reported Storm-Related Damage and Casualties in Dare County**

*Source: NOAA, National Climatic Data Center (Reports from National Weather Service in Categories)*
Period of Record: Storms (1/1993-7/1999,except 6-7/1993); Tornadoes (1/1950-12/1992); Wind and hail (1/1959-12/1992)
Hurricane, tropical storm, and winter storm damages are multi-county estimates and storm-specific

| Events | *Numbers* | *Deaths* | *Injuries* | **Property Damage* | **Crop Damage* | **Total Damage* |
|---|---|---|---|---|---|---|
| Dare | | | | | | |
| Extreme Cold | 1 | 0 | 0 | $0 | $385,064 | $385,064 |
| Hail | 19 | 0 | 0 | $0 | $0 | $0 |
| Floods | 3 | 0 | 0 | $0 | $0 | $0 |
| Thunderstorm Wind | 66 | 0 | 0 | $541,435 | $0 | $541,435 |
| High Winds | 4 | 0 | 0 | $36,585 | $0 | $36,585 |
| Rip Currents | 3 | 2 | 3 | $0 | $0 | $0 |
| Waterspouts | 12 | 0 | 1 | $106,745 | $0 | $106,745 |
| Funnel Cloud | 1 | 0 | 0 | $0 | $0 | $0 |
| Tornado | 29 | 1 | 19 | $9,934,283 | $0 | $9,934,283 |
| Subtotal | 138 | 3 | 23 | $10,619,047 | $385,064 | $11,004,111 |
| Hurricanes, Tropical Storms & Winter Storms (multi-county events that affected Dare) | | | | | | |
| Hurricanes | 8 | 19 | 14 | $1,450,556,400 | $566,399,842 | $2,016,956,241 |
| Tropical Storms | 5 | 0 | 0 | $24,125,687 | $43,052,156 | $67,177,844 |
| Winter Storms | 4 | 0 | 0 | $25,438,518 | $0 | $25,438,518 |
| Subtotal | 17 | 19 | 14 | $1,500,120,605 | $609,451,998 | $2,109,572,603 |

*Damages are in 2004 US dollars, adjusted using the consumer price index (US Bureau of Labor Statistics, March 2004, USDL-02-222, http://www.bls.gov/news.release/cpi.nr0.htm)

*Depth of Flooding*
Flood events in Duck are divided into the following magnitudes: 10-, 50-, 100-, and 500-year recurrence intervals. These events have a 10, 2, 1, or 0.2 percent chance, respectively, of being equaled or exceeded during any year.

The most recent Flood Insurance Study (FIS) for Duck, published on September 20, 2006, lists the storm surge elevations (stillwater elevations) for the various flood intervals by transect. Additionally, wave action associated with the storm surge is calculated to be 3 feet, or an additional 3 feet added to the stillwater elevations. This information is used to determine the Base Flood Elevation for a particular area, which is the estimated elevation above mean sea level of the 100-year flood or the flood having a 1% chance of being equaled or exceeded in any given year. For regulatory purposes, this is generally the elevation that the lowest floor of a structure must be elevated to in order to comply with the provisions of the National Flood Insurance Program. Table 7 below provides a summary of the Special Flood Hazard Areas (SFHA) within the Town of Duck and the corresponding Base Flood Elevations within each SFHA. The SFHA's within the Town are depicted in Figure 4. The Flood Insurance Study for the Town of Duck and Dare County can be viewed and downloaded at www.ncfloodmaps.com.

**Table 7. Summary of Special Flood Hazard Areas and Corresponding Base Flood Elevations**

| Flood Zone | Base Flood Elevation | Acreage |
|---|---|---|
| AE | 6 | 0.373158 |
| | 7 | 123.0351 |
| | 8 | 66.40282 |
| | 9 | 253.2751 |
| | 10 | 57.31805 |
| | **Subtotal** | **500.4042** |
| VE | 12 | 245.6288 |
| | 14 | 13.88993 |
| | **Subtotal** | **259.5187** |

Source: Dare County Flood Insurance Study, 1993.

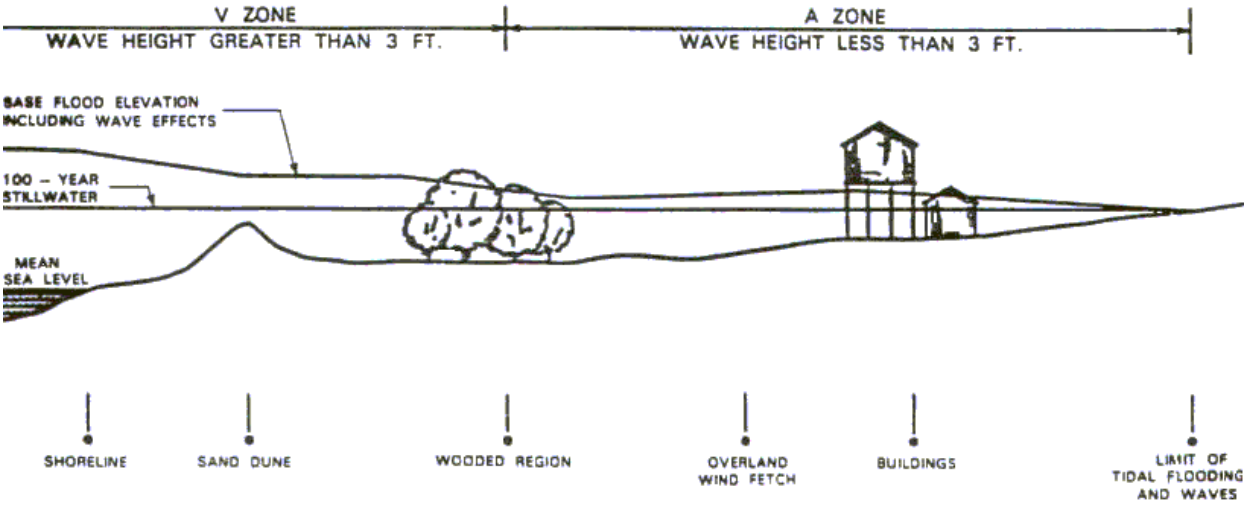



**Figure 2. Flood Insurance Study Schematic**

***Historical Floods***

Please refer to pages 20-26 within Appendix A of the Dare County Multi-Jurisdictional Hazard Mitigation Plan for a detailed description of the historical hurricanes and floods that have had an impact within Dare County.

## Vulnerability Assessment

Hazards can be classified as natural or manmade occurrences. A hazard may or may not pose a threat to people; however, a hazard is primarily a problem when human activities are disrupted. Vulnerability to hazards can be defined and subsequently quantified based on the probability that people will experience injury, loss of life, or property damage from a particular hazard. Hazards may also result in loss of life or injury to animals and livestock, crops, and vegetation; loss of or damage to homes, businesses, and industries; loss or damage to automobiles, furnishings, records and documents; damages or interruptions to power and telephone lines, damage or closing of roads, railroads, airports, and waterways; impacts to the economy including loss of wages, and general disruption of life. It is important to know where and to what extent the community is susceptible to the impacts of hazards.

Vulnerability to hazards exists both at the present time and in the future. The present level of development and infrastructure generates a set of conditions that result in every area having some degree of vulnerability. That degree of vulnerability will change in the future as an area experiences an increase or decrease in development and whether the community implements or ignores hazard mitigation activities. Therefore, we can speak of both present vulnerability and future vulnerability.

***Narrative Summary***

According to the Hazard Identification and Analysis matrix (Table 5), the entire town is vulnerable to hurricanes, nor'easters, and thunderstorms. The size of these storm systems is great enough to threaten all of the areas within the town. The Town is vulnerable to flooding and erosion, particularly the oceanside and soundside areas. There is also a varying degree of risk posed by earthquakes/tsunamis, landslides, tornadoes/waterspouts, flash flooding, wildfire, rip currents, terrorism, and, pandemic events.

Hurricanes and nor'easters pose the greatest risk to Duck of all natural hazards. The geographic location of Duck, coupled with the size of tropical storms and hurricanes, makes Duck especially vulnerable to high winds and storm surge. Hurricanes and tropical storms which make landfall on or near the Outer Banks still maintain much of their intensity when they affect Duck. As the tropical systems pass over land, they are unable to refresh themselves with warm water and lose strength. Duck is surrounded on its eastern and western borders with water. The waterfront areas are at the most risk from storm surge flooding. The entire town is at risk to high winds associated with tropical systems.

For the purposes of this vulnerability assessment, impacts resulting from the primary hazards that threaten Duck (Hurricanes, Nor'easters, Flooding) are quantified based on the potential for property damage. Loss of life and economic impacts are not estimated in the following scenarios. The purpose of this analysis is to identify the areas that are most susceptible to hazards and to provide a comparison of the total value of structural damage that could occur under a worst case scenario.

***Geographic Planning Areas***

For the purposes of this plan, Duck is divided into the following geographic planning areas:

- North Duck
- South Duck

***Structures Subject to Hazards***

There are 1,486 acres within the boundaries of Duck.

During the development of the 2004 Town of Duck Hazard Mitigation Plan, vulnerability was estimated based on the susceptibility of property to flooding and storm surge. The Plan included an analysis of improved properties located within Special Flood Hazard Areas based on the Flood Insurance Rate Maps in effect at that time (May 5, 2003). The analysis also detailed properties located in areas most likely to be inundated with hurricane induced storm surge based on a model developed by the National Oceanic and Atmospheric Administration (NOAA) commonly known as SLOSH (Sea, Lake, and Overland Surge from Hurricanes. The SLOSH model differentiates between slow moving and fast moving storms and depicts flooding based on storm intensity levels ranging from one through five on the Saffir-Simpson Hurricane Scale.

It is important to note that the Flood Insurance Rate Maps for the Town of Duck were revised on September 20, 2006. These revisions expanded the Special Flood Hazard Areas in Duck and increased the number of properties located within the VE (high velocity) and AE flood zones. Another important item to note is that a property tax re-

assessment occurred in 2005 for the entire county. This resulted in a significant increase in the estimated value of buildings and land within the Town.

For the 2009 plan update, a comparison is provided between 2004 and 2009 to show the increase in the boundaries of the Special Flood Hazard Area and the increase in the number and value of properties within each designated flood zone. As stated above, the increase in the number and value of buildings in the Special Flood Hazard Area can be attributed to the increase in the boundaries of the Special Flood Hazard Area due to map revisions that occurred in 2006, the increase in the assessed value of property, and also due to building construction that has occurred over the last five years. It is estimated that approximately 136 new structures were built from 2004 to 2009.

The 2009 plan update also provides a comparison from 2004 to 2009 of the number and value of properties located in areas estimated to be inundated with storm surge by the SLOSH model described above. The SLOSH model has not changed since the 2004 plan was developed; therefore, the comparison will largely focus on the increase in the number of structures that are located within these areas and the increase in the value of these structures based on the 2005 Dare County Tax re-assessment.

Special Flood Hazard Area Comparison (100-year Floodplain):

## Table 8. Total Acreage within Special Flood Hazard Area

| Special Flood Hazard Area Designation | 2004 | 2009 |
|---|---|---|
| AE/AO | 466.83 | 500.40 |
| VE | 103.41 | 259.57 |
| Total | 570.24 | 759.92 |

## Table 9. Comparison of Number/Value of Structures in SFHA by Year

| SFHA Designation | 2004 | | 2009* | |
|---|---|---|---|---|
| | # of Structures | Building Value | # of Structures | Building Value |
| AO/AE | 683 | $125,426,600 | 753 | $260,771,300 |
| VE | 144 | $27,115,100 | 320 | $197,980,400 |
| *Total* | *827* | *$152,541,700* | *1073* | *$458,751,700* |

*Reflects revised September 20, 2006 revised flood maps for Duck and 2005 Dare County Tax Re-assessment

## Table 10. Remaining Undeveloped Acreage in SFHA by Year

| Special Flood Hazard Area Designation | 2004 | *2009 |
|---|---|---|
| AE/AO | 111.69 | 29.28 |
| VE | 24.72 | 3.98 |
| Total | 136.41 | 33.27 |

The Town contains approximately 1,486 acres with its municipal boundaries and 2,218 improved properties. As noted in Table 8, 759 acres are located within the SFHA, which is 51 percent of the total land area within the Town. The SFHA expanded by approximately 190 acres in 2006 when the FIRM maps for the Town were revised. The number of buildings in the SFHA increased by 246, or approximately 30 percent, from 2004 to 2009. The total building value within the SFHA increased slightly more than 300 percent during this time frame, which can be largely attributed to the Dare County tax re-assessment in 2005. The Town is more than 90 percent built out with only a small percentage of undeveloped land remaining within the SFHA. It is anticipated that redevelopment will

continue to occur on older properties, which will have an impact on the size and value of structures that will be vulnerable.

## Table 11. Storm Surge Inundation Comparison – Slow Moving Storm

| Storm Category | Acres | 2004 | | 2009* | |
|---|---|---|---|---|---|
| | | # of Structures | Building Value | # of Structures | Building Value |
| Category 1, 2, & 3 | 710 | 1,073 | $88,382,000 | 1,006 | $387,844,100 |
| Category 4 and 5 | 250 | *Not Provided* | $72,309,800 | 416 | $165,882,300 |
| **Total** | 960 | 1,073 | $160,691,800 | 1,422 | $553,726,400 |

Approximately 64 percent of the total land area of the Town is within the estimated inundation area for slow moving category one through five hurricanes. Slightly less than 50 percent of the total land area within the Town could be expected to be subject to inundation from category one through three hurricanes. Details regarding the value of structures that could be affected by slow moving hurricanes can be found in Table 11. A map depicting these areas is provided in Figure 5.

## Table 12. Storm Surge Inundation Comparison – Fast Moving Storm

| Storm Category | Acres | 2004 | | 2009* | |
|---|---|---|---|---|---|
| | | # of Structures | Building Value | # of Structures | Building Value |
| Category 1, 2, & 3 | 436 | 536 | $48,982,500 | 576 | $238,176,100 |
| Category 4 and 5 | 531 | *Not Provided* | $138,619,400 | 811 | $287,349,500 |
| **Total** | 967 | 536 | $187,601,900 | 1,387 | $525,525,600 |

Similar to the slow moving storm, the fast moving storm impacts approximately 65 percent of the total land area within the Town. However, impacts are significantly less for category one through three hurricanes, with only 29 percent of the total land area of the Town being impacted with this scenario. A much higher intensity fast moving storm is required to impact the same area as a lower intensity, slow moving storm. Total impacts to the number of structures and value of buildings is similar to the impacts from a slow moving storm; however, the distribution of impacts is shifted towards the high intensity storms. This generally means the Town is less vulnerable to the impacts of a fast moving storm when compared to the same intensity slow moving storm. The area impacted by fast moving hurricanes is depicted in Figure 6.

***Critical Facilities***

Seven critical facilities have been identified within the town:

- Duck Fire and Police Department
- Carolina Telephone (Formerly Sprint) switch station
- Town Hall
- Dare County Water tower
- Kellogg's Supply
- Four Seasons Clubhouse
- US Army Corps of Engineers Research Pier

The following table depicts the vulnerability of these facilities to flooding and storm surge:

## Table 13. Vulnerability of Critical Facilities

| Facility | SFHA | Storm Surge Inundation | | Building Value |
|---|---|---|---|---|
| | | Slow | Fast | |
| Duck Fire and Police Department | X | Category 3 | Category 4,5 | $646,900 |
| Carolina Telephone (formerly Sprint) Switch Station | X | Category 3 | Category 4,5 | $165,000 |
| Town Hall | AE | Category 1,2 | Category 1,2 | $1,000,000 |
| Dare County Water tower | AE | Category 1,2 | Category 1,2 | $845,100 |
| Kellogg's Supply | X | Category 4,5 | Category 4,5 | $693,600 |
| Four Seasons Clubhouse | X | None | Category 4,5 | $1,163,000 |
| US Army Corps of Engineers Research Pier | VE | Category 4,5 | Category 3 | $2,637,900 |

Based on the information included in Table 13, the Town Hall, Dare County Water Tower, and US Army Corps of Engineers Research Pier would be the three critical facilities most vulnerable to the effects of flooding and storm surge. Total value of these structures is $4,483,000. This value includes the pier structure at the US Army Corps of Engineers property. This is based on the Dare County Tax records. It is likely that replacement of this structure in particular, would be much higher than the assessment provided by Dare County.

***Repetitive Loss Properties***

Over 2.5 million buildings are insured by the National Flood Insurance Program (NFIP), but a fraction of them (less than 2%) account for 33% of the flood insurance claims paid since 1978. This is because these few properties have been flooded more than once, and some of them have been flooded numerous times. Repetitive loss properties are defined by FEMA as properties for which two or more claims of at least $1,000 have been paid by the NFIP within any 10-year period since 1978. (*CRS Coordinator's Manual*, 1999. Federal Emergency Management Agency, National Flood Insurance Program, Community Rating System. p. 500-3.)

Duck has six repetitive loss properties within its jurisdiction, according to a recent FEMA list of repetitive loss properties.

***Transportation/Hurricane Evacuation Time***

In 2005, the North Carolina State Legislature adopted a standard for hurricane evacuation for the North Carolina Coast. This standard requires that throughout the State of North Carolina, during a Category 3 hurricane with 75 percent tourist occupancy, the time required to evacuate all persons should be no greater than 18 hours (NC Gen. Stat. § 136-102.7, "Hurricane Evacuation Standard"). In many areas, significant upgrades to the transportation network would be necessary to meet this requirement.

The following table, which is an excerpt from the Mid-Currituck Bridge Statement of Purpose and Need document, prepared by the North Carolina Turnpike Authority in April of 2008, presents current and forecast hurricane evacuation clearance times for those evacuating via NC 168 and US 158. This is the primary evacuation route for the Duck community. Evacuation times currently exceed the state's 18-hour clearance time standard by approximately nine hours. The 2035 clearance time (taking into consideration the implementation of the STIP projects listed below) would be 36.3 hours, which is 102 percent over the 18-hour standard.)

## Table 14. 2007 and 2035 Hurricane Evacuation Clearance Times via US 158 and NC 168

*By Tourist Occupancy and By Year in Hours*

| | 2007 | | | | 2035 | | | |
|---|---|---|---|---|---|---|---|---|
| Occupancy | 35% | 50% | 75% | 95% | 35% | 50% | 75% | 95% |
| Category 1-2 | 14.5 | 17.7 | 23.5 | 27.9 | 18.9 | 23.1 | 30.7 | 36.3 |
| Category 3-5 | 17.9 | 21.2 | **27.1** | 31.4 | 24.6 | 28.9 | **36.3** | 42 |

2009-2015 State Transportation Improvement Program

- R-4457 Convert the existing at-grade intersection of US 158 and NC 12 at Southern Shores to an interchange.
- R-2545 Widen US 64 to multi-lanes east of Columbia to east of the Alligator River.
- R-2544 Widen US 64 to multi-lanes east of the Alligator River to US 264.
- R-2574 Widen US 158 to multi-lanes east of NC 34 at Belcross in Camden County to NC 168 in Currituck County.
- R-4429 Upgrade NC 168 to north of SR 1232 and SR 1213 to SR 1216.

This information is included to highlight a specific vulnerability to the Town of Duck, which supports the construction of the Mid-Currituck Bridge project and associated transportation improvements. It is a stated purpose and need of this project to improve hurricane evacuation clearance times and provide alternative evacuation routes in the event NC 12 becomes impassible. It is estimated that with the construction of the preferred alternative of the Mid-Currituck Bridge along with other improvements to US 158, hurricane evacuation times would be reduced in 2035 from the estimate of 36.3 hours with no bridge to between 21.4 and 27 hours if the bridge were constructed in addition to the improvements listed above.

***Coastal Erosion***

The Town has noticed an increase in the impacts from coastal erosion over the course of the last three years, particularly in an area north of the US Army Corps of Engineers Research Pier. Several significant nor'easters, including the Thanksgiving storm of 2006, have caused impacts including the loss of dunes and dune walkovers, damage to accessory structures such as pools and dune decks, and the relocation of two oceanfront houses. The Town has had several meetings with staff at the USACOE Field Research Facility in Duck; primarily to discuss recent research on coastal erosion to determine the cause of this localized erosion. FRF staff is using several different techniques to study erosion throughout the Outer Banks and has been tracking this particular area as an erosion "hotspot." To this point, FRF staff has developed a theory that the erosion in this area is being caused by the exposure of older sediments in the nearshore area which could possibly be the remnants of an ancient riverbed. The older sediments, which are typically larger in size, respond differently to wave action, and in turn affect formation of the nearshore sandbars in this area. Sediment is not accumulating as it would under normal conditions in a linear pattern parallel to the shoreline. The sandbars in this area have a perpendicular shape and therefore do not dissipate wave energy in the same manner as a parallel sandbar. Wave energy is dissipated on the beach and sand is washed into the nearshore zone. Figure 8 has been prepared to identify the area where this has been occurring. Town staff monitors this area frequently during storm events and has developed a method to communicate with property owners to coordinate necessary repairs.

***Development Trends***

(excerpted directly from the Duck 2004 CAMA Land Use Plan)

Current development trends in Duck are expected to continue during the next five years. Some redevelopment of properties is anticipated. Remaining platted and developable lots are dispersed throughout the Town so there is not one area that will likely see a majority of development activity.

As depicted in Table 1, the Town of Duck permanent population in the year 2008 was estimated at 499 persons. The North Carolina State Demographer estimated in 2007 that the Town of Duck population was 515 persons. Although the Town's population has decreased over the last year, it can be estimated by applying the population growth rate from 2000 to 2008 that the Town of Duck will to grow to about 548 persons by 2015 and to 586 persons by 2020. The seasonal population is projected to grow as well throughout the planning period.

As of January 2003, there were 386 residential building lots (platted and recorded) remaining in Duck for residential development. In August of 2009, there were approximately 250 residential building lots remaining in Duck for residential development, with only a few remaining lots large enough to subdivide. These larger lots were generally 30,000 to 50,000 square feet in area and may support two to three additional residential parcels. The Town estimates that approximately 136 new single-family dwellings have been constructed since January of 2004 and that

the Town is now more than 90 percent "built-out." Based on Census 2000 figures, 89.60% of housing units in Duck were vacant (seasonal use) while only 10.40% were occupied. Anticipated conversions of seasonal housing to permanent occupancy and the development of remaining platted and zoned lots and tracts will more than accommodate the populations projected in Duck for the ensuing 5, 10, and 20 year periods. The amount of commercially zoned land in Duck is also deemed adequate to meet the projected populations for the planning period.

Duck is fortunate to be a "new" community, meaning that the Town is only 7 years old and the area has seen significant development only in the past 20 years. The CAMA setbacks along the oceanfront have required beachfront development to be situated further back from the first stable line of vegetation than some of the communities to the south that developed before CAMA setbacks were enacted. Additionally, Duck does not suffer from severe erosion in most areas, and therefore does not share in the problems of homes literally falling into the ocean that is more prevalent in the communities to the south of the town. With sound planning and strict enforcement of existing regulations, Duck can avoid some of the problems faced by oceanfront property owners along other portions of the Outer Banks.

**Figure 3. Critical Facilities**

**Figure 4. Special Flood Hazard Areas**

**Figure 5. Storm Surge Inundation Areas – Slow Moving Storms**

Maximum Estimated Storm Surge Inundation Area
Slow Moving Hurricane
Town of Duck, North Carolina
0 500 1,000 2,000 Feet
Parcels
Built Since 2004
Category 1, 2
Category 3
Category 4, 5
Tax Parcel & Digital Orthophotography provided by Dare County. Building footprints and orthophotos updated in 2007.
SLOSH Model Storm Surge Inundation areas provided by the National Hurricane Center.

**Figure 6. Storm Surge Inundation Areas – Fast Moving Storms**

**Figure 7. Existing Land Uses**

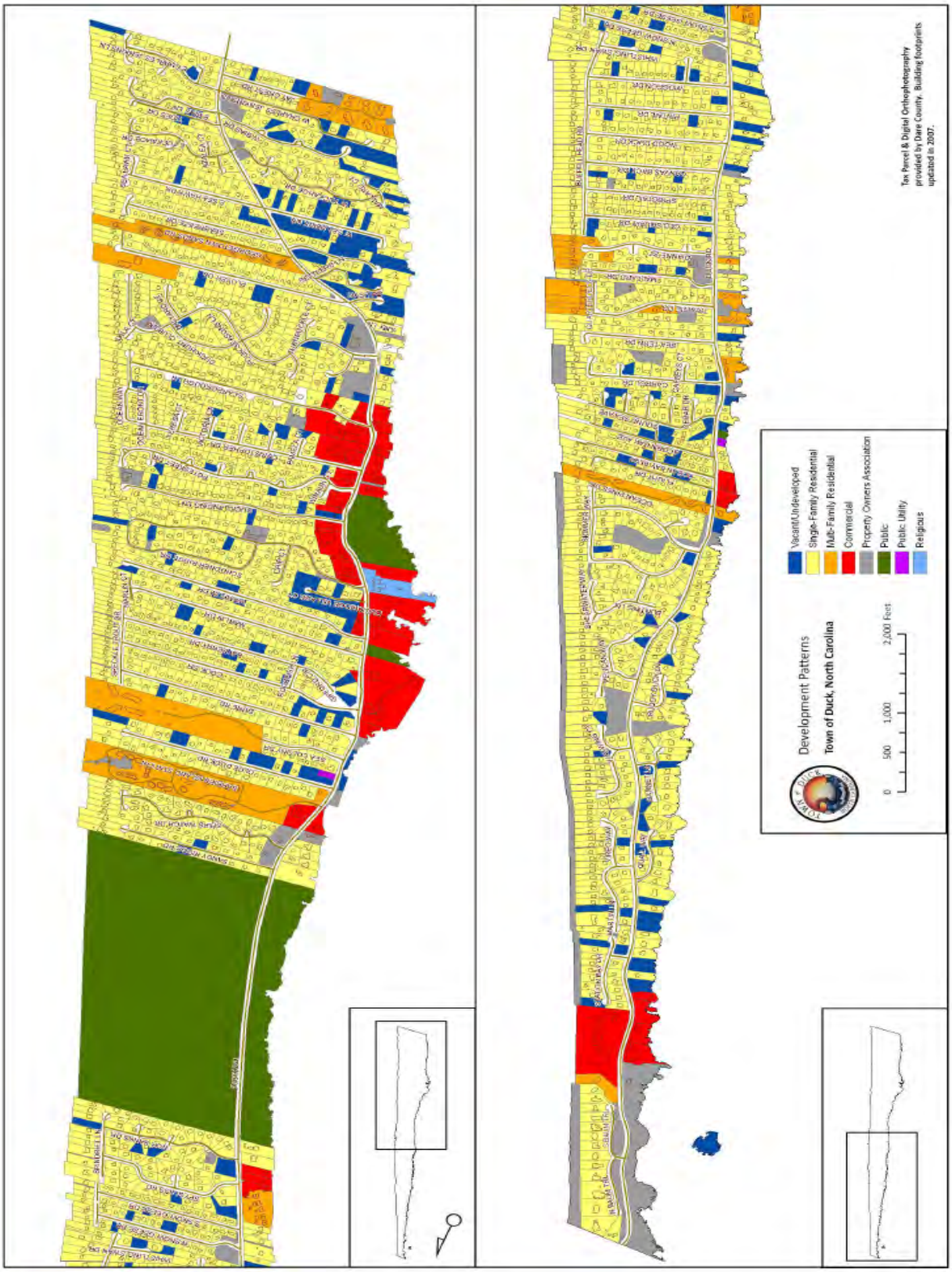



**Figure 8. Coastal Erosion**

2007 Dare County Orthophotography
1996 Dare County Orthophotography
Coastal Erosion
Town of Duck, North Carolina
Dune Vegetation Line
YEAR
1996
2007
0
150
300
600 Feet

## Community Capability Assessment

***Legal Capability***

Local governments in North Carolina only have the legal authority that is granted to them to exercise by the state. This principle is commonly known as "Dillon's Rule," where all power is vested in the state and can only be exercised to the extent delegated. This rule applies to all of North Carolina's counties and cities.

Enabling legislation in the North Carolina General Statutes grants legal authority to the counties and cities. Local regulations that are enacted within the state's enabling authority do not automatically meet judicial acceptance. All regulations placed by local governments on land use and building practices must meet the procedural requirements of the 14th Amendment to the U.S. Constitution, or they may be found invalid. Constitutional protections apply to federal and state governments, as well as all municipalities. All mitigation measures taken by local governments in a regulatory sense must be worded and enforced in a manner that is consistent with the parameters set by the state and federal constitutions.

Local governments have a variety of mitigation measures that are consistent with all constitutional protections and within the limits of Dillon's Rule. All local government powers fall within one of four basic groups of powers: regulation, acquisition, taxation, and spending. Mitigation measures may be carried out under each of the four types of powers.

*Regulations*

1. General Police Powers - North Carolina's local governments possess a broad range of regulatory powers at their disposal. North Carolina General Statutes grant general police powers to counties and cities, allowing them to adopt and enforce ordinances that define, prohibit, regulate, or abate acts, omissions, or conditions detrimental to the health, safety, and welfare of the people, and to define and abate nuisances, including public health nuisances. Some hazard mitigation measures can be included under the general police power available to local governments. Counties and cities may also use their police powers to abate nuisances that could include, by definition, any activities or conditions that make people or property more vulnerable to hazards.

2. Building Codes/Inspections - A number of mitigation measures involve structural modifications and retrofitting homes to be less susceptible to natural hazards. Many of these measures are accomplished through use of the building code. North Carolina has a mandatory building code (NCGS 143-138) imposed throughout the state. Counties and cities are granted the authority to adopt more stringent local building code requirements, but they may not adopt regulations that are less restrictive than the state building code.

3. Land Use - Regulatory authority granted to local governments by the state is the most commonly used manner that counties and towns use to control the use of land within its jurisdiction. Using various land use regulations, a local government may control the amount, timing, density, quality, and location of new development. Land use regulatory authority includes the power to adopt and enforce zoning ordinances, floodplain ordinances, and subdivision regulations.

   Planning. In order to exercise the regulatory powers granted by the North Carolina General Statutes, local governments are required to designate a planning agency. The planning agency may perform a number of duties, including: make studies of the area; determine objectives; prepare and adopt plans for achieving those objectives; develop and recommend policies; ordinances and administrative means to implement plans; and perform other related duties.

   Subdivision Regulations. Subdivision regulations govern the division of land for development or sale. These regulations can be used for mitigation purposes in various ways. They may prohibit the subdivision of land subject to flooding. Subdivision regulations may also set a standard for public infrastructure that ensures it is adequate for the assessed risk. They may require that developments be built in a hazard-resilient manner, such as requiring "deep" lots in shorefront areas to remedy shoreline erosion. However, 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.

Floodplain Regulations. Structures built in the floodplain are subject to damage by rising waters. In addition to increasing the number of properties at risk, development in the floodplain reduces the flood storage capacity of these areas, resulting in greater flood heights. Communities should consider the relocation, elevation or acquisition of buildings in the floodplain. At a minimum, elevation and relocation guidelines should meet NFIP standards.

***Acquisition***

In the long run, it is less expensive to acquire and demolish a building than to repeatedly provide for its reconstruction. In addition to reducing the public cost of recovery and reconstruction, acquisition can be a tool for accomplishing other community goals. It can help increase floodplain storage capacity, preserve wetlands, maritime forests, estuaries and other natural habitats, and provide open space, beach access, and parks and recreation areas. There are several alternative ways to approach acquisition of floodprone properties.

1. Fee Simple Acquisition of Land and Damaged Structures
   Land ownership is often defined as a bundle of rights, of which the right to develop is only one. When one person owns all the rights associated with a parcel of land, they are said to own the land "in fee simple." Acquiring a property in fee simple provides a local government with the greatest level of control over the use and disposition of a parcel. 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.

   There are four types of buyouts where built property is involved. *Basic buyouts* are community-run programs without a relocation element. *Buyout and infill* programs are designed to encourage the relocation of families and structures from the floodplain to vacant lots in less hazard-prone neighborhoods. Communities operating *buyout and reorganization* plans often create new subdivisions into which they actively relocate houses and businesses. The community will usually sponsor the planning and installation of infrastructure. *Buyout and complete relocation* is the construction of a new town using new or relocated old buildings.

2. Easements
   The owner of an easement has one or more of the rights in a property, leaving the rest of the "bundle" in the hands of the land owner. Easements either grant an affirmative right to use property, such as a right of access, or restrict the land owner's right to use the property in a particular way. Easements can be written either to allow public access or to prohibit it. They must be clear about the restrictions placed on the property. They should also allow inspection by public officials to ensure compliance with the easement provisions. An administrative process for policing easements should be established. The best incentive for encouraging the donation of a conservation easement is the fact that the donation may qualify the donor for tax credits.

3. Relocation of Existing Development
   Relocation means moving a building or facility to a less hazard-prone area, either within the same parcel or on a new parcel. This technique is typically used to avoid coastal or riverine flood hazards. "Relocating" can also be used to describe the process of demolishing a building and reconstructing it outside the hazard area.

***Spending***

Hazard mitigation principles should be made a routine part of all spending decisions made by local governments. The most common forms of hazard mitigation-related spending techniques is capital improvements programming (CIP) and limiting government expenditures in high-hazard areas.

1. Capital Improvements Programs (CIP)
   Capital improvements programs are timetables that define when, where, and what level of municipal services a government will supply. Typically a part of the comprehensive plan, the CIP sets public spending on improvements for the ensuing five to ten years. Timetables can be effective at managing growth because it is rarely feasible for a developer to provide water, sewer and other services without a public subsidy.

2. Limiting Government Expenditures in High-Hazard Areas
   Regional and local governments should limit their expenditures for roads and other infrastructure in high-hazard areas. This technique will discourage development in these areas, which can greatly reduce disaster-related

damage and recovery costs. Government facilities, especially those that house emergency services, should not be located in high-hazard areas. By avoiding these areas, local governments can help ensure these facilities will function during and in the immediate aftermath of an emergency. They can also reduce the cost of post-disaster repairs to public structures.

***Taxation***

The power of taxation extends beyond merely the collection of revenue. A number of communities set preferential tax rates for areas that are unsuitable for development and can be used to discourage development in hazardous areas.

1. Differential Assessment
   Differential taxation is a technique for reducing the tax burden on land facing development pressure by recognizing that undeveloped properties require fewer public services. This technique can moderate the pressure to develop land at its "highest and best" use in one of several ways; by reducing the assessed value of land to a percentage of urban land; or by assessing the value of land based on its income-producing capacity, as opposed to its market value.

2. Special Assessment Districts
   Special assessment districts apply to property owners who directly benefit from a specific public improvement. These owners of both new and existing development in the district are charged a fee that is proportional to the benefits received from the improvement. There are a number of ways to apply this technique, from temporary assessments that raise revenue for a specific improvement to indefinite assessments that fund independent, special purpose governmental entities.

***Institutional Capability***

Duck is a chartered municipality, which is governed by a Mayor-Commissioner form of government. Police, Fire, and Rescue departments play a critical role in the mitigation of and response to natural hazards. Additionally, a number of other local agencies play important roles in the institutional capability. These agencies are:

- Town Clerk
- Sheriff
- Dare County Register of Deeds
- Duck Fire Department
- Coast Guard
- Red Cross
- Insurance industry
- NC Department of Transportation
- NC Division of Water Quality
- Coastal Area Management Act
- Federal Emergency Management Agency
- NC Department of Corrections
- NC Division of Emergency Management
- Local media
-

***Technical Capability***

There are a number of local, state, and federal agencies available to help Duck with various aspects of hazard mitigation. They are:

- NC Division of Community Assistance
- Federal Emergency Management Agency
- Albemarle Commission
- NC Division of Emergency Management
- National Flood Insurance Program (NFIP)
- Insurance Services Organization (ISO)

- National Oceanic & Atmospheric Administration / National Weather Service
- Universities
- Coastal Resources Commission
- US Forest Service
- US Corps of Engineers

***Fiscal Capability***

**Sources of Funding**
Contact the North Carolina Division of Emergency Management for a listing of over 300 government funding sources for mitigation and disaster assistance (available on CD).

**Hazard Mitigation Grant Program (HMGP)**
The Federal Disaster Assistance Act (Stafford Act) provides funds authorized by the federal government and made available by FEMA for a cost-share program to states. The HMGP provides 75% of the funds while the states provide 25% of the funds for mitigation measures through the post-disaster planning process. The Division of Emergency Management administers the program in this state. The state share may be met with cash or in-kind services. The program is available only for areas affected by a Presidentially-declared disaster.

**Disaster Preparedness Improvement Grant (DPIG)**
This grant provides federal matching funds for communities to develop hazard mitigation plans, expand existing plans, update disaster preparation plans, and to prepare the administrative plans required to qualify for Hazard Mitigation Grant Program grants. Funds for the DPIG are provided by FEMA and the Division of Emergency Management administers the program in each state.

**Flood Mitigation Assistance Program (FMAP)**
This program provides grants for cost-effective measures to reduce or eliminate the long-term risk of flood damage to the built environment and real property. The program's main goal is to reduce repetitive losses to the National Flood Insurance Program. The FMAP is available to eligible communities every year, not just after a Presidentially declared disaster. Funds for the FMAP are provided by FEMA and the Division of Emergency Management administers the program in each state.

**Public Assistance Program (PA)**
The Public Assistance provides federal aid to communities to help save lives and property in the immediate aftermath of a disaster and to help rebuild damaged facilities. Grants cover eligible costs associated with the repair, replacement, and restoration of facilities owned by state or local governments and nonprofit organizations. The Public Assistance program is administered by FEMA.

**Small Business Administration Disaster Assistance Program**
This program provides loans to businesses affected by Presidentially declared disasters. The program provides direct loans to businesses to repair or replace uninsured disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible. Nonprofit organizations are also eligible. The SBA administers the Disaster Assistance Program.

**Community Development Block Grants (CDBG)**
The CDBG program provides grants to entitlement communities (metropolitan cities and urban counties) for post disaster hazard mitigation and recovery following a presidential declaration of a Major Disaster of Emergency. Funds can be used for activities such as acquisition, rehabilitation or reconstruction of damaged properties and facilities and redevelopment of disaster-affected areas. Funds may also be used for emergency response activities, such as debris clearance and demolition and extraordinary increases in the level of necessary public services. HUD provides funds for the CDBG and the Division of Community Assistance administers the program in each state.

**Table 15. Community Capabilities Assessment**

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| *1. Preventive – keep flood problems from getting worse. They are usually administered by building, zoning, planning, and/or code enforcement offices.* | | | | |
| *Planning and zoning* | *To be determined* | *Low* | *Low* | *Low because the regulations do not focus specifically on hazard mitigation effort* |
| *Open space preservation* | *N/A* | *Low* | *High* | *Low because open space in Duck will not necessarily lead to a more hazard-resilient environment* |
| *Floodplain regulations* | *Adopted October 6, 1978* | *High* | *Low* | *High because the ordinance requires new construction to be built at or above BFE* |
| *Stormwater management* | *NCGS 143-214.7(c)* | *High* | *Medium* | *High because the regulations require new developments to provide for stormwater* |
| | | | | |
| *2. Property Protection – usually undertaken by property owners on a building-by-building or parcel basis.* | | | | |
| *Building elevation* | *Adopted October 6, 1978* | *High* | *Low* | *High because the ordinance requires new construction to be built at or above BFE* |
| *Insurance* | *Adopted October 6, 1978* | *High* | *Low* | *High because well-insured structures can be reconstructed* |

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| *3. Natural Resource Protection – preserve or restore natural areas or the natural functions of floodplain and watershed areas.* | | | | |
| *Wetlands protection* | *Section 404, Clean Water Act of 1972* | *High* | *Low* | *High because wetlands provide a natural function of the floodplain* |
| *Erosion and sediment control* | *Sedimentation Pollution Control Act* | *High* | *Low* | *High because this measure provides for the retention of surface runoff* |
| *Coastal barrier protection* | *Coastal Area Management Act* | *High* | *Low* | *High because measures protect against erosion* |
| | | | | |
| *4. Structural Projects – keep flood waters away from an area with a levee, reservoir, or other flood control measure* | | | | |
| *Storm swales* | *N/A* | *High* | *Low* | *Low because the current storm swales do not effectively mitigate flooding problems* |
| *Storm sewer* | *N/A* | *High* | *Medium* | *Medium because although water is channeled and diverted from property, drainage problems still arise* |
| *Bulkheads* | *N/A* | *High* | *Low* | *High because bulkheads protect the shoreline from erosion* |
| *Beach nourishment* | *N/A* | *High* | *High* | *High because such measures can protect beachfront homes from erosion for a limited time* |
| | | | | |

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| *5. Public Information Activities – advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains.* | | | | |
| *Library* | *N/A* | *Low* | *Low* | *Low because people do not take advantage of the library* |
| *Outreach projects* | *N/A* | *Low* | *Low* | *Low because people often ignore outreach material* |
| *Map information* | *F.I.R.M.s* | *High* | *Low* | *High because the FIRMs are used before floodplain property is developed* |
| *Technical assistance* | *N/A* | *High* | *Low* | *High because there is a number of local, state, and federal agencies* |
| *Web page* | *N/A* | *Medium* | *Low* | *Medium because although the web page reaches many citizens, some citizens do not have access* |
| *Dune and beach maintenance* | *N/A* | *Medium* | *Low* | *High because such measures can protect beachfront homes from erosion for a limited time* |
| *Wind loads* | *NC State Building Code Volume 1* | *Medium* | *Low* | *Medium because a properly constructed building will be able to withstand hurricane force winds up to the design limits* |
| *Erosion* | *N/A* | *Medium* | *Low* | *Medium because public information about the process erosion can help protect waterfront property* |

ANNEX 3

RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF DUCK, NORTH CAROLINA, REQUESTING ACTION BY THE DARE COUNTY BOARD OF COMMISSIONERS TO MERGE THE HAZARD MITIGATION PLAN FOR THE TOWN OF DUCK WITH THE DARE COUNTY HAZARD MITIGATION PLAN

Resolution #09-07

WHEREAS, on October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 to reinforce the importance of pre-disaster mitigation planning to help reduce disaster losses; and

WHEREAS, North Carolina Senate Bill 300 requires all local governments to have an approved Hazard Mitigation Plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004); and

WHEREAS, the Town of Duck Hazard Mitigation Plan (Plan) was approved on August 4, 2004 by the Duck Town Council and subsequently approved by the Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management (NCEM); and

WHEREAS, the Town of Duck is currently in the process of updating the Town of Duck Hazard Mitigation Plan as required every five (5) years by FEMA and NCEM; and,

WHEREAS, the Town of Duck, in accordance with guidance provided by FEMA, NCEM, and the County of Dare, now desires to merge said Plan with the County of Dare as part of their Hazard Mitigation Plan update which is currently in process.

NOW, THEREFORE, BE IT RESOLVED on this 5th day of August 2009 that the Town Council for the Town of Duck hereby requests that the Dare County Board of Commissioners incorporate the Town of Duck Hazard Mitigation Plan as part of a Multi-Jurisdictional Hazard Mitigation Plan Update for Dare County.

Adopted this 5th day of August 2009.

Mayor

ATTEST:

Town Clerk

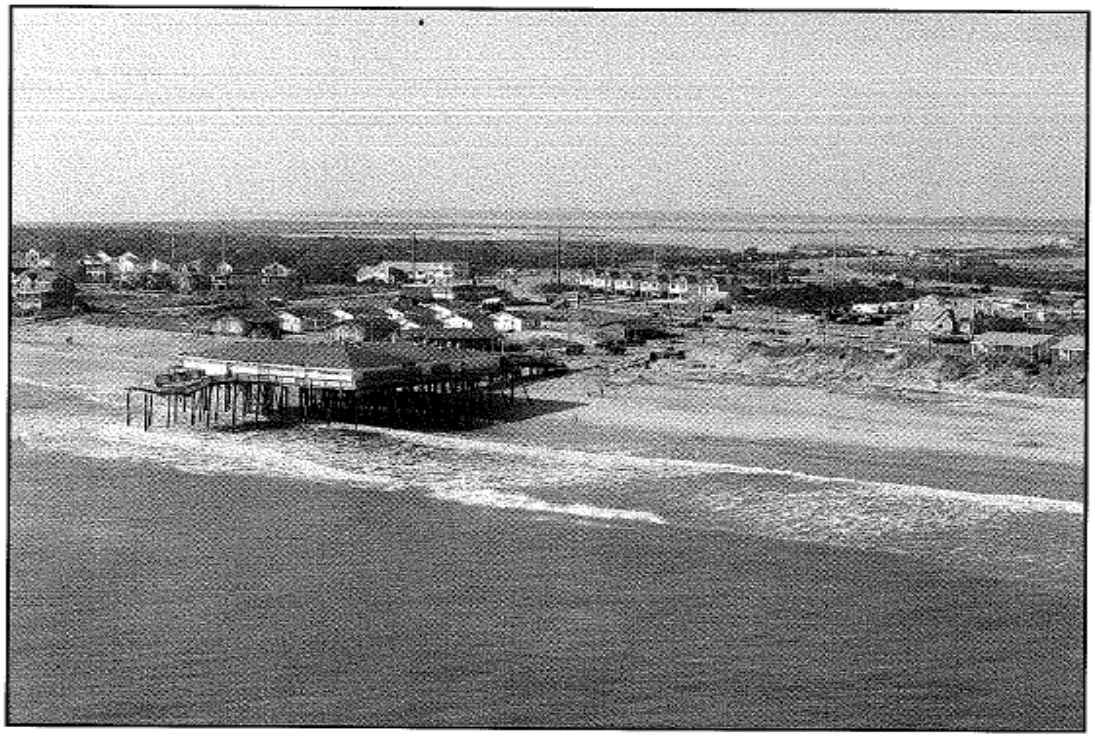
TOWN of DUCK NORTH CAROLINA

**Appendix I**

The Town of Nags Head, North Carolina

# Hazard Mitigation Plan

(Disaster Mitigation Act of 2000 and Senate Bill 300)



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## INTRODUCTION

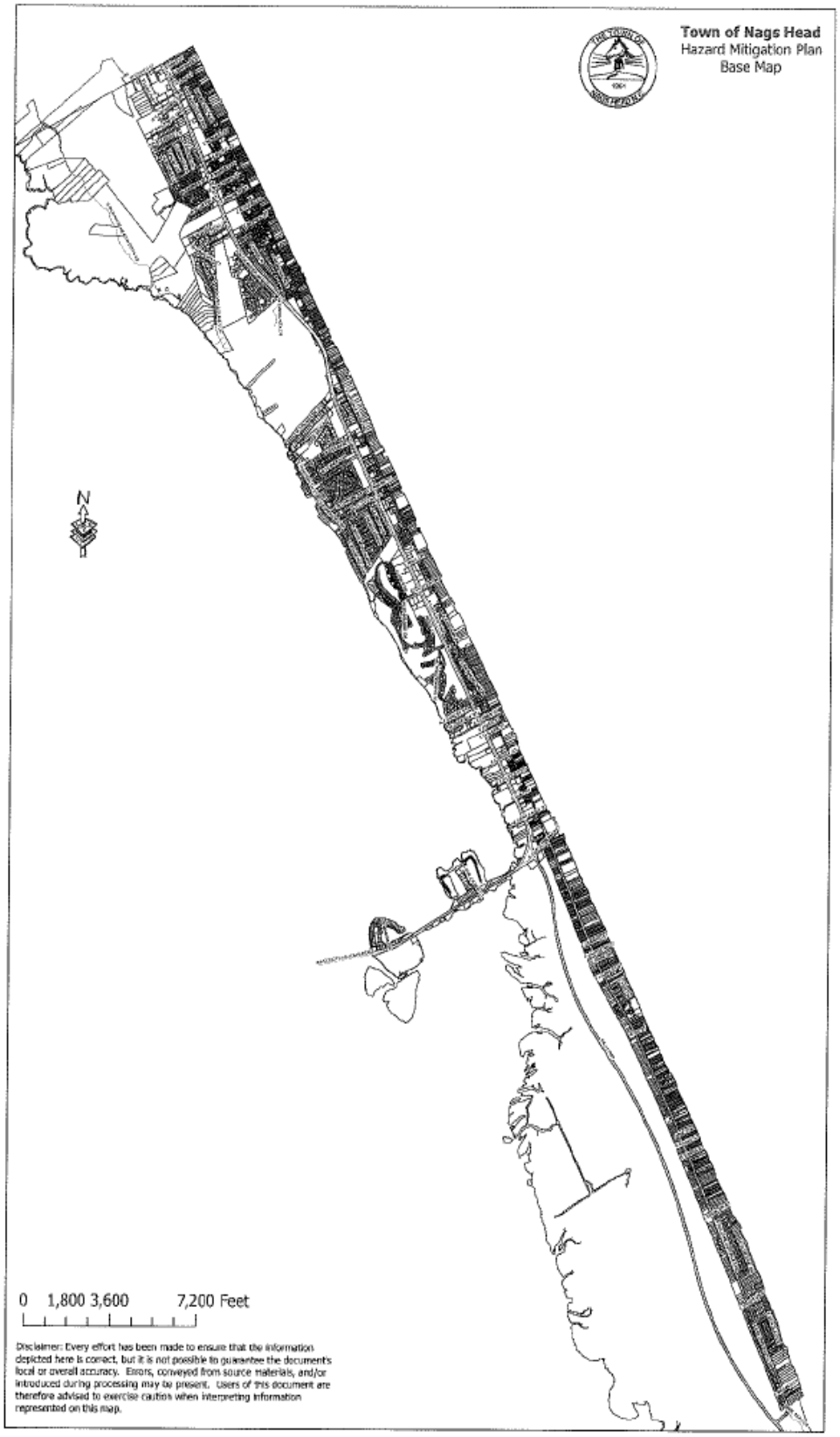
### A. Overview and Problem Statement

The Town of Nags Head is a unique and attractive resort community on the Outer Banks of North Carolina. A number of characteristics make it an attractive place to live or vacation. Among them are its proximity to water and beaches, its abundance of open spaces, its generally low density of development, and the overall quality of its natural environment. Nags Head is primarily an ocean and sound oriented community. The Town is fortunate to have significant natural resources, including the ocean and its beaches, the sound, a complex natural area called Nags Head Woods (consisting of stable, productive marshlands, fresh water ponds, and steep migrating and stabilized dunes), and unique geological features like Jockey's Ridge. Nags Head is a recreational wonderland, closely tied to its natural environment.

Nags Head, from its early beginnings in the 1800s, has consisted predominantly of single-family cottages and a few hotels. Family operated businesses and cottage courts made up the commercial sector of Nags Head. These factors contributed to a certain charm, and a slow and relaxed pace of life. The Town has been and still is an annual vacation spot for a countless number of families who make repeat visits from thief hometowns. For many visitors and residents, Nags Head is a "family beach."

Nags Head has been slow to develop when compared to other resort and vacation areas along the east coast, e.g., Myrtle Beach, South Carolina; Ocean City, Maryland. This slow growth has partly been a result of the remoteness of the Town. However, like all of the Dare County beach communities, Nags Head, especially since the mid-to-late 1980s, has experienced tremendous growth and development. As an indication, the permanent population increased 80 percent from 1980 to 1990 and nearly 50 percent from 1990 to 2000. The most significant growth pressures in the Town are, and will continue to be, generated by seasonal resort development. The task the Town is now facing is how to balance the needs of residents, visitors, and the tourist industry, and not destroy those natural and cultural features that have made Nags Head an attractive place to live and visit. The Town currently has close to 3,800 single-family dwelling units. Of that number 12 percent were built before the advent of modern storm resistant building codes.

Because Nags Head's proximity to the ocean and sound and the continued development growth along the Outer Banks, the potential for damage to life and property is increasing in Nags Head; especially resulting from storm induced flooding and wind damage. Through mitigation planning efforts and practical experience, the Town of Nags Head is continually increasing its awareness of the threats these hazards pose and the means to reduce their impacts. Nags Head has been successful in implementing many of the mitigation strategies identified herein, and has developed in this document a method of prioritizing their future implementation. The Town of Nags Head remains committed to policies and operational procedures that will mitigate the impacts of natural and human induced hazards before and after events occur.


Town of Nags Head
Hazard Mitigation Plan
Base Map
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Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.

## B. Purpose of the Plan

The purpose of this Hazard Mitigation Plan is two fold; one is to comply with North Carolina Senate Bill 300, Disaster Mitigation Act of 2000 and the second purpose is to permit Town officials to make the most deliberate and informed decisions about future growth and hurricane hazard preparation and response. The plan attempts to comprehensively analyze the likely impacts of flooding, hurricanes and other disaster events and to identify Town goals with respect to these impacts. Another purpose of this Plan is to address the indentified goals and develop the needed actions to manage our responses consistent with these goals. This Plan will be used and referenced in future land or water use decision making, and in particular by several key sets of local actors: the Board of Commissioners, Planning Board, Board of Adjustments, and the Town's various departments.

While the following plan represents the codification of Town policies at one point in time, this Hazard Mitigation Plan is dynamic and evolutionary. Numerous land and water use decisions are made each month and will serve as an overall framework for guiding future decisions by the Town. The Town will review this Plan on an annual basis.

## C. The Planning Process

The Planning process for the Nags Head Hazard Mitigation Plan included the formulation and involvement of a Hazard Mitigation Planning Committee, a series of public meetings, opportunities for public review and comment, and input from relevant local, regional and state agencies.

1. Planning Committee

The Hazard Mitigation Planning Committee was established by the elected Board of Commissioners on August 6, 2003 and is composed of the following Staff positions:

- Chief Building Inspector
- Public Safety Director
- Environmental Protection / Public Health Coordinator
- Public Works Director
- Town Manager's Executive Assistant
- Town Engineer
- Planner

Additionally, the Assistant Fire Chief, Fire Marshal, and Planning Director attended committee meetings and provided input during the process.

For the most part, this committee includes Town Staff that have been involved in previous mitigation planning exercises, including the draft of the 2002 Hazard Mitigation Plan (Senate Bill 300) and the CRS floodplain management plan. The Planning Committee met in September of 2009 to discuss various components of the plan. Minutes from the committee meeting are included in Appendix A.

2. Public Meetings and Input

Opportunities were provided for neighboring communities, agencies, businesses, academia, non-profits, and other interested parties to be involved in the planning process. Although an indirect form of input for this plan, the community forums held directly after Hurricane Isabel (10/2003) provided a wealth of public, staff, and elected official input regarding the Town's storm related recovery and operational procedures. Additionally, a public meeting to present and receive comments on the draft plan was held on September 30, 2009. In attendance were

roughly 9 citizens and staff persons. To advertise the meeting and receive comments on the draft plan, a notice was published in a local newspaper (the Coastland Times), on the Town website, and on the bulletin board in Town Hall. The draft plan was available for review on the website, and at the Town Hall. Additionally, a plan availability notice was sent via email to staff from Dare County and local municipalities. A copy of the meeting minutes, the meeting advertisements, and a summary of additional comments are included in Appendix A.

Several responses were received on the draft plan at the September 30, 2009 public meeting. These comments were incorporated into the draft plan and the final public meeting will be held when the plan is approved by FEMA. Notices for the draft plan were published in local newspapers, on the Town website, and on the bulletin board in Town Hall. Notices were sent via email to emergency management personnel from Dare County and local municipalities requesting comments and input. A copy of the meeting minutes, the meeting advertisements, and a summary of additional comments are included in Appendix A.

3. Documentation and Analysis

Staff from the Planning and Development Department, were responsible for coordinating committee meetings, compiling committee and public comments, formulating the analyses included and discussed herein, and drafting the document text and mapping. Much of the information used in to create this document was derived from the 2002 Hazard Mitigation Plan which was previously adopted to meet the requirements of North Carolina Senate Bill 300. Generally, the planning process included the following steps:

1. Identification of relevant local hazards
2. Assessment of vulnerability; potential for damage to life, property and critical facilities
3. Assessment of Nags Head's capability to mitigate or respond to hazard induced impacts
4. Formulation of interim conclusions
5. Establishment values and goals; balancing economic prosperity with the need to protect life and property
6. Formulate of mitigation strategies and policies
7. Preparation of the final plan
8. Assignment implementation responsibilities
9. Establishment of procedures for monitoring, evaluation, and reporting progress
10. Establishment of procedures for revisions and updates
11. Adoption of plan

## II. HAZARD IDENTIFICATION

Nags Head is positioned as a barrier island community along the mid-Atlantic coast of the United States located between the Atlantic Ocean and the Roanoke Sound. Hurricanes and tropical storms generated in the Atlantic and Gulf of Mexico continually threaten the Outer Banks of North Carolina. Low pressure systems moving from west to east across the United States commonly move offshore into the Atlantic and intensify, creating coastal storms or 'Nor'easters' which produce high winds, wave action and flooding along the eastern seaboard. Hurricanes, tropical storms and coastal storms represent the primary hazards that threaten life and property within Nags Head. These events occur more frequently than any other hazard and historically have presented the greatest potential for damage.

Sources of flooding can come from three events: (1) ocean wave action, storm surge and overwash, (2) soundside (estuarine) wave action, storm surge and overwash, and (3) severe rainfall events that can accompany a hurricane or

storm. These events create unique concerns in each area of the Town and may require a multitude of preparation actions. While the following discussion focuses on hurricanes, extra-tropical storms, and northeasters; the Town does on rare occasion experience winter ice and snowstorms, waterspouts, and less frequently; tornadoes and wildland, brush, and forest fires. Other hazards discussed include terrorist threats, chemical spills, drought, and erosion. A very slight possibility exists that Nags Head could experience indirect impacts from volcanic activity, earthquakes, and tsunamis. These are discussed briefly but have not been included in the profile discussion.

A hazard profile exercise was performed to prioritize hazard threats based on their degree of impact and probability of occurrence. Three qualitative ranking categories were used to describe and prioritize each hazard; frequency of occurrence, severity level, and magnitude/distribution. A more detailed description of each ranking category is included below. Historic occurrence information was used to support the development of the profile, when available. When historic data on hazards could not be found, hazards were profiled using anecdotal evidence provided by Town Staff that was present at the time events occurred. Several hazards were included for discussion purposes although there was no history of occurrence at the time this document was written. The matrix shown below includes the results of the hazard profile exercise.

**Hazard Profile Matrix – Ranking Category Descriptions**

The identified hazards were profiled according to the following three categories:

Frequency of Occurrence

- Highly – Near 100% probability in the next year.
- Likely – Between 10 and 100% probability in the next year, or at least one chance in the next 10 years.
- Possible – Between 1 an 10% probability in the next year, or at least one chance in then next 100 years.
- Unlikely – Less than 1% probability in the next year, or less than one chance in the next 100 years.

Magnitude/Distribution

- Mild
- Moderate
- Severe

Severity Level

- Catastrophic – Multiple deaths, complete shutdown of facilities for 30 days or more
- Critical – Multiple severe injuries, complete shutdown of critical facilities for at least two weeks.
- Limited – Some injuries, complete shutdown of critical facilities for more than one week, more than 10% of property is severely damaged.
- Negligible – Minor injuries, minimal quality of life impact, shutdown of critical facilities and services for 24 hours or less, less than 10% of property is severely damaged.

**Table 1. Hazard Profile Matrix**

| ***Hazard*** | **Frequency of Occurrence** | **Severity Level** | **Magnitude / Distribution** | **Comment** |
|---|---|---|---|---|
| *Hurricanes/Tropical Storms* | *Likely* | *Limited to Critical* | *Moderate* | Negligible injuries due to predictability of storm; negligible to catastrophic property damage depending on intensity and duration of storm |
| *Nor'easters* | *Highly* | *Negligible to Critical* | *Mild to Severe* | Similar to hurricanes; depends on intensity and duration of storm |
| *Flood* | *Likely* | *Limited to Critical* | *Moderate* | Can result from coastal storms or intense rainfall events; depends on intensity and duration of storm |
| *Coastal Erosion* | *Highly* | *Negligible* | *Mild to Moderate* | This is normal erosion (not erosion impacts from severe storms); normal erosion occurs every year but impacts are gradual and predictable |
| *Tornadoes/ Straight Line Winds/ Water Spouts* | *Likely* | *Limited* | *Moderate* | These hazards have occurred during hurricanes or thunderstorms but little documentation exists to analyze frequency or impacts |
| *Terrorism* | Possible | Catastrophic | Severe | Nags Head is less than 75 miles from a primary terrorist target (Port of Hampton Roads and NOB – Norfolk); main threat would be chemical or biological attack spread by blowing winds; no history to base an accurate analysis. |
| *Ice Storms* | *Possible* | *Negligible to Limited* | *Mild - Moderate* | Last ice storm in 1996 with limited impacts |
| *Chemical Spills* | *Likely* | *Limited* | *Mild to Moderate* | These could include propane tanks rupturing, gasoline and fuel oil spills, and hazardous chemicals stored in flood prone areas |
| *Wildland. Brush and Forest Fires* | *Possible* | *Negligible* | *Moderate* | Homes are isolated from areas of heavy brush / Homes are accessible to firefighting equipment; some areas of woods are not |
| *Protection of Water Supply* | *Possible* | *Negligible* | *Mild* | Drought can affect contaminant levels; other water sources could mitigate impacts |
| *Package Treatment Plants* | *Possible* | *Negligible to Limited* | *Mild* | Possible impacts to environment from facility shutdown |

## A. Hurricanes and Tropical Storms

Hurricanes and tropical storms are formed from tropical low-pressure systems that intensify and produce high winds, waves, rain, and flooding. Typically they have a well defined center of circulation and counterclockwise winds in the northern hemisphere. These low pressure systems become tropical storms when their sustained winds reach 39 mph. They become hurricanes when their sustained winds reach 74 mph. Hurricanes and severe Tropical storms represent serious threats to life and property on the North Carolina coast. North Carolina is second only to Florida in the number of hurricanes striking its mainland. According to the National Hurricane Center, between 1900 and the present North Carolina experienced 28 hurricanes or an average of approximately one hurricane every four years.

Collective response to hurricanes and severe storms can be conceptualized in terms of four primary phases: (1) pre-storm mitigation, (2) warning and preparedness, (3) response, and (4) recovery and reconstruction. This Plan addresses all of the above.

There have been a number of storms since 1950 that have affected North Carolina, Dare County and Nags Head. Recent notable hurricanes have included Gloria, 1985; Charlie, 1986; Bob, 1991; Emily, 1993; Arthur and Fran, 1996; Bonnie, 1998; Dennis and Floyd, 1999; Isabel in 2003, and Ophelia in 2005. Many of the above named storms resulted in both wind and flood damage. Floyd and Dennis on the other hand resulted in flood damage and very little wind damage. While there have been other storms that have affected the area, the above are the most noteworthy.

Hurricanes can create a storm surge not only in the Atlantic Ocean but also in estuarine waters causing flooding along the sound shoreline. Much of land along the estuarine shoreline is low in elevation and can and does flood frequently. In reviewing several recent storms and other rain events, the Town has identified the following areas a particularly troublesome. Additional Town resources (men and equipment) are needed and allocated to these areas before, during, and after a storm event.

Areas that are frequently inundated by storm water during recent hurricanes include the southern part of South Nags Head, the South Nags Head drainage ditch, the area around the Outer Banks Pier, Juncos Street, and just north of MP 18 – in the vicinity of Tides Drive. Two areas on the Nags Head/Manteo Causeway (South Virginia Dare Trail/US RT 64/264) which have a history of flood waters over the road include the area in the vicinity of the estuarine accesses site and near the east bound and west bound approaches of the “Little Bridge”. Homes on Pond Island frequently flood due to their low elevation and their proximity to estuarine waters, which increases potential for wave action. The area around Lakeside Street near the Roanoke Sound also frequently floods, especially during storms which travel inland and up the coast. Other troublesome areas include the estuarine area o n the north and west side of Whalebone Junction including Sugar Creek Restaurant, Gray Eagle Street, and the Windmill Point Restaurant. The western portion of Danube Street the sound access at the intersection of Hesperides Drive floods during severe storms and hurricanes from sound overwash. An area that typically floods and where floodwaters can remain over an extended period of time is Soundside Road. Floodwaters have been observed covering about half of the road distance from Roanoke Sound to US 158. At times, the entire western portion of the road, which runs along the estuarine shoreline, cane be under water.

Along NC 12 (the Beach Road) areas that frequently flood most are Forrest Street, the Old Post Office site, Kitty Hawk Kites/Sports (Casino Outfall) Ocean Rescue Station at Jockey’s Ridge, Small Street, and in the vicinity of Wrightsville Avenue from Admiral Street to Driftwood Street. The eastern portions of the Municipal Complex site have flooded in the past with up to 18 inches of ocean water overwash surrounding the “Board Room.”

It was noted that in the past the “flapper Valve” on at least one of the five ocean outfalls failed to close and thus seawater flowed into the drainage system. These ocean outfalls are installed and maintained by NCDOT to convey and distribute stormwater collected in the swales of DOT maintained roads. The Town has continually requested that NCDOT perform maintenance on these valves to prevent this from happening in the future.

## B. Nor’easters and Extra-tropical storms

In addition to hurricanes, Nags Head is subject to extra-tropical storms and nor'easters. Low pressure systems moving across the United States often strengthen once offshore, creating intense winds and rainfall and the potential for flooding. This strengthening occurs more often in wintertime when there is a temperature gradient between air over a cold landmass and the warm waters of the Gulf Stream. Perhaps the most notable event of this type was the Ash Wednesday Storm in March 1962. This storm, while not a hurricane, caused millions of dollars in damage not only to Nags Head but too much of the eastern seaboard. Another notable storm was and extra-tropical storm, the "storm of century", which occurred in March 1993. This storm originated in Florida, traveled inland through North Carolina, and produced a storm surge that flooded estuarine areas of the Town with up to eight feet of water. Very little wind damage was associated with this storm. These storms can also often cause substantial beach erosion and oceanfront property damage.

### C. Rain/Storm water – Areas of Frequent Flooding

In addition to the storm events previously mentioned, less intense rainfall events have caused flooding in several areas of the Town. Indentified areas include:

- The northern portion of Vista Colony subdivision
- A small section in North Ridge on Lookout Road and Cutty Sark Lane.
- The western half of Deering Street in Southridge
- The southeast corner of the Nags Head Acres subdivision
- The area between Driftwood Street and Bonnett Street and along Wrightsville Avenue
- Subdivision including Old Nags Head Place, Dolphin Run, and Seven Sisters
- Several locations along NC 12 and NC 1243. These two roads have seen an increase in flooding in the last few years due to development growth and the increasing practice of filling of residential lots, which tends to displace water onto Town roadways during storm events.

### D. Coastal Erosion

Coastal erosion is a common occurrence on the Nags Head beaches. According to the Coastal Area Management Authority, Nags Head beaches are eroding, or losing sand, at a rate of between two feet and seven feet per year. This erosion rate can vary from year to year; the rate is based on the historic average measured sand loss in any given area. Erosion can occur suddenly during coastal storms or gradually due to the normal forces of waves, winds, and tides (CAMA, 12/2001). Erosion has a direct effect on the vulnerability of properties to flooding and storm surge. Loss of the beach profile and dunes reduces the barrier between properties and the ocean. Additionally, the westward migration of the beach and dunes affects the ability to redevelop property. Homes that are damaged from severe storms are often not repairable due to state regulations that control oceanfront development and the allowable setbacks between the dune line and oceanfront structures. Nags Head experienced a considerable amount of erosion from Hurricane Isabel. Several portions of town were left with little to no dune line and other areas saw escarpments cut into the existing dunes. The vulnerability to storm surge, ocean overwash, and flooding increases exponentially with each severe storm as the dune barrier is further reduced.

### E. Tornadoes, Straight Line Winds, and Waterspouts

Tornadoes and waterspouts are rare events but they have and do occur. These events typically produce wind and debris damage. A tornado is defined by the National Weather Service as a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. Typically this is characterized by a condensation funnel or a debris cloud. A waterspout is generally a tornado over water. These are often weaker than land-based tornadoes.

The waterspouts that come ashore from either the Roanoke Sound or the Atlantic Ocean are generally less severe than tornadoes. Tornadoes and waterspouts are usually associated with storm fronts that pass through the area however they can also be generated by hurricanes. A tornado passed over South Nags Head in 2000 causing minimal damage. Straight line winds are very strong winds that produce damage that shows a lack of a rotational damage pattern. Straight line winds are common with the gust front of a thunderstorm or originate with a downburst from a thunderstorm. The roof of a home on the west side of US 158 in Nags Head Cove was damaged from a storm related downburst in 2003.

**F. Ice Storms**

The last ice storm the Town experienced was in 1996. This storm produced minimal damage. A severe winter storm occurred in 2003 with eight + inches of snow accumulation in the Town and ice on roadways for several days. The majority of damage was limited to frozen pipes. However, there was one residential structure fire where a residence was totally destroyed that was directly related to this winter storm.

**G. Terrorism**

Although Nags Head is not a primary terrorist target, the Town is less than 75 miles from the Port of Hampton Roads and the military facilities of that area. There are many forms of terrorist threats. Wind blowing chemical or biological agents would likely represent the minimal potential terrorist threats in Nags Head; however, no history of this activity is available to base an accurate analysis. The Town has initiated and implemented terrorist protection measures at our water production facility.

**H. Chemical Spills and Environmental Contamination**

Potential chemical hazards include propane tanks rupturing, gasoline and fuel oil spills, and hazardous chemicals stored in flood prone areas. A portion of the Town's drinking water supply comes from a surface water body (the Fresh Pond). While a portion of the Fresh Pond is fenced, contamination of this potable water source is a possibility. No development is allowed within 500 feet of the Fresh Pond and only limited development can occur within 1,200 feet.

**I. Wildland, Brush, and Forest Fires**

Wildland fires are any non-structure fires, other than prescribed fires, that occur in a wildland or area where development is virtually nn-existent.

Nags Head contains a 1,000-acre maritime forest which can be considered a wildland area. This forest is comprised of typical coastal species of grasses and trees. The Town and the Nature Conservancy own approximately 73 percent of the land in Nags Head Woods. Within the woods there is an extensive system of hiking trails as well as one gravel road that transverses the forest. A major electrical transmission line also runs through a portion of the woods. There is probability of fire starting within the woods by electrical storms, careless hikers, or downed electrical transmission lines. Also, residential areas in South Nags Head west of SR1243 from Gulfstream Street to the southern Town limits are susceptible to wildland interface brush fires. This is due to their proximity to the Cape Hatteras National Seashore. The National Park Service maintains a fire break along the eastern boundary of the National Seashore in South Nags Head to limit fire susceptibility.

**J. Protection of Water Supply**

The Dare County Reverse Osmosis plant, in Kill Devil Hills, and the Skyco Plant on Roanoke Island, can now meet current peak demand without the water from the town's Fresh Pond Water Treatment Plan. As of June 2009, the Fresh Pond plant has been permanently taken off-line and all permits have been rescinded. It will no longer serve as a source of drinking water for rather Nags Head or the Dare County Regional System.

**K. Sewage Treatment Plants and Septic Systems**

The Town relies primarily on on-site septic systems; however, within the Town there are several sewage treatment plants and numerous low-pressure septic systems. During recovery after a severe storm, monitoring of on-site septic systems and treatment plants is critical to ensure that environmental damage does not occur.

### L. Earthquakes, Volcanoes, and Tsunamis

Nags Head is at little risk from the effects of earthquakes, volcanoes and tsunamis.

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock in the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of caverns. Nags Head faces minimal risk of earthquakes generated impacts due to its location in the eastern part of North Carolina away from any significant seismic zones.

A volcano is a vent at the Earth's surface through which magma (molten rock) an associated gases erupt, and also the cone built effusive and explosive eruptions (USGS, 9/4/2000). No active volcanoes exist in the State of North Carolina.

A tsunami is series of waves of extremely long wave length and long period generated in a body of water by an impulsive disturbance that vertically displaces the water. There are many causes of tsunamis by the most prevalent is earthquakes. In addition, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis (NOAA, 2003). Research indicates Nags Head and coastal North Carolina is at low-risk from tsunami impacts due to the infrequency of their occurrence.

## III. VULNERABILITY ASSESSMENT

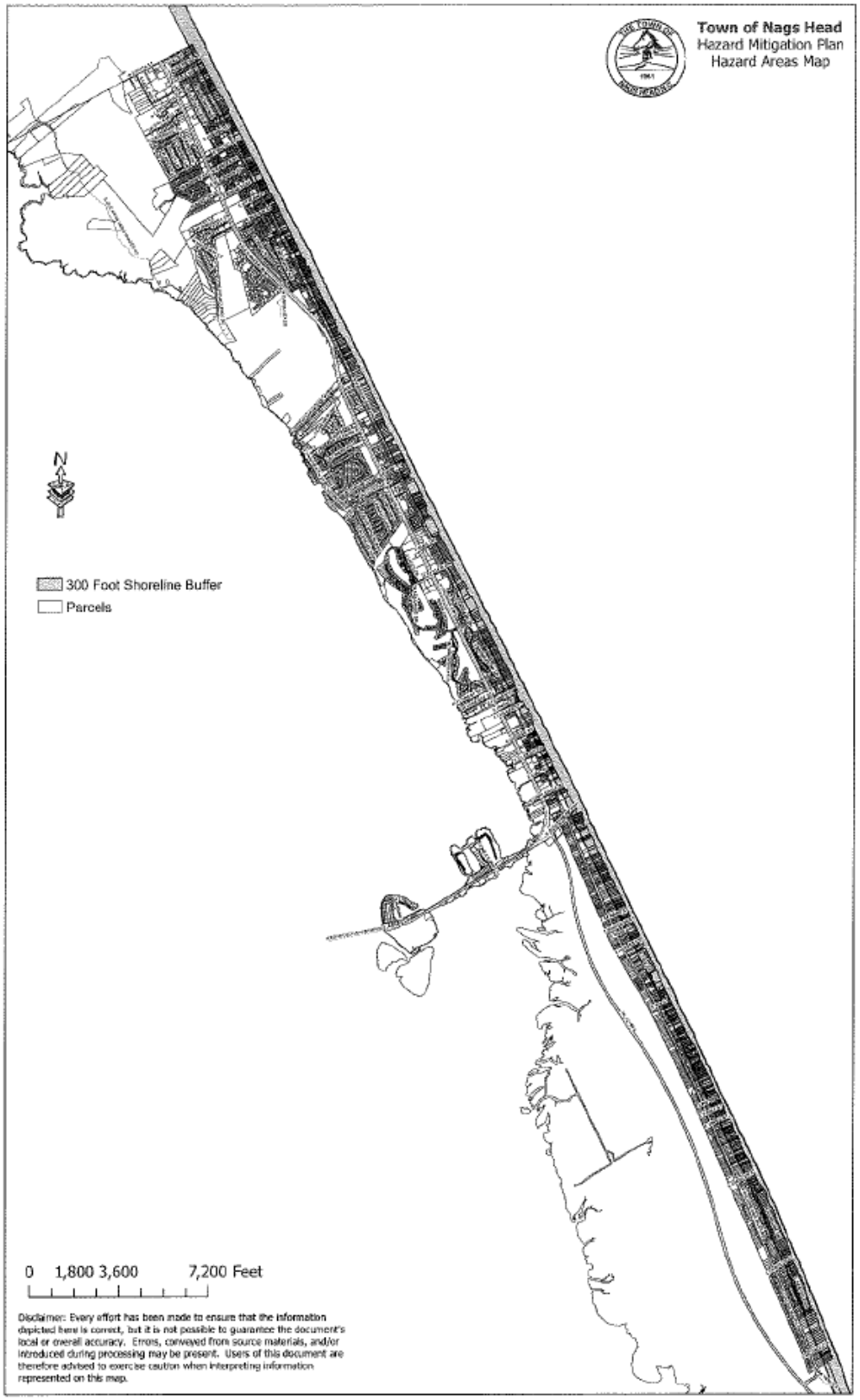
Vulnerability to hurricane and storm hazards can be assessed first by analyzing the nature and location of physical hazards, and then by estimating the extent to which people and property are exposed to these forces. The Town performed a hazard assessment analysis as part of out 2000 Land and Water Use Plan. The following is an update to that analysis. There are two approaches to delineating areas that are vulnerable to coastal storms. One uses proximity to the ocean; the other uses topography or elevation of the land above mean sea level. Because both have validity, both are explored.

### A. Identified Hazard Areas

Several maps have been included in this section to depict the high hazard areas of the Town. These areas include properties within 300 feet of the ocean, flood zones, incipient inlets, hurricane storm surge areas, and areas susceptible to brush fires. Hurricane storm surge areas were generated based on a generalized SLOSH (Sea, Lake and Overland Surges from Hurricanes) output; a model developed by the National Hurricane Center to estimate storm surge inundation areas. As a note – the following paragraphs will refer to "pre-FIRM," structures. Structures built before the Town's participation in the Flood Insurance Program are generally termed "pre-FIRM," whereas structures built after our regular participation in the Flood Insurance Program (1972) are termed post-FIRM. "Pre-FIRM" structures may not meet the minimum requirements of the National Flood Insurance Program, which includes construction of the first floor above a minimum base flood elevation.

1. 300-foot Zone

Hurricane experts have argued that experience shows that the most extensive damage from hurricanes occurs within 300 feet of the ocean. While this is more a "rule of thumb" than a scientifically established hazard zone, it nonetheless represents a useful guide for measuring the extent of property at risk and appropriate mitigation measures. Much of the oceanfront property east of South Virginia Dare Trail (NC12) and South Old Oregon Inlet Road (NC 1243) is within this 300-foot zone.


Town of Nags Head
Hazard Mitigation Plan
Hazard Areas Map
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300 Foot Shoreline Buffer
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0 1,800 3,600 7,200 Feet
Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.

2. Flood Zones (National Flood Insurance Program

This task included determining the flood zones for each property and then calculating building and property values for each flood zone.

*a. A-Zone*

An A-zone is a special flood hazard area inundated by the 100-year flood. Base flood elevations are not determined. The Town has one unnumbered A-Zone and that is the Fresh Pond. Fresh Pond is approximately 12 acres in area and is owned by the Towns of Kill Devil Hills and Nags Head.

*b. VE-Zone/Special Flood Hazard Area*

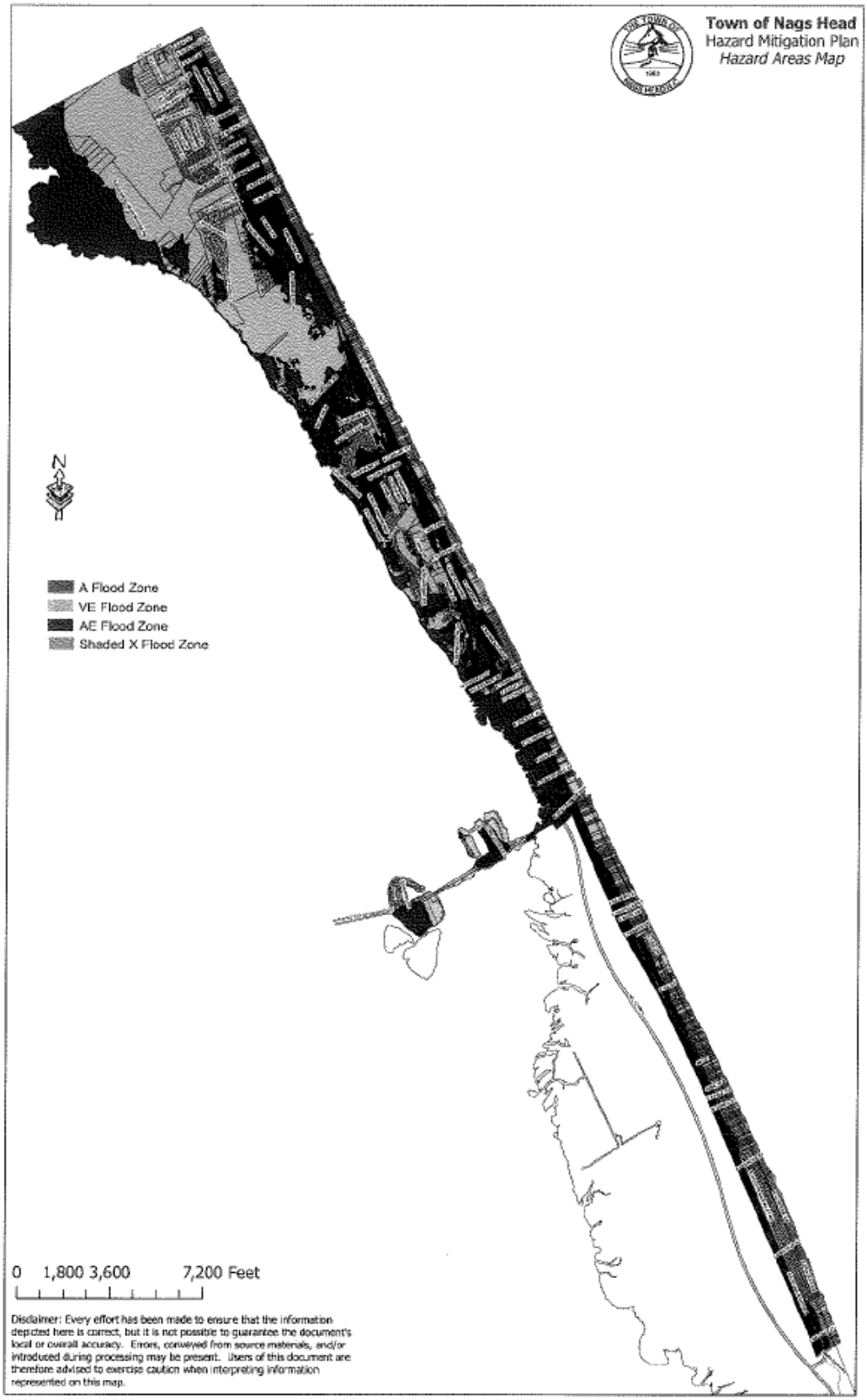
This zone delineates areas of the Town which will be subject to substantial wave action during a 100-year storm (technically, areas of the coast which could be subjected to waves three feet high). The VE-Zone constitutes a stretch of oceanfront from the southern to the northern borders of the Town.

*c. AE-Zone/100-year Flood/Special Flood Hazard Area*

This zone delineates those areas in the community, which have an annual probability of one percent of being flooded, i.e., areas, which will be inundated, by the 100-year flood. In Nags Head, these zones are located over much of the jurisdiction. Specifically, these areas include most of the land east of NC 12 and NC 1243 (although there are VE-Zones along the frontal dunes), much of the land between NC 12 and US 158, portions of land west of US 158 along the estuarine shoreline, and Cedar and Pond Islands.

*d. X-Zone/Areas of Minimal Flooding*

These re areas where flooding is unlikely and are outside the 500-year floodplain. These are areas of relatively high elevation and extend from Jockey's Ridge north and west of South Croatan Highway (US 158), to the Town's northern boundary.


Town of Nags Head
Hazard Mitigation Plan
Hazard Areas Map
N
A Flood Zone
VE Flood Zone
AE Flood Zone
Shaded X Flood Zone
0 1,800 3,600 7,200 Feet
Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.

*e. CBRA Coastal Barrier Resources Act*

The Coastal Barrier Resources Act of 1982 designated certain portions of the Gulf and East Coast as undeveloped coastal barriers. A portion of Nags Head Woods is in a CBRA zone.

3. Wind Damage

Wind damage can occur in any part of the Town and in any flood zone. Those areas that are not in a special flood hazard (AE or VE flood zones) area are more likely to receive wind and not flood damage should a major storm hit the area while structures located in a special flood hazard area are likely to receive both wind and/or flood damage.

4. Incipient Inlets

An incipient inlet is a land area that due to its unique topographical features and proximity to water bodies that an inlet connecting the ocean and sound could form in this area.

*a. Whalebone Junction Incipient Inlet*

In any major storm or hurricane, the formation of new inlets is a possibility. While the prediction of inlet formation and their precise location is highly uncertain, particular physical features can be used to identify likely sits (lynch, 1983). In an analysis or potential inlets on the North Carolina coast, the Whalebone Junction area was identified based on several factors; maximum elevation, island width, canal dimensions, and rate of erosion. Width and elevation of a barrier island appear to be the most important factors.

The potential Nags Head inlet identified by Lynch is a canal that enters the island near Whalebone Junction. Lynch calls this site "extremely hazardous," based on a composite of several of the crucial primary and secondary factors. Drawing a straight line across the island from this canal and placing a 425-foot erodible area (estimated width of area subject to erosion) on each side of this line yields the Whalebone Junction incipient inlet hazard zone.

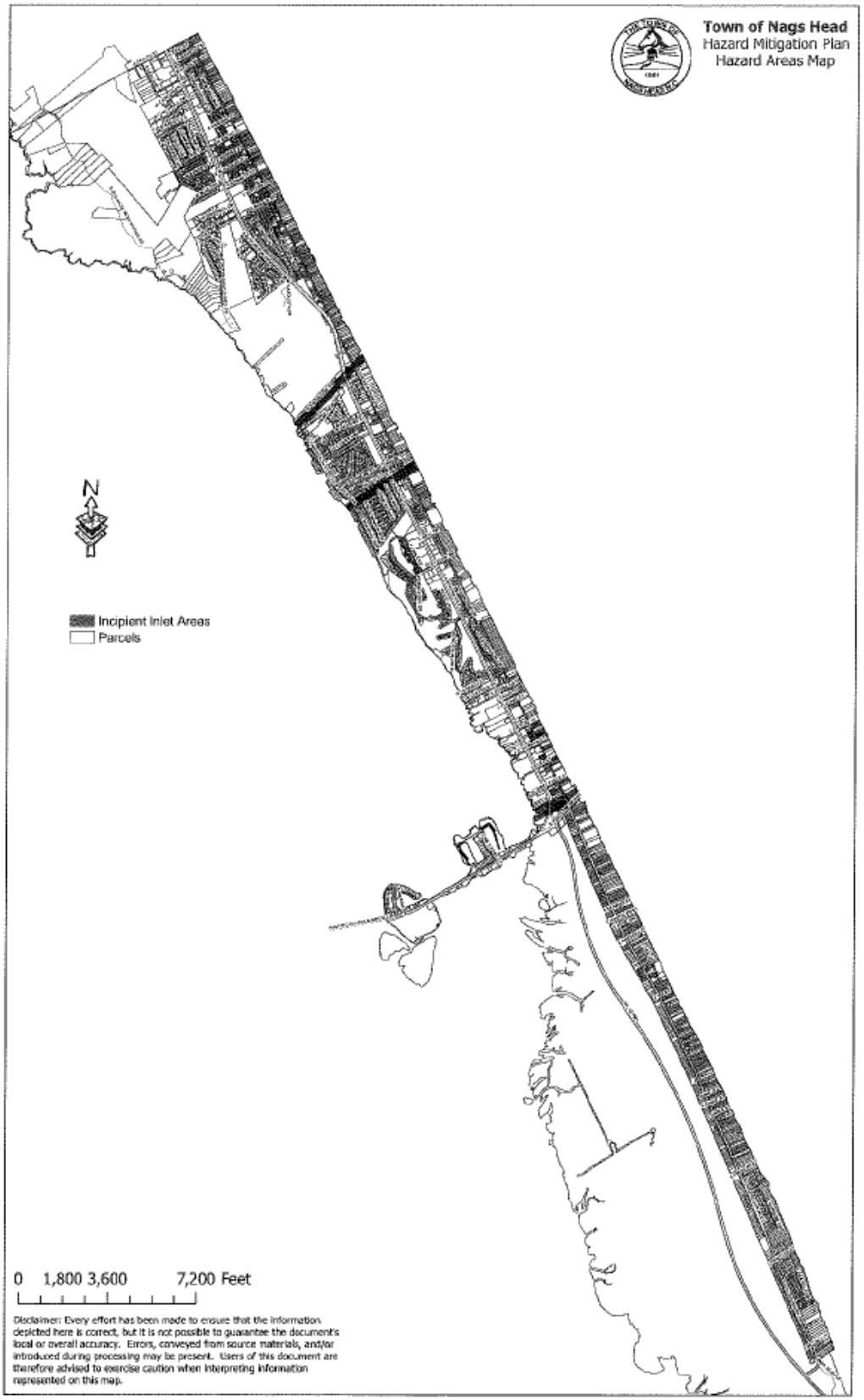
Although not identified by Lynch, local experience (see Brower, Collins, and Beatley, 1984) indicates that there are two other areas (south of Jockey's Ridge and Marlin Waterway) that should be considered for inlet formation.

*b. Marlin Waterway Incipient Inlet*

A second potential inlet has been identified along the Marlin Waterway in the Old Nags Head Cove area. Here finger canals have been excavated from the sound approximately 1,000 feet perpendicular to the shoreline. Marlin Waterway is the main west to east canal in this area. This means that storm water from the sound would have a clear funnel traversing the island more than halfway to the ocean. This represents a serious inlet threat, and unfortunately is located in the center of a large subdivision. Extending the path of the longest canal (Marlin Waterway) to the Atlantic Ocean, and placing a 325-foot erodible area (estimated width of area subject to erosion) on each side of this line, yields an identifiable hazard zone. This a crude delineation, as is the case with the other incipient inlets, and is meant only to provide decision-makers with a general idea of the geographical area of concern.

*c. South Jockey's Ridge Incipient Inlet*

A third potential inlet can be identified in the area just south of Jockey's Ridge State Park along Soundside Road. This area has been identified because of its relatively frequent flooding. Extending the path of this road and placing a 100-foot erodible area (estimated width of area subject to erosion) on each side yields an identifiable, albeit crude, hazard zone. This same area was the site of extreme flooding and damage alongside Soundside Road (formerly Jigsaw Road) in 1962.


Town of Nags Head
Hazard Mitigation Plan
Hazard Areas Map
N
Incipient Inlet Areas
Parcels
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Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.

5. Hurricane Storm Surge

Areas that would be affected by the surge of Category 1 through Category 5 hurricanes were evaluated for potential property damage in terms of building and property value. Storm surge zones were clipped based on the Town of Nags Head boundaries to calculate affected areas. Extraterritorial jurisdiction areas were not included.

*a. Category 1*

According to the generalized SLOSH output, the area of the Town within Category 1 storm surge zone is 1,550 acres.

*b. Category 3*

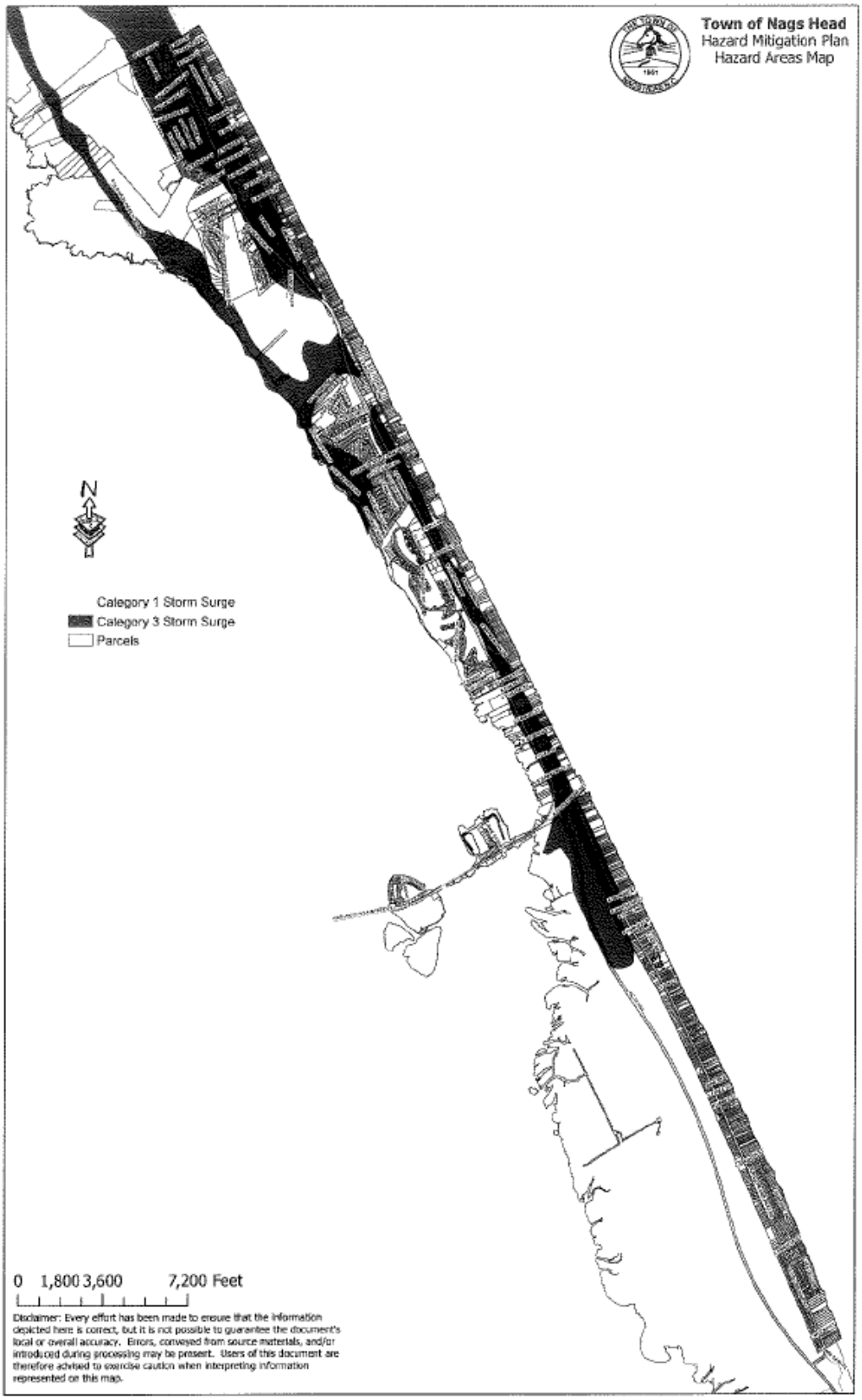
This area includes the acreage and property values for Category 1 hurricanes since these areas would also be affected by Category 3 hurricanes. According to the generalized SLOSH output, the area of the Town within Category 3 storm surge zone is 2,778 acres.

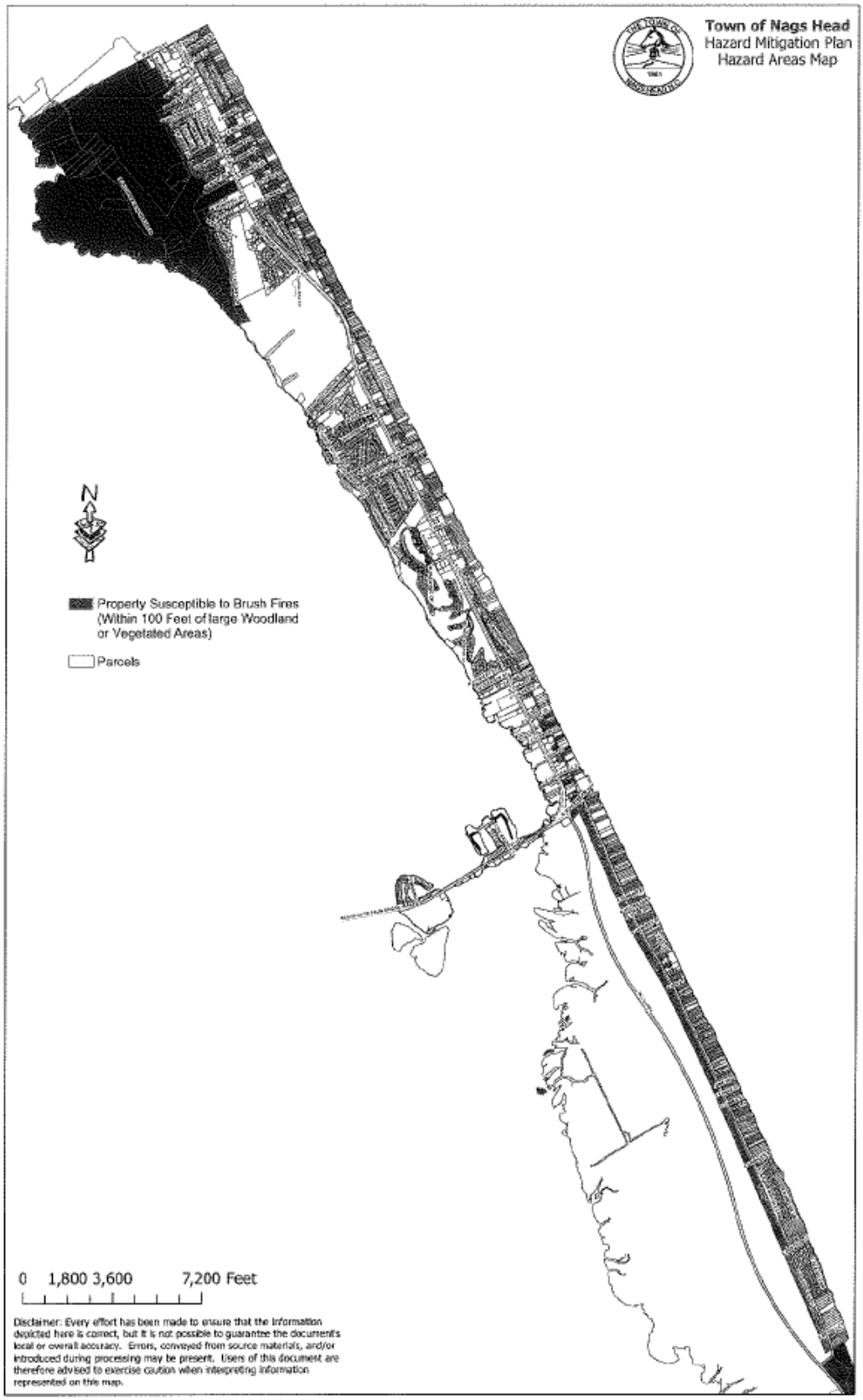
*c. Category 5*

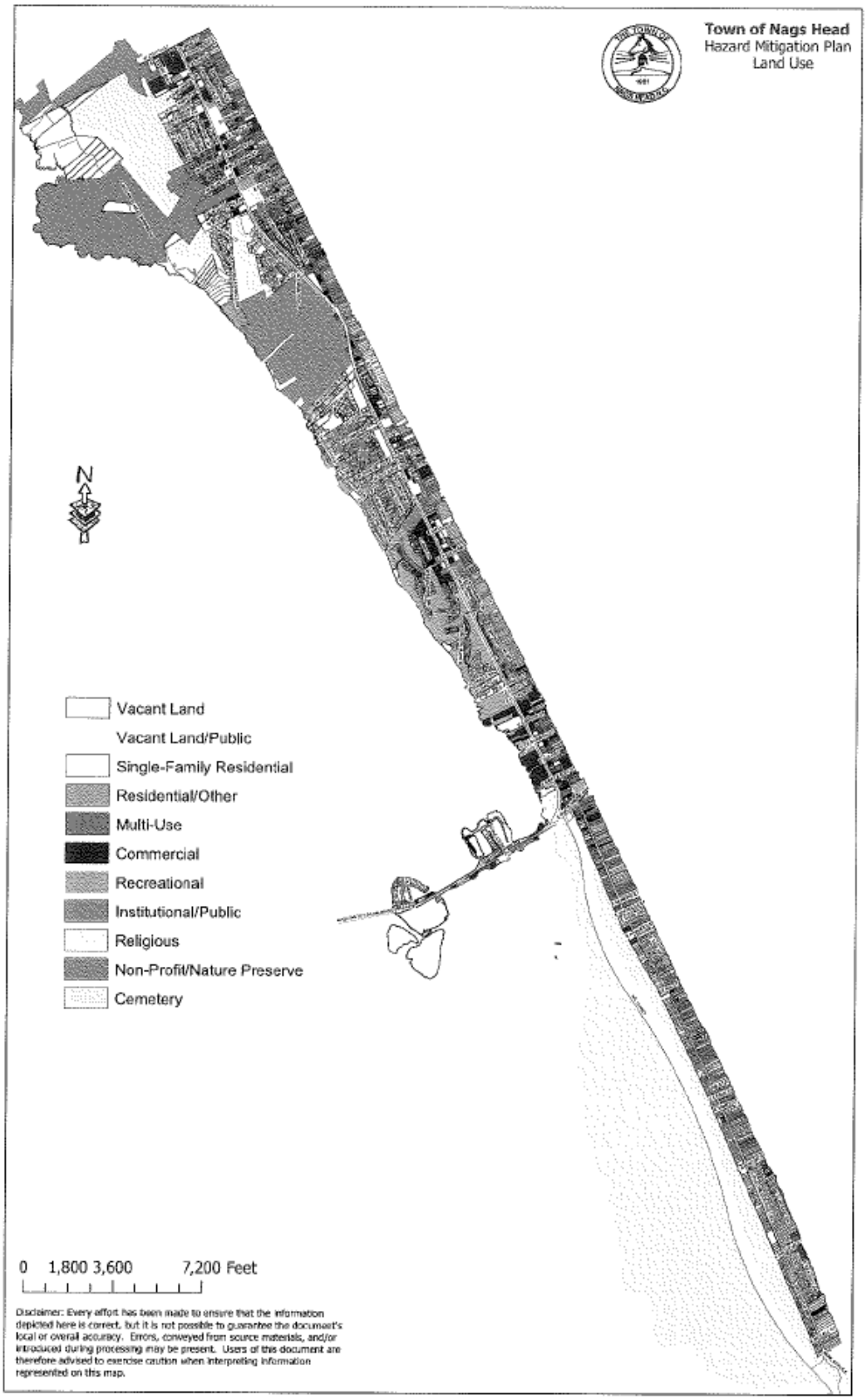
The generalized SLOSH output used in this analysis did not detail Category 5 storm surge areas.

6. Brush Fires

Areas that are generally more susceptible to brush fires include Nags Head Woods and properties adjacent to the Cape Hatteras National Seashore. To calculate vulnerability to brush fires, the Nags Head Public Safety Department recommended including properties within these two general areas and those adjacent properties within 100 feet of their boundaries.


Town of Nags Head
Hazard Mitigation Plan
Hazard Areas Map
N
Category 1 Storm Surge
Category 3 Storm Surge
Parcels
0 1,800 3,600 7,200 Feet
Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.


Town of Nags Head
Hazard Mitigation Plan
Hazard Areas Map
N
Property Susceptible to Brush Fires (Within 100 Feet of large Woodland or Vegetated Areas)
Parcels
0 1,800 3,600 7,200 Feet
Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.


Town of Nags Head
Hazard Mitigation Plan
Land Use
N
Vacant Land
Vacant Land/Public
Single-Family Residential
Residential/Other
Multi-Use
Commercial
Recreational
Institutional/Public
Religious
Non-Profit/Nature Preserve
Cemetery
0 1,800 3,600 7,200 Feet
Disclaimer: Every effort has been made to ensure that the information depicted here is correct, but it is not possible to guarantee the document's local or overall accuracy. Errors, conveyed from source materials, and/or introduced during processing may be present. Users of this document are therefore advised to exercise caution when interpreting information represented on this map.

## B. Repetitive Loss Properties

Repetitive loss properties are properties that have received two or more insurance flood claims in excess of $1,000.00 each that have been paid by NFIP within any ten year period. The Town has 203 repetitive loss properties, the majority of which are in the southern portion of South Nags Head. Repetitive loss properties represent another class of properties at risk due to their proximity to flood waters and localized conditions which make them more susceptible. In Nags Head, repetitive loss properties are typically vacation rental homes concentrated in the southern part of the Town. Over the years, the Town has acquired several washout properties such as the Ehmann and Archibald properties located in South Nags Head and in 2007 assisted with the State's acquisition of the Jeanettes Pier site. These properties have been preserved for beach access. In 2006, the Town adopted new flood maps which increased the number of flood policies and extended more stringent regulations to a greater number of properties than the earlier maps. The Town also continues to investigate mitigation programs and grants to assist property owners with relocating threatened structures. The grants, however, require local government match and the Town has not taken the position to support relocation with government financial assistance. The Town recognizes beach nourishment as our preferred alternative for addressing the impacts from barrier island migration and ocean erosion; these include, but are not limited to acquisition of threatened structures, relocation of threatened structures and the establishment of innovative technology or designs which may be considered experimental. The Town continues to lobby the State for a statewide beach management strategy and there is an ongoing dialogue between Town Staff and elected officials, CAMA and State representatives. The Town has also sought funding from local and regional sources to assist with the local match for federally funded beach nourishment projects. In 2005, Dare County enacted an increase in the general sales tax devoted to beach nourishment. Although it was repealed in 2006 the Town currently receives interest payments from the fund. The Town uses the funds for Town wide sand fencing projects. The Town is also pursuing a locally funded beach nourishment project which would involve an increase in ad valorem taxes. The Town has asked the County and the State to contribute to this locally funded project. On March 5, 2008 the Board of Commissioners adopted a resolution requesting Congress to readopt the Upton-Jones amendment which assisted owners of properties threatened by erosion and in danger of collapse. The Upton-Jones amendment allowed property owners to make claims on their NFIP flood insurance policies to cover the cost to relocate or dismantle the threatened building.

The Town of Nags Head also participates in the Community Rating System program and is rated a Class 6. In order to maintain our rating, the Town maintains elevation certificates for new construction and improvements, provides Flood Insurance Rate Map information upon request, provides current flood information on the Town website, and continues to implement our drainage system maintenance program. Town Staff also sponsors a public retrofitting workshop in the fall of every year to inform property owners of techniques to make their homes.

## C. Areas of Greatest Risk

The areas of greatest risk are those that are exposed to multiple hazards. The most vulnerable property would be those structures that are exposed to both flooding and wind during a hurricane or coastal storm event. The oceanfront VE flood zone properties would generally be the most vulnerable due to their proximity to ocean waves and high velocity storm surge. Properties in the AE zone that are closer to the ocean and that are lower in elevation would also be highly susceptible, especially in areas with little remaining dune system to retain storm surge. Vulnerability would typically decrease as you move away from the ocean towards higher ground. The AE properties along the soundfront, particularly in identified incipient inlet areas, would also be susceptible to flooding. Wind damage would be potential for all property, however, properties west of US 158 typically have more protection from the wind than those along the oceanfront.

## D. Population Projections

1. Permanent Population

**Table 2 Summary of Population Projections**

| Year | Population |
|---|---|
| 1990 | 1,838 |
| 1995 | 2,029 |
| 2000 | 2,700 |
| Current (2003) | 2,885 |
| 2005 | 3,036 |
| 2010 | 3,305 |
| 2015 | 3,592 |
| 2020 | 3,869 |
| 2025 | 4,117 |
| 2030 | 4,353 |
| Census and projection data: NC State Data Center. | |

The above growth projections were developed by the North Carolina State Data Center for Dare County through the year 2030. In 2000, Dare County's total population was 29,967. Nine percent, or 2,700 individuals of the County's population, can be attributed to residents of Nags Head. The State anticipated growth rate for Dare County from 2000 to 2010 is 22 percent, from 2010 to 2020, 17 percent, and the anticipated growth rate from 2020 to 2030, 15 percent. This projection assumes that Nags Head's growth will continue to be 9 percent of the Dare County population.

The State Data Center projects the 2025 Nags Head population at 4,117 residents.

Permanent population does not, however, capture the real growth pressures that currently and will continue to be placed on the Town of Nags Head. Rather, Nags Head is a resort community, which experiences dramatic increases in seasonal population during the summer months. The problems of growth which the Town must address in the future are generated by this seasonal component of the population along with the residential and commercial development produced to accommodate it.

2. Seasonal Population

Making certain assumptions about the number of individuals residing in each dwelling unit and hotel/motel rooms in the Town allows us to estimate the potential seasonal peak population. Table 3 resents the methodology and calculates for this procedure. The results indicate that under existing development, peak daily summer population can exceed 36,646 people.

**Table 3 Estimated Current Peak Visitor and Resident Population**

| Existing dwelling units as of January 1, 2004 | | | |
|---|---|---|---|
| Land Use | DUs | Intensity Persons/DU[2] | Peak Population[2] |
| Single-family/duplex[1] | | | |
| Pre-1996 | 2,917 | 8 | 23,336 |
| Post-1996 | 848 | 10/20[3] | 8,480/16,960 |
| Multi-family | 424 | 6 | 2,544 |
| Hotel/Motel/Ctg Court | 653 | 3.5 | 2,286 |
| Total | 4,842 | | 36,646/45,126 |

[1]Based on previous construction information, this estimate assumes an average of four bedrooms prior to 1996. Post 1996 homes average close to five bedrooms with greater occupancy capacities.
[2]Single-family occupancy is based on two persons per bedroom

[3]To illustrate maximum occupancy potential, occupancy for single-family and duplex post-1996 is calculated using both 10 person and 20 person occupancy.

The estimated number of residents and visitors during the peak period, e.g., when hotel/motel rooms are at full occupancy, is in stark contrast to the 2,885 or so permanent residents in the Town. It is clear that it is this peak or maximum population which must be considered for planning purposes. In addition, the number of visitors during the spring and fall months has increased substantially in the last few years.

3. Build-out Population

As Nags Head continues to grow and develop, the size of its peak population will grow as well. The analysis of land availability, permissible development, and building trends, allows us to estimate the extent of future peak population, and in turn demands placed upon the natural and man-made environments. Table 4 resents the likely peak population that would result from the maximum build-out, with the current composition of land uses.

**Table 4. Approximate Number of Dwelling Units at or Near Build-Out**

| Potential DUs in 8 Years | | | | | |
|---|---|---|---|---|---|
| | DUs | Proj. DUs | Total DUs | Person/DU | Total # * |
| SF/Duplex pre-1996 | 2,917 | | 2,917 | 8 | 23,336 |
| SF/Duplex 1996-2004 | 848 | | 848 | 10/20 | 8,480/16,960 |
| SF/Duplex post-2004 | | 924 | 924 | 10/20 | 9,240/18,480 |
| Multi-family | 424 | 96 | 520 | 6 | 3,120 |
| Hotel/Motel/ Cttg Court | 653 | 80 | 733 | 3.5 | 2,565 |
| Total | 5,746 | 1,100 | 5,942 | | 46,741/64,461 |
| SF/Duplex=109 du/yr | M/F =12 units/yr | | | Hotel =10 units/yr | |
| *To illustrate maximum occupancy potential, occupancy for single-family and duplex post-1996 is calculated using both 10 person and 20 person occupancy | | | | | |

4. Build-Out Damage Potential

It would be extremely difficult to estimate a dollar value for future hazards. However, one could estimate a present value of future damage by applying our current level of build-out to the current value of structures within the Town and projecting this number forward to total build-out. Using the build-out projections above, it is estimated that Nags Head is roughly 88 percent developed. Current value of structures within the Town according to Dare County assessment is $979,465,367. If it is assumed that this number equals 88 percent of total build-out value, we can calculate 100 percent build-out value of structures at $1,155,769,133. Of, course, this number would not account for future assessment increases not does it reflect contraction replacement costs.

**E. Critical Facilities**

There are a number of critical facilities that are necessary for the operation of the town and local community. These facilities are listed below and an estimate of replacement cost is included. Note: These estimates include the value of the building and its contents and assume complete destruction.

Town Hall: Most administrative functions occur within the confines of the Municipal Complex at 5401 South Croatan Highway. The building has limited backup power generation capabilities. The loss of this facility would greatly hamper recovery efforts. Estimated replacement coat $6,000,000.

Municipal Fire Stations: The town has two fire stations. Limited backup power is available. Estimated replacement cost for both of these facilities is $12,000,000. The Town is also currently in the process of constructing a new fire station in South Nags Head. The construction cost is yet to be determined.

Former Outer Banks Medical Center: This Town owned facility becomes the command facility in the event of a severe hurricane. Limited backup power is available. Estimated replacement cost is $850,000.

Outer Banks Hospital: This is the only hospital within Dare County. The hospital has backup power generating capabilities and has a hurricane evacuation and operation plan. Estimate replacement costs is $35,000,000.

Sewage Treatment facilities: Most of the buildings within the Town are served by on-site septic systems. However, there are several private package treatment plants, which collectively serve 600 to 800 dwelling units. Estimated replacement cost is $5,000,000.

Power Transmission facility: There is one major power transformer facility within the Town. Loss of this facility would affect much of Dare County. Estimated replacement cost is $1,750,000.

Municipal water treatment and pumping facilities: The Town maintains one water processing facility and two pump stations; one at Eighth Street and one at Gull Street. Estimated replacement cost is $10,000,000.

Britthaven Nursing Home: This facility has an established evacuation plan in the event of a serve hurricane. The facility is not in a special flood hazard area. Estimated replacement cost is $8,500,000.

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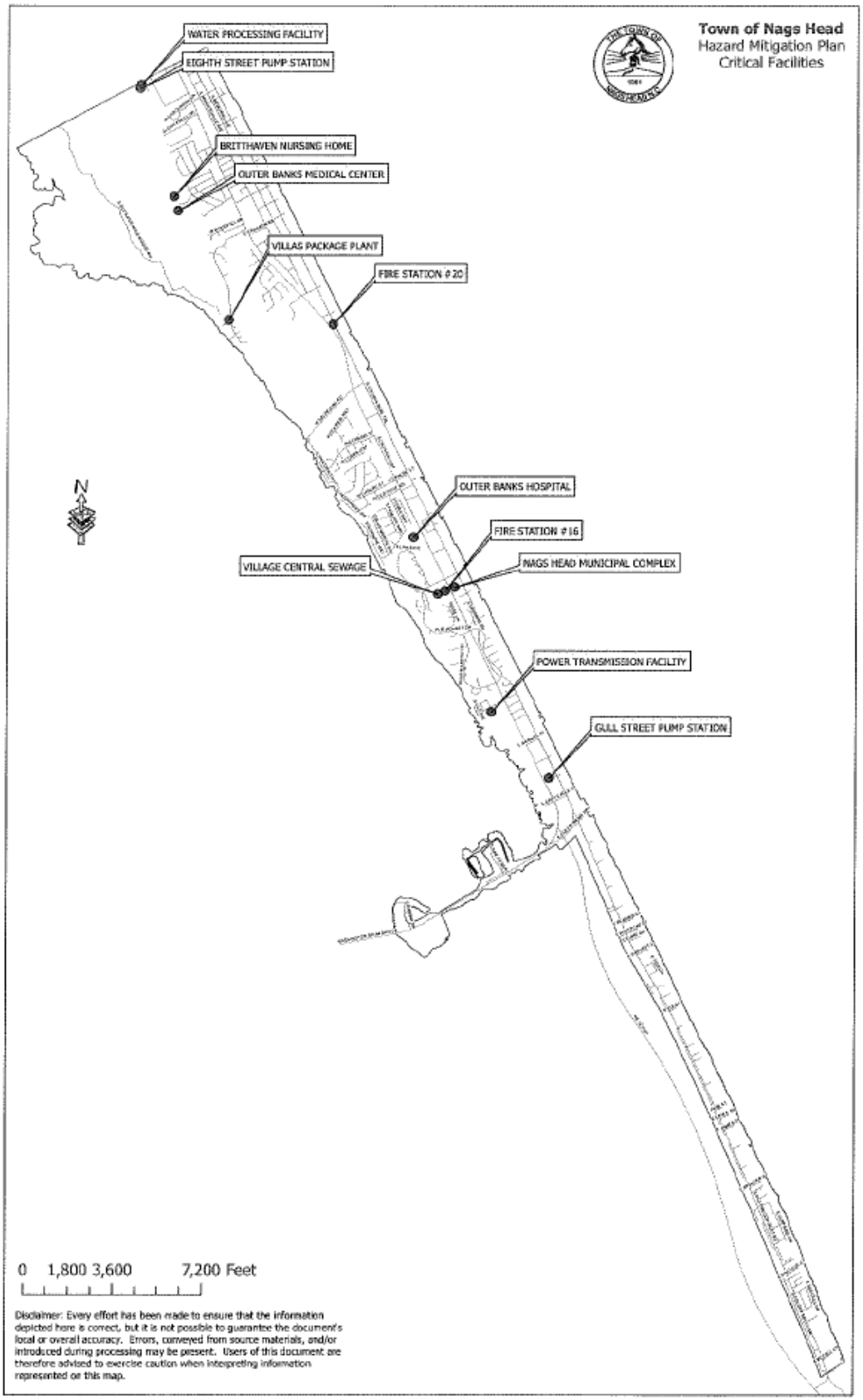
Town of Nags Head
Hazard Mitigation Plan
Critical Facilities
WATER PROCESSING FACILITY
EIGHTH STREET PUMP STATION
BRITTHAVEN NURSING HOME
OUTER BANKS MEDICAL CENTER
VILLAS PACKAGE PLANT
FIRE STATION # 20
OUTER BANKS HOSPITAL
FIRE STATION # 16
VILLAGE CENTRAL SEWAGE
NAGS HEAD MUNICIPAL COMPLEX
POWER TRANSMISSION FACILITY
GULL STREET PUMP STATION
N
0 1,800 3,600 7,200 Feet
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## IV. COMMUNITY CAPABILITY ASSESSMENT

Because Nags Head has a long history of coastal storms, Town policies have continually evolved to address mitigation. The Town has two main policy documents that govern hazard mitigation; the Town's 2000 Land and Water Use Plan and the 2001 Floodplain Management Plan, which was prepared as a component of the Community Rating System (CRS). Additionally, the Town's zoning ordinance and the adoption of the 2002 International Building Code series are additional regulatory mechanisms currently in place to mitigate hazard impacts. The Town is also actively involved with the National Flood Insurance Program and is rated as a Community Rating System Class 6 community. The Town continues to investigate innovative programs and seek funds for mitigation measures such as relocation of threatened structures and more stringent building codes for high hazard areas that support the growth management policies of the Town. The town's strategies to meet these goals are outlined under Section VI Mitigation Strategies and Policies.

Various Town departments continue to advance their pre- and post storm mitigation capabilities. The Public Works Department annually pre-positions debris removal agreements and maintains staff and equipment that can assist DOT and contractors with removal of debris and cleaning of roads and ditches. The Town'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 utilized mutual aid building inspectors for damage assessment and storm recovery and is familiar with that process. Additionally, Town GIS and information technology capabilities continually improve to help provide information before and after a storm both internally and to the public. Town Staff, because of recent experiences including Hurricane Isabel, have become increasingly familiar with FEMA public assistance procedures and the relationship between reimbursement and disaster recovery. Several opportunities were provided by the Board of Commissioners and Town Staff after Hurricane Isabel for citizens to voice their opinions about the Town's storm recovery and mitigation procedures. Many of the comments generated from these forums were used partially for the development of mitigation strategies in this plan. The Town remains financially, technically, and politically committed to mitigation activities primarily because of the recognized vulnerability to natural hazards.

To identify potential community capability shortfalls, various Town policies and operational procedures were reviewed, some of which included the 2000 Land and Water Use Plan, the 2006 Land Use Plan, the 2006 Stormwater Management Plan and the CRS Floodplain Management Plan. The following concerns were identified; these include needed policy updates as well as needed future mitigation activities. Some information form the 2004 Hazard Mitigation Plan was incorporated into the 2006 Draft Land Use Plan.

### A. Beach Nourishment

- The health, maintenance and stability of the ocean front dunes and the beach is essential and represents the Town's first line of defense against storms or hurricanes. The Town continues to lobby for a county wide beach nourishment project.

- Up to 80 percent of structures in the Town are vulnerable to a Category 3 hurricane. With the large number of structures at risk, the Town should investigate methods and incentives to provide a greater degree of protection in the event of a hurricane.

- The Town's flood maps were completed in 1993. They do not accurately reflect the current conditions. Although, the State of North Carolina is currently involved in a statewide floodplain mapping project, Nags Head had not received the new maps at the time this plan was prepared. The Town adopted the new FIRM maps on September 20, 2006.

- Nationwide Repetitive loss areas account 35% of all flood insurance losses. Nags Head has several repetitive loss areas.

- Post storm coordination with FEMA is paramount for damage assessment and reimbursement. Nags Head should continue to develop its relationship with FEMA to improve this process.

### C. Post Storm Mitigation

- Damage assessment is an essential component for hurricane and storm recovery. To assist property owners, the Town should continually seek ways to provide the most current, accurate and informative damage assessment information.

**D. Recovery and Operations**

- Cellular phone service can be a useful form of communications after a hurricane and their continued and reliable operation is essential for recovery. The Town has granted leases to several cell phone providers.

- Intergovernmental cooperation is essential for a coordinated recovery.

- The Town needs to develop consistent debris removal procedures and locations for temporary debris storage until permanent debris disposal sites are identified and approved.

- During a hurricane the Town maintains a staff of "essential personnel" and public safety employees. Their safety and protection during and after a storm is essential.

**E. Transportation and Drainage**

- The establishment of an emergency access route parallel to US 158 is essential for emergency vehicles and emergency response in the event US 158 is closed by storm damage, debris, or flood waters.

- There are numerous areas within the Town that typically flood during severe storm events and hurricanes. These areas have been identified in this report.

- Localized areas of poor drainage within the Town have been identified and have been noted in this plan. Areas of the North Ridge, Old Nags Head Place, Dolphin Run, Seven Sisters, and Nags Head Acres Subdivisions as well as scattered areas throughout the Town are also noted.

**F. Damaged Homes**

- The prolonged existence of damaged homes on the ocean beach represents a potential safety risk and aesthetic concern.

**G. Zoning and Open Space**

- The preservation of natural areas and open space is important for recreational purposes, visual image, and stormwater retention.

- After a storm event there could be strong pressures to change zoning regulations. The Town should be proactive with zoning changes that could aid in post-disaster recovery.

**H. Sewer Treatment Systems**

- The Town has numerous package treatment plants, low-pressure sewage treatment systems, and septic systems. Many of these facilities are located in special flood hazard areas. Storm events can cause sewage treatment systems and on-site septic systems to fail or otherwise not operate correctly, impacting the environment.

**I. Critical Facilities**

- Britthaven Nursing Home is a critical facility which does and has presented evacuation concerns due to the large elderly population.

- A new elementary school is currently under construction within the Town. A school mitigation plan and evacuation plan is essential. The school is complete.

- Proper design and construction of the new Fire Station is critical to limit storm damage potential.

## V. MITIGATION GOALS AND VALUES

The primary objective of the Town of Nags Head related to hazard mitigation is to reduce to the extent possible, damage to life and property from hurricanes, severe coastal storms, and the other hazards identified in this plan. To support this objective, the following goals will serve to guide the development of mitigation strategies and policies:

- The Town seeks to reduce damage to property through the development of policies, ordinances, operational procedures, and infrastructure that reflect careful consideration of mitigation planning efforts.

- The Town seeks to enhance the safety of and service to the public through pre- and post-storm communication of policies and procedures.

- The Town seeks to develop and maintain infrastructure and critical facilities that have a low-vulnerability to hazard induced damage.

- The Town wishes to seek methods to protect existing structures from storm-related damage.

- The Town wishes to direct redevelopment to minimize future damage potential.

## VI. MITIGATIN STRATEGIES AND POLICIES

The following are policies /strategies and implementing actions which were developed using information provided during the review of Town policies and operational procedures as described in Section IV. Implementation of these actions will apply to all property within the Town. The following timetable represents a prioritization for implementation of mitigation related polices and strategies. A= annually (for the next 5 years), B=6 months, C=1 year, D=2 years, E=3 years. The department(s) responsible for implementation is listed at the end of each implementing action. The Hazard Mitigation Planning Committee used the following criteria to develop these implementation priorities. Particular emphasis was placed on cost benefit review.

- Cost vs. Benefits

- Staffing capability

- Local, State, and Federal political climate

- Funding sources (internal and external)

- Effectiveness is satisfying mitigation goals

- Third party participation

### A. Beach Nourishment

1. Background

Islands have a dynamic and ever-changing environment. Barrier islands have been shown to migrate, and are subject to a complex and numerous sets of natural forces, e.g., overwash processes, littoral drift, inlet formation, and dune and beach dynamics. They are further modified by storms and hurricanes. Coastal erosion, as a result of normal offshore littoral patterns, the occurrence of hurricanes and storms, and the general sea level rise which has been occurring (Titus, 1985), make development along the shores of barrier islands particularly tenuous.

In other localities, problems have arisen by allowing the construction of immovable buildings along the ocean shore, necessitating the expenditure of public funds to protect these structures when natural forces threaten them. Several methods have been used to stabilize the ocean beach. Primary among them are: (1) sand moving programs, e.g., beach nourishment, sand pushing; (2) sand trapping structures, e.., groins, jetties; and artificial reefs, and (3) shoreline protection works, e.g., bulkheads, seawalls, revetments.

Beach nourishment programs involve efforts to push or place sand onto the beach in an attempt to build back former dunes and upper beach. Beach nourishment projects are typically expensive and the results are temporary and often require continual nourishment. A single nor'easter may eliminate much of the sand deposited under a nourishment program. Beach nourishment programs, however, represent efforts to preserve oceanfront property without damaging neighboring property or destroying the public's use of the beach.

Groins and jetties are structures built perpendicular to the shoreline. Jetties are often very long and intended to keep sand from filling in inlets and shipping channels. Groins are smaller and attempt to trap sand flowing in the littoral current. Such structures are expensive, unsightly and cause extensive erosion problems down-current, as they rob these beach areas of the natural sand replenishment they would normally receive.

Shoreline protection works, such as seawalls and revetments, are built parallel to the coastline and are designed to directly shield shoreline property form the ocean forces. The City of Galveston, Texas, for instance, has constructed a 17-foot high seawall, which protects its urban area. Such structures, however, reflect wave action, and intensify currents that steepen the profile of the beach and damage the property beyond the ends of the structure. In the long run these structures serve to destroy or seriously undermine the beach, require continual maintenance and investment, and are largely ineffective in protecting property from shoreline processes without perpetual nourishment of the beach seaward of the hardened shoreline. Moreover, these structures are extremely costly to build. The Coastal Resources Commission, recognizing the inappropriateness of shore-hardening devices such as wooden bulkheads, seawalls, rock or rubble revetments, jetties, groins and breakwaters, has prohibited their use on North Carolina ocean beaches.

On the oceanfront, several actions can result in the destruction or removal of homes. Houses can be destroyed by storms or erosion or they can be relocated either on the same lot or off the lot. Tracking the fate of oceanfront houses can be problematic. If the house is moved either on the same lot or off the lot, the Town will issue a permit. If the house is condemned (for lack of septic or building code problems), the Town will also issue a permit for its removal. If the house is destroyed and in shambles on the beach, it is generally too late to issue a permit. These properties can soon become a public nuisance and it is often difficult to require their removal. Town records reveal that there have been approximately 96 houses moved from the oceanfront or demolished from 1987 through 1996, 44 house relocated on the same lot, and 56 properties listed as "washouts" on the Dare County tax listing. A "washout" represents a property where the building no longer exists and in all likelihood was destroyed by a storm or erosion. Most of the building permit activity for destroyed homes or relocated structures has occurred in South Nags Head.

Since 1989, the US Army Corps of Engineers has been conducting studies to determine the feasibility of constructing a federal Hurricane and Storm Damage Prevention Berm on portions of the northern beaches of Dare County.

These studies have: (1) determined the value of land development along the oceanfront, (2) the cost of constructing such a project, (3) the supply of recoverable, compatible sand available, and (4) the benefit coast ratio between berrm construction costs and the value of oceanfront and near ocean structures that would be protected by such a berm.

Three structures of the northern beaches have been identified as meeting the standards for federal appropriations. Virtually all of Nags Head is included within this identified project area. The costs for initial construction of the entire Dare County project are estimated at approximately 70 million dollars. Previous nourishment projects have been funded 65 percent by the federal government, with the remaining 35 percent coming from state and local sources. The federal beach nourishment study was completed in the fall of 2000. AT the time this document was written, easements were being acquired for the first phase of the project, which was tentatively scheduled to begin in

January 2005. Within Nags Head, this phase includes the area from Hawks Nest Court to the Outer Banks Fishing Pier in South Nags Head.

2. Beach Nourishment Funding

The Town supports beach nourishment projects for the Town beaches subject to commensurate funding appropriations from federal, state, and local sources. The Town will support and encourage the establishment of a statewide beach nourishment strategy and policy along with a dedicated funding program designed specifically for beach restoration and nourishment projects.

Implementing actions:

- The Town will actively lobby the State for a state policy and strategy on beach nourishment and beach re-nourishment. Timetable A: Board of Commissioners, Planning, Administration. The Town has applied for the required permits and hopes to receive permit approval within the next six (6) months.

- The Town will lobby the State to establish an annually state funded statewide nourishment program. Timetable A: Town Managers Office, Planning. In 2005, Dare County enacted an increase in the general sales tax devoted to beach nourishment. Although it was repealed in 2006 the Town currently receives interest payments from the fund. The Town uses the funds for Town wide sand fencing projects.

- The Town will seek funding from local and regional sources to assist with the local match for federally funded beach nourishment projects. Timetable A: Town Managers Office, Planning. In 2005, Dare County enacted an increase in the general sales tax devoted to beach nourishment. It was repealed in 2006. In 2008, the Town established a beach nourishment fund. In 2009, the Town applied for a Water Resources grant to assist with the local match and was not selected for the grant.

- The Town shall request authorization to extend any ocean outfall, which will be affected by any re-nourishment project. Timetable D: Public Works, Planning. The Town has received assurances from the Division of Costal Management (DCM) that the outfalls may be repaired to their original configuration. The Town continues to work with NCDOT and DCM to repair outfalls.

3. Beach Nourishment –General

The Town recognizes beach nourishment as out preferred alternative for addressing the impacts from barrier island migration and ocean erosion. However, the Town also supports a variety of methods to abate the impacts to ocean erosion; these include but are not limited to: acquisition of threatened structures, relocation of threatened structures, and the establishment of innovative technology or designs which may be considered experimental, which can be evaluated by the CRC to determine consistency with 15 NCAC 7m .0200 and the other general and specific use standards within the CAMA rules.

Implementing actins

- The Town will sponsor studies designed to determine the financial contribution the beach makes to the Outer Banks and the region. Timetable D: Administration, Planning. In 2006, the Town established a committee to address this. December – January 2007 the committee presented a recommendation to the Board of Commissioners. A Town referendum was held April 17, 2007 and failed to gain enough support for passage.

- Following a severe storm the Town shall consider purchasing land in damage prone areas. Timetable A: Planning, Administration. No property has been purchased in damage prone areas.

**B. Mitigation and FEMA**

Mitigation represents a proactive approach to reducing the vulnerability of risk to properties in the Town. The Town will investigate innovative programs and seek funds for mitigation measures such as relocation of threatened

structures and more stringent building codes for high hazard areas that support the growth management policies of the Town.

Implementing actions

- The Town shall consider the applicability of requiring "V Zone" structural certification for structures in the 100-year (A) flood zone. Timetable D: Planning. New flood maps were adopted September 20, 2006: No additional action needed as the new flood maps addressed the Town's concerns

- The Town will consider establishing a committee comprised of a cross section of interests to explore and make recommendations to the Board of Commissioners regarding amendments to our Flood Ordinance which address freeboard and other flood mitigation measures recognized by FEMA and the CRS program to reduce flood loses. Timetable C: Board of Commissioners. 2006: The model flood ordinance was reviewed by staff; the Town's Planning Board and the Board of Commissioners and was modified to address higher regulatory standards and adopted on September 20, 2007.

- The Town shall support the continued education and training of the Town's Building Inspectors and planning staff in inspections and mitigation activities. Timetable A: Planning. 2009: Inspectors attend periodic training workshops and have increased training as a result of BCEGS.

- The Town will actively work with FEMA and the State during the Statewide floodplain mapping project. Timetable A: Planning. The new flood maps were adopted September 20, 2006.

- The Town shall develop a program to identify businesses and material storage areas where significant amounts of toxic or hazardous products are stored which would be subject to flooding. Timetable C: Public Safety, Public Works. Through annual fire prevention inspections, Nags Head Fire Staff evaluates and determines protection of toxic or hazardous products stored in areas prone to flooding. No formal program currently exists.

- The Town shall develop regulations to require fuel tanks, including LP tanks to be adequately anchored to prevent flotation or submersion in the event of flooding. Timetable D: Public Safety, Planning. The Town informs repetitive loss property owners of yearly retrofitting workshops held in the fall.

- The Town shall participate in the Community Rating System program by continuing the following CRS credit activities: Timetable A: Planning.

Table 9. CRS Credit Activities

| Activity | Description of Activity |
|---|---|
| 310 | Elevation certificates |
| 320 | Map determinations |
| 330 | Outreach projects |
| 340 | Hazard disclosure |
| 350 | Flood protection library |
| 360 | Flood protection assistance |
| 410 | Additional flood data |
| 420 | Open space preservation |
| 430 | Higher regulatory standards |
| 440 | Flood data maintenance |
| 450 | Stormwater management |
| 510 | Repetitive loss projects |
| 530 | Retrofitting |
| 540 | Drainage systems maintenance |
| 610 | Flood warning program |
| 630 | Dam safety |

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## C. Post Storm Mitigation

The time period after a storm is a critical time to ensure that all Town regulations are adhered to and that the area is safe for visitors to return. This time period is also an opportunity to utilize current building codes and available regulations to mitigation future damage potential.

Implementing actions

- Following a severe storm or hurricane, reconstruction will be evaluated for compliance with the adopted zoning ordinance, CAMA regulations, and all other applicable local, state and federal regulations. Timetable A: Planning. This is an ongoing endeavor.

## D. Recovery and Operations

Intergovernmental cooperation and employee safety are essential components for a safe recovery. Effective communication of policies and procedures among Town Staff and to residents and property owners is crucial to strengthen the reentry and recovery process.

Implementing actions

- On issues of mutual concern, the Town shall coordinate recovery and post storm response activities with Dare County, the State of North Carolina, and the Federal Government. Timetable A: All Town Departments. The Town participates in preparedness meetings such as the VA/NC hurricane meeting and hurricane recovery exercises with adjacent jurisdictions (mutual aid).

- During a hurricane the Town maintains a staff of essential personnel and elected officials. When available the Town shall consider acquiring or building a command facility. Essential components may include a mobile radio transmission tower, satellite internet capability and enhanced telephone service. Timetable A: All Departments. The Town has established the former Outer Banks Medical Center facility as a backup EOC. In 2006 the Town acquired a mobile command center.

- Following a hurricane the Town shall establish an information center staffed with Town, State and Federal employees who are available to assist property owners in the reentry and recovery process. Timetable A: Mayor, Manager, Planning, Administrative Services. The Town has established areas and identified personnel to carryout the above.

- Following a declared emergency storm event, only those areas where damage assessment is complete and that have been declared relatively secure shall be open to the public. Timetable A: Public Safety, Planning. Material, manpower and procedures have been identified to carry out this task.

- The Town leases space to cellular phone service providers on the Town's two water tanks. Cellular phone service provides an essential form of communications after a storm. The Town shall consider requiring cellular phone service providers to structurally design their tower mounted equipment to withstand greater wind loads than is required by the State building code. Timetable (when leases expire): Administration, Town Managers Office. The Town enforces the State Building Code. A new fire alarm control panel was also installed and fire alarm service completed in the Towns emergency command center.

- The Town shall identify and implement methods to streamline the damage assessment process. This may include collection of damage assessment data utilizing handheld GIS units. This shall also include methods to expedite the availability of damage and condemnation information to Town staff and the public. Timetable C: Planning. The Town has acquired the needed equipment and trained personnel how to use it. The Town continues to refine the use of the equipment.
- The Town shall continue to pre-position debris removal agreements on a yearly basis. Timetable A: Public Works, Administration. The Town has secured agreements with two debris haulers and one debris monitoring contractor.

- The Town shall obtain pre-storm authorization from the NC Department of Transportation (DOT) to clear DOT maintained roads after storm events. Timetable A: Administration, Planning, Public Safety, Public Works. The Town has mutual id agreements with other Dare County agencies. The Town also participates in the Statewide Mutual Aid Compact and enlists volunteers for the damage assessment process after a storm.

- The Town shall designate a Staff level Director and Deputy Director of Emergency Management. Timetable B: Administration, Public Safety. The Town has designated the Fire Chief as the Emergency Management Coordinator. In 2009, the Town designated the Deputy Fire Chief as Deputy Emergency Management Coordinator.

- The Town shall continue to improve methods to provide public information after a storm. This shall include an automated voice messaging system with storm damage and re-entry information, a Mayor's radio broadcast, email broadcasts, improved real-time website information with relevant local contact information, available information at traffic stops, and designation of a post-storm public information officer. Timetable A: Administration, Town Manager's Office, Management Information Systems. The Town is capable of providing the above services through the Town's PIO and Dare County Joint Information Center.

- The Town shall communicate post-storm recovery and operations policies and procedures to residents and property owners prior to hurricane season. The Town shall consider providing this information in the Town Newsletter, on Local Government Access Channel, and the Town Website. Timetable B: Administration, Management Information Systems. Information is provided to residents and property owners as described above.

- The Town shall develop a Crisis Communications Plan which will detail the process for distributing information internally and externally to the public before and after storms. Timetable B: Administration. In 2006, the Town has adopted and "Emergency Operations Plan" which details duties of Town staff before, during and after an emergency. That Plan was updated in August 2009.

**E. Transportation and Drainage**

Implementing actions

- The Town will develop regulations requiring a greater street standard (dimensional and construction) where it can be reasonably demonstrated that nearby streets may be destroyed by a storm or other natural event and that the proposed street may be required to accept greater amounts of traffic. Timetable D: Planning, Public Works. Other coastal communities are being contacted to determine if this is a possible option, and if adopted, would it be enforceable.

- The Town shall consider the establishment of an emergency transportation route parallel to US 158 from the northern Town boundary at Eighth Street south to Health Center Drive. Timetable D: Planning, Public Works, Public Safety. This area is not a particularly vulnerable area.

- Prior to a flooding event, the Town's Street Department shall assemble the necessary traffic barricades and equipment to address flooding conditions noted in this plan. Timetable A: Public Works. This action is performed prior to a storm.

- The Town shall identify alternative means of ingress and egress to the Outer Banks Hospital site and Britthaven Nursing Home facility. Timetable B: Planning, Public Safety. This has been investigated an no feasible alternative exists.

- Through the budget and CIP process, the Public Works Department shall request funds to comprehensively review and improve the Town's drainage system. Additionally, funds shall be requested to address specific, localized drainage issues. Examples include the North Ridge, Vista Colony and Nags Head Acres subdivisions. Timetable A: Public Works. The Town established a Stormwater Utility, funded by a $2 per

month charge on all water bills, in the spring of 205. The first project funded was a major update to the Town's Stormwater Management Plan, and the creation of a Stormwater CIP. Projects on this list are being undertaken as funds permit.

**F. Damaged Homes**

The Town recognizes that damaged homes and structures on the oceanfront present nuisance and aesthetic concerns. The Town shall take appropriate measures to abate this nuisance. The Town will investigate changes in NFIP regulations to establish realistic policies and procedures for declaration of destroyed structures.

Implementing actions

- The Town will take a more proactive approach to enforcing removal of nuisance structures, with upfront communication policies to property owners and the issuance of civil citations to abate the nuisance. This shall include the establishment of a new timetable for compliance of condemned structures, with the goal of full compliance within four months of initial condemnation. Timetable A: Planning. The Town continues to explore procedures to expedite removal of nuisances.

- The Town will petition FEMA through our state and regional NFIP representatives to consider adopting realistic regulations regarding the determination of destroyed structures. Timetable C: Planning. On March 5, 2008 the Town adopted a resolution requesting Congress to readopt the Upton-Jones amendment.

- Relocation of threatened structures is a viable option for reducing storm damage and erosion and mitigating nuisance properties. The Town may seek funds and consider changes to the flood ordinance which will assist in the relocation or removal of these threatened structures. Timetable C: Planning. Town Staff is aware of grant programs; however, the grants require a local match and the Town has not taken the position to support relocation with governmental financial assistance.

- The Town shall continue aggressive monitoring of entry into condemned homes to prevent safety hazards. Timetable A: Planning. Enforcement of Building Code and nuisance regulations continuing.

**G. Infrastructure**

The proper placement or replacement of the Town's Infrastructure (roads, water lines etc.) after a storm is an essential mitigation tool to limit damage from future storm events.

Implementing actions

- It shall be a Town policy that damaged Town infrastructure be built back to established Town standards only if it can be demonstrated that there is a reasonable expectation to survive future hazard events. Timetable C: All Town Departments. Waterlines have been replaced only if they meet these criteria.

- The Town shall develop contingency plans for those Town streets that may be lost as a result of erosion. This can include development of alternative routes or access, or upfront declaration of the potential for future improvements. Timetable D: Public Works, Town Manager, Board of Commissioners. The Town has followed the same procedure for waterlines, and water services that cannot be restored in their previous location. The Town with assistance from the Town Attorney in 2006-2007 has identified alternative means of access to properties. The Town modified development regulations to assist with providing access to properties where a Town road has been damaged or lost.

**H. Zoning**

Another key element in the reconstruction process is the enforcement of existing zoning rules and land use regulations.

Implementing actions

- Storm damage reconstruction shall reflect pre-storm conditions to the extent possible. Redevelopment shall comply with the Land Use Classification Map and the zoning ordinance. Timetable A: Planning. Enforcement is ongoing.

- As the amount of available vacant oceanfront land diminishes, the Town can expect redevelopment of existing sites. It is the Town's position that the existing oceanfront development regulations adequately address concerns such as building height and density, and that currently permitted uses adequately represent the desired uses for the oceanfront. Timetable A: Planning. This policy is presently in place.

**I. Sewage treatment plants and septic systems**

The Town relies primarily on on-site septic systems; however, within the Town there are several sewage treatment plants and numerous low-pressure septic systems. During recovery after a severe storm, monitoring the function of on-site septic systems and treatment plants is critical to ensure that environmental damage does not occur.

Implementing actions

- The Town shall consider seeking authority and adopting regulations which would allow qualified Town staff to inspect sewer treatment facilities and on-site septic systems after a storm. These regulations should also allow staff to request the corrective actions necessary to ensure proper operation of these systems. Timetable C: Board of Commissioners, Administration, Planning and Septic Health. Town staff is trained to inspect systems, but no authority to entire private property has been requested. In 2007 the Town adopted a regulation that prohibits "pump and haul" operations for residential uses where the septic system can not be repaired.

- The Town shall take a proactive approach to educating citizens on the negative implications of using septic system that has suffered storm damage. The Town will develop educational materials informing homeowners on the proper care of a system impacted by floodwaters. Timetable B: Septic Health, Public Works. This process is ongoing through the Septic Health Initiative.

**J. Critical Facilities**

An essential component to storm preparedness and the recovery process is the protection of critical facilities and the individuals they serve.

Implementing actions

- The Town shall require Hurricane Evacuation Pans from sensitive, vulnerable or critical facilities which are likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood or hurricane, including, but not limited to: hospitals, nursing homes, police stations and fire stations. Timetable A: Planning, Public Safety. Emergency plans concerning critical facilities are updated annually and added to the Emergency Operations Plan.

- The evacuation, operation, and recovery plans for the Outer Banks Hospital and the Britthaven Nursing Home shall be reviewed and approved by the Town's Public Safety Department. These plans shall address the evacuation of critically ill patients, securing the facility prior to and during the storm, and plans for startup after the storm. Timetable B: Planning, Public Safety. In 2009, Fire, Police, Emergency Management and EMS Staff met with representatives of Outer Banks Hospital and Britthaven Nursing Home to determine methods to best serve the affected special needs population. These interactive meetings identified several deficiencies. Steps have been taken to mitigate hazards and implement new procedures.

- The design of the proposed elementary school shall address flooding and hurricane resistant construction. Timetable (when plans submitted): Planning, Public Safety. The school is complete and construction meets or exceeds State Building Code requirements.

- It is strongly urged that evacuation drills and tornado drills be conducted at the proposed elementary school. Timetable (when school completed): Public Safety. This is a school function.

**K. Natural Resource Protection**

Open and natural spaces are important elements in Nags Head for their aesthetic value as well as to provide important natural flood mitigation functions such as stormwater retention. The Town will inventory open space, actively pursue grants and funding opportunities, and develop and implement a plan to acquire and preserve open space throughout the Town.

Implementing actions

- The Town will identify important areas to be acquired as open space and shall request funds for acquisition of these areas through the budget, CIP, and grant process. Timetable A: Planning. The Town purchased the "Whalebone Park" site in the fall of 2008.

- The Town will consider an incentive program rewarding those developers which set aside additional open space in perpetuity. Timetable E: Planning. No action taken as of this date.

- The Town shall continue to acquire land for open space and recreational purposes. Timetable A: Planning. The Town purchased the "Whalebone Park" site in the fall of 2008.

- The Town will complete the work needed to dedicate appropriate Town owned property(ies) to the State of North Carolina as a nature preserve. Timetable A: Administration, Planning. No action taken.

**L. Brush Fires / Fire Protection**

The Town has several areas with greater property damage potential resulting from brush fires. Nags Head Woods is a 1,000 acre maritime forest which abuts several residential neighborhoods. The residential areas in South Nags Head west of SR 1243 from Gulfstream Street to the southern Town limits are susceptible to brush fires because of their proximity to the Cape Hatteras National Seashore. The Nags Head Public Safety Department has an ongoing program to mitigate the potential for damage in these areas.

Implementing actions

- The Town shall maintain fire breaks where appropriate. The Town shall coordinate with the National Park Service to maintain the fire break in South Nags Head. Timetable A: Public Safety. The addition of a staffed Nags Head South Station 21 on February 14, 2006 vastly improved the firefighting capabilities of the Town and specifically benefits the South Nags Head residential community. Providing prompt firefighting services in the wild land/urban interface reduce the hazard and damage potential of uncontrolled wildfire in this area. Ongoing fire prevention efforts include wild land fire prevention discussions with homeowners to assist in maintaining safe clearances from combustible vegetation. 2009, the National Park Service and Dominion Power created a 30'-40' fire break between homes located west of Old Oregon Inlet Road and NPS property. The fire break lessens the opportunity for uncontrolled fires to affect residences.

- The Town shall continue the program to remove dead wood in critically fire prone areas. Timetable A: Public Safety. State of NC grant funding is not currently available for fuel removal program funding; however, homeowners may access the fire prevention staff to determine an optimal way to create fire safe landscaping.

- The Town shall review and require maintenance of access for emergency vehicles and fire apparatus. Timetable A: Public Safety. Annual fire inspections of commercial facilities identify areas of fire lane non compliance and required corrections are mandated by code enforcement officials. Technical reviews of proposed commercial developments incorporated NC fire code access lane requirements. Provide annual

review of Nags Head Woods road to determine if adequate fire apparatus clearance is available; completed in spring 2007, and a substantial vegetation removal/rod grading project was completed fall 2008.

- The Town shall evaluate the Nags Head Woods Fire Plan on a regular basis and coordinate information with Nature Conservancy Staff. Timetable A: Public Safety. An evaluation meeting and update of Nags Head Woods Plan was conducted in the summer of 2008. Fire staff performed an annual drive through of Nags Head Woods and conducted regular meetings with Nags Head Woods Steward Aaron McCall to discuss observed hazards and mitigation/prevention. A meeting was scheduled with the Nature Conservancy to review the Nags Head Woods fire plan and discuss changes that may be needed.

- The Town shall continue cooperation with the US Forest Service and Dare County for mutual aid fire protection. Timetable A: Town Manager's Office, Public Safety. Nags Head Fire Rescue provided mutual aid structural firefighting services to all those Dare County Fire Departments requesting assistance in 2009, as well as utilizing incoming resources to assist in mitigating hazards exceeding the capabilities of Nags Head Fire Rescue. Nags Head continues to maintain excellent mutual aid working relationships with all Dare County fire departments.

- The Town shall continue to evaluate and update the Nags Head Urban Wild Fire Interface Plan as necessary. Timetable A: Public Safety. An evaluation was completed in 2009, no changes were made to current plan.

- The Town shall continue to review the water system throughout the Town for fire protection capabilities and prioritize capital improvements as necessary. Timetable A: Public Safety, Town Manager's Office, Public Works. In 2009, Nags Head Fire staff worked with Nags Head Water staff to implement waterline improvement to benefit Northridge Subdivision, Old Nags Head Cove, West Side Court and Gray Eagle Street.

- The Town shall continue to inventory fire hydrants, water distribution infrastructure, and other town infrastructure in support of fire planning efforts. Timetable C: Public Safety, Planning. In 2008 the inventory was reviewed and updated. An additional 1,640 feet of 8-inch waterline under design for US 158 bypass from Bonnett to Baltic streets was determined to be needed. Lack of funding has prevented the line from being built.

- The Town shall continue to evaluate and update the capital improvements plan for fire protection infrastructure. Timetable E: Public Safety. The Town of Nags Head anticipates a "shared facility" partnership with the Town of Kill Devil Hills. This arrangement is based on NC ratings system recommendations that determined a strategically placed fire station would enhance response and lower insurance ratings in both towns.

- The Town shall continue its fire education program. This includes newsletter and newspaper articles on fire protection as well as grants from the State Division of Forestry for fire education. Timetable A: Public Safety. The Town shall improve fire protection in Nags Head Woods with the installation of 'dry hydrants' and maintenance and improvements to Nags Head Woods Road. Timetable B: Public Safety. Nags Head Woods rod is maintained by Nags Head Public Works and roadway material is added as needed to maintain an acceptable driving surface. In 2009, newsletter articles were published, and the website updated with current fire prevention information. The "Change your clock, change your battery" program resulted in the installation of numerous new smoke detectors placed in homes in Town. Fire information supplied for the annual October Fire Prevention Night and Fire Prevention week.

- With the installation of the new water tank, the Town shall install a new 12 inch water line from the Public Works facility to Barnes Street. This will increase fire flow to north end neighborhoods. Timetable C: Public Works, Public Safety, Planning. This was completed in 2006.

- The Town shall research available data on underground storage tanks and leaking underground storage tanks. Timetable C: Planning, Public Safety. Underground fuel tanks, when required by fire code, have been removed or brought into compliance with Fire Code and DEHNR standards.

## M. Water Protection

Nags Head is a member of the Dare County Regional Water System, but no longer operates the Fresh Pond Water Treatment Plant. This has eliminated the threat from natural, or man made disasters to this former Public Water Supply source. The Town does operate over 75 miles of distribution system waterlines, and two major pump stations. The Town shall continue to identify improvements to make the water system safer.

Implementing actions

- The Town shall coordinate with Kill Devil Hills regarding fencing around their portion of the Fresh Pond. Timetable B: Public Works, Town Manager's Office. The Fresh Pond Water Treatment Plant has been permanently decommissioned.

- The Town shall continue to evaluate the implementation of water restrictions during periods of drought. Timetable A: Public Works, Town Manager's Office. The Town has a Water Storage Plan.

- The Town of Nags Head shall continue to monitor develop and the installation of on-site septic systems with the Fresh Pond Area of Environmental Concern. Timetable A: Planning. Process monitored through the development and permitting process.

- The Town shall continue to cooperate with Dare County on the development of additional water supply well facilities. Timetable A: Planning, Public Works. The Town continues to cooperate with Dare County as requested. Additional wells and 2 million gallons of treatment capacity added to Dare County Water Plant in Kill Devil Hills in 2005-2006.

# VII. MONITORINGM, EVALUATING, AND REPORTING PROGRESS

The Town will review this Plan on an annual basis or after a declared disaster. The annual report will review progress, discuss actions that were not completed and provide a justification for this, and will discuss potential revisions as well as recommendations for new implementing actions. During this annual evaluation, it will be important to determine the feasibility and the need to implement items not yet addressed. The evaluation should utilize input from the mitigation planning committee, Town Staff, and citizens to determine if current conditions call for changes to the plan. Mechanisms for public input will be available through the Town website, Board meeting audience response, and Town Staff. Monitoring of implementation items will be done by the responsible parties listed for each item. Monitoring will be conducted on as needed basis in accordance with the timeline and target completion date specified. Progress reporting of all implementation actions shall be conducted by the responsible parties listed for each item during the annual report process. Criteria to be addressed during the annual review include:

- Have conditions changed since the last plan update which requires revisions to plan goals or strategies?

- Has the nature or magnitude of risks changed?

- Are there current financial or staffing constraints that inhibit implementation of certain strategies?

- Are there other legal, technical, or political factors limiting implementation of mitigation strategies?

- Have the strategies implemented to date been effective? What measures of effectiveness can be used to document this?

- Did third parties participate in the implementation of the plan in the way that was desired or expected?

## VIII. REVISIONS AND UPDATES

Planning Staff as directed by the Town Manager will review the evaluation report and present the findings to the Board of Commissioners with recommendations for updates and revisions. At least one plan update will occur every five years in accordance with FEMA requirements. As updates occur; the date, reason and responsible party will be noted. The 2004 Plan was reviewed by the Planning Committee and found to be effective. No deficiencies were found with the 2004 mitigation strategies and actions and no new policies were added.

### Continued Public Involvement

Each plan update will be advertised and public input will be solicited in a similar manner to the initial plan. As mentioned above, mechanisms for continued public input will be available through the Town website, Board meeting audience response, and Town Staff.

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**Annex 4 – Project Documentation**

Resolution No. 09-10-019
BOC Meeting October 7, 2009

**RESOLUTION OF THE TOWN BOARD OF COMMISSIONERS OF THE TOWN OF NAGS HEAD, NORTH CAROLINA, REQUESTING ACTION BY THE DARE COUNTY BOARD OF COMMISSIONERS TO MERGE THE HAZARD MITIGATION PLAN FOR THE TOWN OF NAGS HEAD WITH THE DARE COUNTY HAZARD MITIGATION PLAN**

**WHEREAS**, on October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 to reinforce the importance of pre-disaster mitigation planning to help reduce disaster losses; and

**WHEREAS**, North Carolina Senate Bill 300 requires all local governments to have an approved Hazard Mitigation Plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004); and

**WHEREAS**, the Town of Nags Head Hazard Mitigation Plan was approved on August 4, 2004 by the Nags Head Board of Commissioners and subsequently approved by the Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management (NCEM); and

**WHEREAS**, the Town of Nags Head is currently in the process of updating the Town of Nags Head Hazard Mitigation Plan as required every five (5) years by FEMA and NCEM; and

**WHEREAS**, the Town of Nags Head, in accordance with guidance provided by FEMA, NCEM, and the County of Dare, now desires to merge said Plan with the County of Dare as part of their Hazard Mitigation Plan update which is currently in process.

**NOW, THEREFORE, BE IT RESOLVED** on this **7th** day of **October 2009** that the Town Board of Commissioners for the Town of Nags Head hereby request that the Dare County Board of Commissioners incorporate the Town of Nags Head Hazard Mitigation Plan as part of a Multi-Jurisdictional Hazard Mitigation Plan Update for Dare County.

Adopted this 7th day of October 2009.

M. Renée Cahoon, Mayor
Town of Nags Head

ATTEST:

Carolyn F. Morris, Town Clerk

**DRAFT AGENDA**

**TOWN OF NAGS HEAD BOARD OF COMMISSIONERS**
**NAGS HEAD MUNICIPAL COMPLEX BOARD ROOM**

**WEDNESDAY, SEPTEMBER 2, 2009; 9:00 A.M.**

**REGULAR SESSION**

A. **CALL TO ORDER**

B. **MOMENT OF SILENT MEDITATION AND PLEDGE OF ALLEGIANCE**

C. **ADOPTION OF AGENDA**

D. **AUDIENCE RESPONSE** - Time Specific - 9:00 a.m.

E. **RECOGNITION OF EMPLOYEES** *(Summary Sheet)*
Intro of new employee - Public Safety - Police Dept - Eddie McKeever; July 2009
Intro of new employee - Public Safety - Police Dept - James Tate; July 2009
TWENTY YEARS; Chip Holcomb; Public Safety - Fire Captain; August 2, 1989
THREE YEARS; Gregory South; Public Safety - Police Officer/CID; August 17, 2006
THREE YEARS; Paul Lipscomb; Public Safety - Police Officer; August 23, 2006

F. **CONSENT AGENDA**

4) Consideration of Budget Adjustment
*(Summary Sheet)* *(Memo)* *(Ordinance)* *(Spreadsheets)*

5) Consideration of Tax Adjustment Report *(Summary Sheet)* *(Report)*

6) Approval of Minutes *(Summary Sheet)* *(Aug 5 2009 minutes)*

7) Consideration of contract amendment for Automated Clearing House (paperless) transactions with First South Bank *(Summary Sheet)* *(Contract amendment)*

8) All Hazards Annual Report - part of annual Community Rating Service Report
*(Summary Sheet)* *(Report)*

9) Parks and Recreation Plan Survey *(Summary Sheet)* *(Survey)* *(Letter from Mayor)*

10) Request for Public Hearing to consider zoning ordinance text amendment initiated by the Nags Head Planning Board to Town Code Section 48-167(4), Required Parking by Use, Restaurants - to establish a definition for "neighborhood restaurant" and provide a reduced parking

**Town of Nags Head**

Planning and Development Department

Post Office Box 99
Nags Head, North Carolina 27959
www.townofnagshead.net

Telephone 252-441-7016
FAX 252-441-4290

Hazard Mitigation Planning Committee
Meeting #3
September 21, 2009

**Minutes**

Attendees

Dave Clark
Todd Kraft
Roberta Thuman
Butch Osborne
Angela Welsh
Ronnie Balance
David Ryan

Planning Staff reviewed with the 2007 Hazard Mitigation Plan which was distributed. This included the Mitigation Strategies and Polices section of the Plan. The Committee reviewed and discussed each policy and updated them with current mitigation activities.

It was suggested that the committee take out the policy #2 under Transportation and Drainage since the area discussed is not particularly vulnerable. It was also agreed that policy #4 under the same title be taken out since no feasible alternative transportation route exists. The Committee also agreed to revise policy #1 under the Infrastructure title. Under the Natural Resource Protection title it was agreed to strike policy #2.

The Committee also discussed repetitive loss properties and storms which have occurred since 2004. The two most prominent storms being Ophelia in September of 2005 and the Thanksgiving Day storm in 2006.

It was agreed that the Plan should be updated and forwarded to a public meeting on September 30, 2009.

**Angela Welsh**

**From:** Angela Welsh

**Sent:** Monday, September 21, 2009 9:13 AM

**To:** 'jessicap@darenc.com'; Sandy Sanderson; 'jheard@kittyhawktown.net'; 'cread@southernshores-nc.gov'; 'clayton@townofduck.com'; 'Davenport, Shanda'; Butch Osborne

**Subject:** Town of Nags Head Hazard Mitigation Plan update public meeting

ATTENTION

The Town of Nags Head is in the process of finalizing the Town's Hazard Mitigation Plan as required by the Federal Disaster Mitigation Act of 2000. The Town is holding a public meeting on Wednesday September 30, 2009 at 2:00 in the Board Room to present the draft plan update. The plan includes an assessment of the town's vulnerability to natural and human induced hazards as well as the mitigation strategies that have been proposed to lessen their impacts. Copies of the plan are also available on the Town's website. The Town would like to invite the public to comment on the plan by attending the meeting on September 30, 2009.

**Hazard Mitigation Plan update**

**2:00 p.m.**

**Wednesday, September 30, 2009**

**Board Room - Nags Head Municipal Complex**

Angela M. Welsh
Planner, Planning and Development Department
Town of Nags Head
252.441.7016
252.441.4290 fax
welsh@townofnagshead.net

Only after the last tree has been cut down, Only after the last river has been poisoned, Only after the last fish has been caught, Only then will you find money cannot be eaten.
~ Cree Prophecy

partnership ... signed ... students experience in personal finance so they can make educated decisions about money.

North Carolina Sen. Kay Hagan will be attending the event. The Democrat's first piece of legislation in Congress would provide states with incentives to expand financial literacy education.

# ATTENTION

The Town of Nags Head is in the process of finalizing the Town's Hazard Mitigation Plan as required by the Federal Disaster Mitigation Act of 2000. The Town is holding a public meeting on Wednesday September 30, 2009 at 2:00 pm in the Board Room to present the draft Plan update. The Plan includes an assessment of the Town's vulnerability to natural and human induced hazards as well as the mitigation strategies that have been proposed to lessen their impacts. Copies of the Plan are also available on the Town's website. The Town would like to invite the public to comment on the Plan by attending the meeting on September 30, 2009.

**Hazard Mitigation Plan update**
**2:00 p.m. • Wednesday, September 30, 2009**
**Board Room - Nags Head Municipal Complex**
**5401 S Croatan Highway; Nags Head 27959**

## NOTICE OF MUNICIPAL ELECTIONS FOR THE TOWNS OF: DUCK, KILL DEVIL HILLS, KITTY HAWK, MANTEO, NAGS HEAD & SOUTHERN SHORES

An election will be held on Tuesday, November 3, 2009 in the Towns of Duck, Kill Devil Hills, Kitty Hawk, Manteo, Nags Head and Southern Shores, to elect officials. The polls will be open for voting on November 3rd from 6:30 AM to 7:30 PM. Dare County municipal elections are non-partisan plurality elections. The candidates receiving the highest number of votes will be elected.

All voters registered within their Municipality are eligible to vote these elections. Residents of the county who are not registered to ... DAY, OCTOBER 9, 2009. A voter who he...

Town of Nags Head Hazard Mitigation Plan
Update Public meeting
September 30, 2009

George H. Moore N.H.
Richard S Edwards
Gwen Englebright N.H.

**APPENDIX J**

# Town of Kitty Hawk Hazard Mitigation Plan

Adopted October 5, 2009

# Town of Kitty Hawk Hazard Mitigation Plan
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## A. Introduction

Natural hazards, such as floods, hurricanes, tornadoes, winter storms, earthquakes, wildfires, and other hazardous natural events occur every year and re an essential component of the earth's natural systems. These events damage the ecological environment, but the natural environment possesses remarkable recuperative capabilities, restoring plant and animal habitat in a short time.

The built, or manmade, environment does not posses these recuperative capabilities. When these natural hazards interact with the built environment, disasters occur. The frequency of disasters is increasing, not necessarily because natural hazards are occurring more frequently, but as a result of more people choosing to live, work, and visit locations where the risks of natural hazards are greater. Since the 1960's increasing numbers of people are choosing to live and work in areas at risk from coastal storms and repetitive flooding. These facts make it imperative that coastal communities undertake floodplain management and hazard mitigation.

## B. Purpose

The Kitty Hawk Hazard Mitigation Plan conducts an assessment of current hazard risks and outlines objectives to eliminate, reduce, and mitigate risks. The plan is intended to guide policy in the Town's vulnerable areas and to assist state and federal funding efforts. This document has also been prepared to qualify as a "floodplain management plan" to be credited under the Community Rating System (CRS) of the National Flood Insurance Program (NFIP).

Due to its close proximity to the Atlantic Ocean and sounds, the Town of Kitty Hawk is particularly vulnerable to flooding and storm surge inundation. Developing a hazard mitigation plan and implementing hazard mitigation procedures can help the Kitty Hawk community save lives, reduce injuries, prevent or reduce property damage, reduce other economic losses, protect critical facilities, and minimize social dislocation and stress.

The Town of Kitty Hawk participates in the NFIP and is certified under the CRS. The NFIP provides federally supported flood insurance in communities that regulate development in their floodplains. The CRS reduces flood insurance premiums in those communities with safety and risk management programs that go above and beyond the minimum regulatory requirements.

This document has been formatted to fit within the context of the Dare County Hazard Mitigation Plan. Additional background information is contained in Dare County's plan and appendices. The format of this plan is useful to both Town and County policy makers, as the Town's specific concerns are put in the broader context of Dare County's goals and objectives.

## C. Town of Kitty Hawk Description

Located on the Outer Banks of North Carolina, the Town of Kitty Hawk was incorporated in 1981 and offers year-round residents and visitors a unique and relaxing environment. The Town consists of a thriving village that has been around for generations, newer beach community or residential cottages, commercial areas supporting the needs of the residents, and preserved maritime forest called Kitty Hawk Woods.

The beach and village areas of the community generally consist of low to medium density, single-family residential development served by relatively small-scaled businesses. The community contains a pattern of development that remains on a human scale and in harmony with nature. It is a pattern of development that Kitty Hawk residents, both year-round and seasonal, are quite comfortable with and want to retain. The boundaries and growth of Kitty Hawk are constrained by the Town's location abutting the Atlantic Ocean to the east, Town of Kill Devil Hills to the south, Kitty Hawk Bay/Currituck Sound to the west, and Town of Southern Shores to the north.

The current U.S. Census (2000) figure for the Town of Kitty Hawk shows a year round population of 2,991. According to a more recent estimate by the North Carolina State Data Center (2208), the population of Kitty Hawk has increased to a year round population of approximately 3,432. The Town's population during the peak tourist season in the summer increases many times that amount.

U.S. Census figures estimate that there were 2,622 housing units within the Town's 8.23 square miles in 2000. Current estimates place the number of housing units at over 3000. Of the 2,622 units counted by the Census Bureau, 1,265 are in use year round and 1,353 are classified as vacant units. 94.8% of the vacant units (1,282) are for "seasonal, recreational, or occasional use." A majority of these units are used for vacation purposes, either rented by the week to vacationers or seasonal use by the owner. According to the housing statistics from the U.S. Census Bureau, a majority (52.8%) of the housing units in Kitty Hawk were built between 1980 and 1989. Over 70% of the owner occupied units are valued at $100,000 and $199,999.

Please see the tables on the following pages for more detailed facts and figures concerning the population and housing characteristics of the Town of Kitty Hawk. These facts are intended to highlight the fact that, in addition to its tens of thousands of seasonal visitors, Kitty Hawk contains a variety of residents and housing stock that could potentially be affected by a natural or man-made disaster.

## Table 1: General Demographic Characteristics

Source: U.S. Census 2000

| POPULATION | | |
|---|---|---|
| **TOTAL POPULATION** | **2,991** | **100.0** |
| | | |
| **SEX** | | |
| Male | 1,523 | 50.9 |
| Female | 1,468 | 49.1 |
| | | |
| **AGE** | | |
| Under 5 years | 169 | 5.7 |
| 5 to 9 years | 174 | 5.8 |
| 10 to 14 years | 203 | 6.8 |
| 15 to 19 years | 163 | 5.5 |
| 20 to 24 years | 104 | 3.5 |
| 25 to 29 years | 177 | 5.9 |
| 30 to 34 years | 217 | 7.3 |
| 35 to 39 years | 261 | 8.7 |
| 40 to 44 years | 290 | 9.7 |
| 45 to 49 years | 265 | 8.9 |
| 50 to 54 years | 224 | 7.5 |
| 55 to 59 years | 188 | 6.3 |
| 60 to 64 years | 168 | 5.6 |
| 65 to 69 years | 137 | 4.6 |
| 70 to 74 years | 125 | 4.2 |
| 75 to 79 years | 72 | 2.4 |
| 80 to 84 years | 33 | 1.1 |
| 85 years and over | 21 | 0.7 |
| | | |
| Median Age | 40.6 | |
| | | |
| | | |
| | | |
| | | |
| **RACE** | | |
| White | 2,935 | 98.1 |
| Black or African American | 19 | 0.6 |
| American Indian and Alaska Native | 7 | 0.2 |
| Asian | 8 | 0.3 |
| Native Hawaiian and Other Pacific Islander | 1 | 0.0 |
| Some other race | 6 | 0.2 |
| Two or more races | 15 | 0.5 |
| | | |
| **HOUSEHOLDS** | | |

| | | |
|---|---|---|
| **TOTAL HOUSEHOLDS** | **1,265** | **100.0** |
| | | |
| **HOUSEHOLDS BY TYPE** | | |
| Family households (families) | 867 | 68.5 |
| With own children under 18 years | 353 | 27.9 |
| Married-couple family | 742 | 58.7 |
| With own children under 18 years | 288 | 22.8 |
| Female householder, no husband present | 92 | 7.3 |
| With own children under 18 years | 47 | 3.7 |
| Nonfamily households | 398 | 31.5 |
| Householder living alone | 301 | 23.8 |
| Householder 65 years and over | 101 | 8.0 |
| | | |
| Households with individuals under 18 years | 381 | 30.1 |
| Households with individuals 65 years and over | 285 | 22.5 |
| | | |
| Average household size | 2.35 | |
| Average family size | 2.79 | |

## Table 2: Housing Characteristics

Source: U.S. Census 2000

| **HOUSING UNITS** | | |
|---|---|---|
| | | |
| **TOTAL HOUSING UNITS** | **2,622** | **100.0** |
| | | |
| **HOUSING OCCUPANCY** | | |
| Occupied housing units | 1,265 | 48.3 |
| Vacant housing units | 1,353 | 51.7 |
| For seasonal, recreational, or occasional use | 1,282 | 49.0 |
| | | |
| Homeowner vacancy rate (percent) | 1.0 | |
| Rental vacancy rate (percent) | 13.7 | |
| | | |
| **HOUSING TENURE** | | |
| Occupied housing units | 1,265 | 100.0 |
| Owner-occupied housing units | 945 | 74.7 |
| Renter-occupied housing units | 320 | 25.3 |
| | | |
| Average household size of owner-occupied unit | 2.40 | |
| Average household size of renter-occupied unit | 2.23 | |
| | | |
| | | |
| **UNITS IN STRUCTURE** | | |
| 1-unit, detached | 1,778 | 67.8 |
| 1-unit, attached | 211 | 8.0 |
| 2 units | 30 | 1.1 |
| 3 or 4 units | 55 | 2.1 |
| 5 to 9 units | 180 | 6.9 |
| 10 to 19 units | 23 | 0.9 |
| 20 or more units | 6 | 0.2 |
| Mobile home | 333 | 12.7 |
| Boat, RV, van, etc. | 6 | 0.2 |
| | | |
| **YEAR STRUCTURE BUILT** | | |
| 1999 to March 2000 | 82 | 3.1 |
| 1995 to 1998 | 251 | 9.6 |
| 1990 to 1994 | 343 | 13.1 |

| | | |
|---|---|---|
| 1980 to 1989 | 1,385 | 52.8 |
| 1970 to 1979 | 314 | 12.0 |
| 1960 to 1969 | 136 | 5.2 |
| 1940 to 1959 | 74 | 2.8 |
| 1939 or earlier | 37 | 1.4 |
| | | |
| **Specified Owner-Occupied Units** | **770** | **100.0** |
| **VALUE** | | |
| Less than $50,000 | 2 | 0.3 |
| $50,000 to $99,999 | 94 | 12.2 |
| $100,000 to $149,999 | 333 | 43.2 |
| $150,000 to $199,999 | 208 | 27.0 |
| $200,000 to $299,999 | 100 | 13.0 |
| $300,000 to $499,999 | 24 | 3.1 |
| $500,000 to $999,999 | 7 | 0.9 |
| $1,000,000 or more | 2 | 0.3 |
| Median (dollars) | $144,600 | |

## D. Planning Process

Planning is one of the best ways to correct the challenges associated with hazard mitigation. The objective of the planning process is to produce a program of activities that will best tackle flooding and other hazard mitigation issues in the community. A well-prepared plan will guide a community's flood, stormwater, and related activities so that they can be implemented economically and in ways mote attuned to the needs and objectives of the community and its residents. A plan that is well-prepared and implemented will result in less flood damage during floods and improved protection of the floodplain's natural and beneficial functions, which achieves the objectives of the community and the National Flood Insurance Program (NFIP).

In response to repetitive flood losses in the late 1990's, Kitty Hawk worked with the North Carolina Division of Community Assistance (DCA) to prepare a floodplain management plan for Community Rating System (CRS) purposes. The DCA also facilitated the planning process as the Town officials and an appointed hazard mitigation planning committee provided important leadership and input into this project. The committee was divided into three groups with focus areas on preventive activities, property protection, and natural resource protection. Final approval of this plan occurred in 2005.

On October 5, 2009, the Kitty Hawk Town Council voted unanimously to adopt a resolution requesting that Kitty Hawk's updated plan be merged with the Dare County Hazard Mitigation Plan. A copy of this resolution is attached.

## E. Identifying Hazards

Kitty Hawk is located on a barrier island. By definition, a barrier island is a strip of land that evolved to absorb the ocean forces and protect the mainland. Ocean overwash, hurricane force winds, heavy waves, and erosion are natural processes on barrier islands and contribute to a dynamic shoreline. A barrier island left in its natural state is a constantly changing entity. An island with little or no development has few problems adjusting to the forces that nature places upon it. However, problems are more likely to occur when people build immovable objects on an island that is in a constant state of change. Like many communities in Dare County, the Town of Kitty Hawk is susceptible to many different natural hazards, including hurricanes, severe thunderstorms, tornadoes, flooding, severe winter storms, and Nor'easters.

The Town accepts and acknowledges the hazards identified by Dare County.

## F. Profiling Hazards

The Town of Kitty Hawk acknowledges and accepts the hazard profiles and analysis performed by Dare County.

## G. Assessing Vulnerability

The Town of Kitty Hawk acknowledges and accepts the vulnerability assessment performed by Dare County.

In a disaster preparedness and response, "vulnerable populations" are people who feel they cannot comfortably or safely access and use the standard resources offered in disaster preparedness, relief and recovery. They include by are not limited to those who are physically or mentally disabled (blind, deaf, hard-of-hearing, cognitive disorders, mobility limitations), limited or non-English speaking, geographically or culturally isolated, medically or chemically dependent, homeless, frail/elderly, and children.

The Kitty Hawk Police and Fire departments maintain a list and knowledge of many individuals in the community with special needs. The Town does not contain larger facilities with vulnerable populations (such as nursing homes, group homes, orphanages, etc.), but does have several preschool and day care facilities.

- Heron Pond Montessori School (2 locations)
- Kitty Hawk Methodist Church Preschool
- Ocean View Preschool
- Sea Me Grow Day Care

However, the Town has specifically identified the following "critical facilities" that are essential to the health, safety, and viability of the community. These are the buildings, services, and utilities without which residents and businesses cannot function for a lengthy period of time.

- Kitty Hawk Town Hall
- Kitty Hawk Police Department
- Kitty Hawk Fire Department
- Kitty Hawk Public Works Department
- Kitty Hawk Bath House
- United States Post Office
- Dominion Power Facility & Power Lines
- Croatan Highway (U.S. Hwy. 158)
- Virginia Dare Trail (N.C. Hwy. 12)
- Kitty Hawk Road
- Beach Access Points
- Sandy Run Park
- Dare County Boat Landing

## H. Assessing Community Capability

The Town of Kitty Hawk has a relatively small staff with limited resources and capabilities. The mitigation strategies chosen are financially feasible and appropriate to meet the needs and capabilities of the Town.

Kitty Hawk has participated in the National Flood Insurance Program (NFIP) since the adoption of a town-wide flood damage prevention ordinance in 1984, shortly after the Town's incorporation in 1981. Prior to that time, the area of the town was covered by Dare County's flood program. The Town has been involved with the Community Rating System (CRS) program since 1991 and currently maintains a Class 6 rating (tied for the best of any community on the Outer Banks). The CRS rating has been accomplished by the Town's commitment to reduce property damage and save lives while facilitating development in accordance with local, State, and Federal regulations.

In addition to the Town's CRS program, there are many existing policies, programs, and ordinances that may affect the Town's vulnerability to hazards and its ability to respond appropriately, including:

- Town of Kitty Hawk Storm Preparedness, Response & Recovery Plan
- Town of Kitty Hawk Zoning Ordinance

- Town of Kitty Hawk Subdivision Ordinance
- Town of Kitty Hawk Flood Damage Prevention Ordinance
- Town of Kitty Hawk CAMA Land Use Plan

## I: Identification & Analysis of Potential Mitigation Actions

| ***Policies and Programs*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** |
|---|---|---|
| **1. Preventive** | | |
| Planning and zoning | High | Low |
| Open space preservation | High | Low |
| Floodplain regulations | High | Medium |
| Stormwater management | High | Medium |
| Drainage system maintenance | Low | High |
| Dune and beach maintenance | Low | High |
| Floodplain management | High | Low |
| Thoroughfare planning | Medium | High |
| Public information program strategy | High | Low |
| Erosion and sediment control | Medium | Medium |
| **2. Property Protection** | | |
| Relocation | High | High |
| Acquisition | High | High |
| Building elevation | High | High |
| Floodproofing | Medium | Low |
| Insurance | High | High |
| Landscaping/Fill | High | Medium |
| **3. Natural Resource Protection** | | |
| Wetlands protection | Medium | High |
| Coastal barrier protection | Low | High |
| **4. Emergency Services** | | |
| Flood warning | High | High |
| Flood response | High | High |
| Critical facilities protection | Medium | High |
| Health and safety maintenance (septic tanks) | High | High |
| **5. Structural Projects** | | |
| Beach nourishment | Medium | High |
| Storm sewer | High | Medium |
| Dune stabilization | High | High |
| Drainage system maintenance | High | High |
| **6. Public Information Activities** | | |
| Map information | High | Low |
| Library | High | Low |
| Technical assistance (local, state, federal) | High | Low |
| Outreach projects | High | Low |
| Real estate disclosure | High | Low |
| Public information program study | High | Low |
| CAMA Area of Environmental Concern notice | Medium | Low |

## J. Implementation of Mitigation Actions: 2005 Kitty Hawk Plan

**Preventive**

1. Implement beach and dune re-nourishment projects.
    - In 2005, the Town completed a beach nourishment project to replace areas of the oceanfront beach and dune lost during Hurricane Isabel.
    - In 2006, the Town planted beach grass to help stabilize approximately three miles of the primary oceanfront dune.
    - In 2007-08, the Town erected over 2.5 miles of sand fencing to help stabilize the primary oceanfront dune.

2. Develop an overall drainage plan for Kitty Hawk.
    - In 2006, an engineering firm completed a stormwater management study for the Town of Kitty Hawk that identified the most significant drainage issues.

3. Revise the storm response plan for Kitty Hawk.
    - On an annual basis, the Town of Kitty Hawk reviews and updates a Storm Preparedness, Response & Recovery Plan.

**Property Protection**

1. Educate homeowners on various mitigation techniques and resources available to them.
    - The Town sends educational mailings to all property owners twice a year as part of its CRS program. The mailed brochure contains information about flood safety and property protection measures, as well as links to more detailed resources.
    - The Town provides general information and links to more detailed resources on its website, local government cable channel, and newsletter.
    - The Town maintains and updates a data base of current flood damage prevention information that is offered to the public.

2. Provide homeowners with the tools necessary to individually hazard-proof their own homes.
    - The Town sends educational mailings to all property owners twice a year as part of its CRS program. The mailed brochure contains general information about flood-proofing homes, as well as links to more detailed resources.
    - The Town provides general information and links to more detailed resources on its website, local government cable channel, and newsletter.
    - The Town maintains and updates a data base of current hazard-proofing information that is offered to the public.

3. Encourage homeowners to remove questionable vegetation around their homes.
    - Although this information is contained in some of the publicly distributed hazard-proofing materials, the Town has not engaged in any active efforts to promote this specific objective.

4. Encourage homeowners to conduct an inventory of their assets to assist with damage claims.
    - Although this information is contained in some of the publicly distributed materials regarding flood insurance, the Town has not engaged in any active efforts to promote this specific objective.

**Natural Resource Protection**

1. Educate citizens on dune vegetation.
    - The Town has provided a copy of *The Dune Book*, an educational booklet on the natural process and importance of maintaining dunes published by N.C. Sea Grant, to every interested property owner in Kitty Hawk.

- In cooperation with the N.C. Cooperative Extension Service, the Town developed a list of beach grasses, marsh vegetation, and other native plants.
- In 2005, the Town initiated an educational program and made signs available to beachfront homeowners advising people not to walk on dunes or damage dune vegetation.

2. Establish town plans for mitigation and recovery through workshops on disaster planning, recovery and reconstruction.
    - On an annual basis, the Town of Kitty Hawk reviews and updates a Storm Preparedness, Response & Recovery Plan.
    - In 2007-2008, all Town employees responsible for emergency preparedness, response, and recovery efforts completed a series of courses offered by FEMA and the N.C. Division of Emergency Management on the National Incident Management System.

3. Clean out culverts to relieve standing water from flooding.
    - In 2006, the Town hired a contractor to complete a "snag and pull" project to remove tree growth and debris from major drainage ditches and waterways.
    - In 2006, NCDOT replaced a number of culverts and cleaned out ditches and outfalls along W. Kitty Hawk Road.

4. Implement plan to arrange for annual topographic information throughout the Town.
    - The Town does not collect this information itself, but works with individual property owners to provide this information from USGS paper and electronic maps.

5. Collect beach erosion data annually.
    - The Town does not have the resources to conduct this type of study. However, the N.C. Division of Coastal Management is monitoring beach erosion very closely and makes that information available to the Town when needed.

**Emergency Services**

1. Update and improve the protocols and procedures (local, county, and state) by which the citizens in Kitty Hawk are made aware of impending storm events and expected impacts.
    - On an annual basis, the Town reviews and updates a Storm Preparedness, Response & Recovery Plan that covers the procedures for notifying residents about impending storm events, as well as notifying residents of available resources during and after a storm.

2. Work with Dare County Control Group to prepare the provision of needed equipment and services to persons and businesses in need of assistance.
    - On an annual basis, the Town of Kitty Hawk and other municipalities enter into an agreement with Dare County to provide equipment and support in case of a significant storm event.
    - The State of North Carolina also has equipment and procedures to respond when needed to provide disaster relief.

3. Define procedures and practices to maintain critical facilities and services to the maximum extent possible during and after a storm event.
    - On an annual basis, the Town reviews and updates a Storm Preparedness, Response & Recovery Plan that defines the roles of each Town department, coordination with other agencies, and provision of back-up services by an outside contractor.
    - The Town enters into agreements with local governments and private contractors on an annual basis to provide back-up supplies and services in the event of a significant storm.

4. Cooperate with Dare County Environmental Health and provide and develop a capacity to assist homeowners with mitigating septic tank failures during storm events.
    - The Town has not taken any action to address this objective.

**Structural Projects**

1. Encourage NC Department of Transportation to elevate Kitty Hawk's highway to Kitty Hawk Landing.
    - An approximately 0.6 mile stretch of W. Kitty Hawk Road was regarded and raised to prevent frequent flooding issues.
    - The Town has formally requested that grading and elevating the remaining portion of Kitty Hawk Road be placed on the list of regional transportation improvement projects for potential funding in the future.

**Public Information**

1. Maintain updated flood map information for citizens and customers.
    - The Kitty Hawk Planning & Inspections Department maintains and distributes paper and electronic versions of FEMA flood maps and technical bulletins.
    - The Town also provides flood information and website links on the Town's website and consistently in the Town newsletter.

2. Initiate outreach projects to inform the public on Town and County initiatives that will reduce hazard related losses of property and life.
    - The Town sends educational mailings to all property owners twice a year as part of its CRS program, as well as additional mailing to repetitive loss property owners.
    - The Town provides flood safety and protection information and website links on the Town's website and newsletter.
    - The Town has developed a PowerPoint presentation and hosted public forums on flood retrofitting.
    - The Town placed important flood information in slideshow that runs on the local government cable channel.

**K: Kitty Hawk Hazard Mitigation Plan – Goals & Actions**

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| **Preventive**<br>**Goals: 1. Pursue beach and dune renourishment as funding becomes available**<br>**2. Resolve identified stormwater drainage issues flood-free roads and highways**<br>**3. Revise storm preparedness, response, and recovery plan** | | | | | |
| Implement beach and dune renourishment projects as funding becomes available | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | Federal/State Grants/Programs | Town Council | Ongoing | High |
| Implement stormwater drainage improvements per the studies/plan | Flooding, Hurricanes and Tropical Storms, Nor'easters | General Fund State Transport. Funds | Town Manager, Public Works | Ongoing | High |
| Revise the storm preparedness, response, and recovery plan for Kitty Hawk | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Town Staff, Town Council | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| **<u>Property Protection</u>**<br><br>**Goals: 1. Reduce individual property owners' losses**<br>**2. Find cost-effective solutions**<br>**3. Streamline damage assessment procedures** | | | | | |
| Educate homeowners on various mitigation techniques and resources available to them | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion, Thunderstorms | General Fund | Planning | Ongoing | High |
| Provide homeowners with the resources necessary to individually hazard-proof their own homes | Flooding, Hurricanes and Tropical Storms, Nor'easters | General Fund | Planning, Inspections | Ongoing | High |
| Encourage homeowners to conduct an inventory of their assets to assist with damage claims | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion, Wildfire | General Fund | Planning | Ongoing | High |
| **<u>Natural Resource Protection</u>**<br><br>**Goals: 1. Educate citizens about the importance of open space and natural resource protection**<br>**2. Promote dune and beach renourishment and support local actions**<br>**3. Establish a hazard mitigation plan, a disaster preparedness plan, and a storm reconstruction/recovery plan**<br>**4. Maintain the existing stormwater drainage system, including all waterways, ditches, and canals**<br>**5. Closely monitor beach erosion** | | | | | |
| Educate citizens about dune vegetation | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Planning, Public Works | Ongoing | High |
| Establish town plans for mitigation and recovery through information on disaster planning, recovery and reconstruction | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Town Staff, Town Council | Ongoing | High |
| Clean out culverts, ditches, and waterways to relieve standing water and facilitate the | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | NCDOT General Fund | Public Works, NCDOT | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| stormwater drainage | | | | | |
| Collect beach erosion data annually | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | NC Division of Coastal Management | NC Division of Coastal Management | Ongoing | High |
| **<u>Emergency Services</u>**<br>**Goal: Improve public safety during and after a storm event** | | | | | |
| Update and improve the protocols and procedures (local, county, and state) by which the citizens in Kitty Hawk are made aware of impending storm events and expected impacts | Flooding, Hurricanes and Tropical Storms, Nor'easters | General Fund | Town Council, Dare County Emergency Management | Ongoing | High |
| Work with Dare County Control Group to prepare the provision of needed equipment and services to persons and businesses in need of assistance | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | Town Council, Dare County Emergency Management | Ongoing | High |
| Work with Dare County to improve the communication systems between all public safety departments within the towns, county, and state so that in the event of a disaster, all entities will be able to communicate with one another. | | Capital Reserve Fund | Town Council, Town Staff, Dare County Emergency Management, Dare County Sheriff's Dept. | Ongoing | High |
| Define procedures and practices to maintain critical facilities and services to the maximum extent possible during and after a storm event | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | Town Staff, Town Council | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| | | | | | |
| **<u>Structural Projects</u>**<br>**Goals: 1. Pursue beach and dune renourishment**<br>**2. Raise roadways above the expected flood levels** | | | | | |
| Implement beach and dune renourishment projects as funding becomes available | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | Federal/State Grants/Programs | Town Council | Ongoing | High |
| Encourage NC Department of Transportation to elevate Kitty Hawk's highway to Kitty Hawk Landing | Flooding, Hurricanes and Tropical Storms, Nor'easters | NCDOT | NCDOT<br>Town Council | Ongoing | High |
| **<u>Public Information</u>**<br>**Goals: 1. Inform property owners about hazard mitigation**<br>**2. Improve overall communication with other governmental agencies and the media** | | | | | |
| Maintain updated flood map information for citizens and customers | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion | NC Division of Emergency Management | NC Division of Emergency Management, Planning | Ongoing | High |
| Initiate outreach projects to inform the public on Town and County initiatives that will reduce hazard related losses of property and life | Flooding, Hurricanes and Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | Planning | Ongoing | High |

**Annex 5**

POST OFFICE BOX 549
101 VETERANS MEMORIAL DRIVE
KITTY HAWK, NC 27949

PHONE (252) 261-3552
FAX (252) 261-7900
WWW.TOWNOFKITTYHAWK.ORG
E-MAIL: INFO@TOWNOFKITTYHAWK.ORG

**RESOLUTION REQUESTING THE DARE COUNTY BOARD OF COMMISSIONERS TO MERGE THE HAZARD MITIGATION PLAN FOR THE TOWN OF KITTY HAWK WITH THE DARE COUNTY HAZARD MITIGATION PLAN**

**WHEREAS,** on October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 to reinforce the importance of the pre-disaster mitigation planning to help reduce disaster losses; and

**WHEREAS,** North Carolina Senate Bill 300 requires all local governments to have an approved Hazard Mitigation Plan in order to receive state public assistance funds (effective for state declared disasters after November 1, 2004); and

**WHEREAS,** the Town of Kitty Hawk Hazard Mitigation Plan (Plan) was approved on November 1, 2004 by the Kitty Hawk Town Council and subsequently approved by the Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management (NCEM); and

**WHEREAS,** the Town of Kitty Hawk is in the process of updating the Town of Kitty Hawk Hazard Mitigation Plan as required every five (5) years by FEMA and NCEM; and

**WHERAS,** the Town of Kitty Hawk, in accordance with guidance provided by FEMA, NCEM, and the County of Dare, now desires to merge said Plan with the County of Dare as a part of its Hazard Mitigation Plan update which is currently in process.

**NOW, THEREFORE, BE IT RESOLVED** on this 5th day of October 2009, the Town Council of Kitty Hawk hereby requests that the Dare County Board of Commissioners incorporate the Town of Kitty Hawk Mitigation Plan as part of a Multi-Jurisdictional Hazard Mitigation Plan Update for Dare County.

**Adopted this 5th day of October 2009.**

**Clifton G. Perry, Mayor**

**ATTEST:**

**Lynn Morris, Town Clerk**

**Appendix K**

TOWN OF KILL DEVIL HILLS

# Hazard Mitigation Plan

Image: Hurricane Isabel, September 15, 2003
Courtesy of NOAA

Kill Devil Hills Board of Commissioners

Raymond P. Sturza II, Mayor
Bob Woodard
Bob Peele
Jeffrey Finch
Paul Buske

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# Town of Kill Devil Hills
# Hazard Mitigation Plan

**Introduction**

This document is the Town of Kill Devil Hills' Hazard Mitigation Plan and a component of the multi-jurisdiction plan sponsored by Dare County. It is prepared to guide policy in the Town's vulnerable areas and to assist state and federal funding efforts. This document has also been prepared to qualify to be credited under the Community Rating System (CRS) of the National Flood Insurance Program (NFIP).

The Town of Kill Devil Hills participates in the NFIP and is certified under the CRS. The NFIP provides federally subsidized flood insurance in communities that regulate development in their floodplains. The CRS reduces flood insurance premiums in those communities that do more than implement the minimum regulatory requirements. The Town has developed this plan in order to limit life and property losses in the event of a major flood.

Additional credit is provided if the activities are implemented based on a floodplain management plan that meets the criteria in Section 511 of the *CRS Coordinator's Manual*. The approach selected for preparing this plan was taken from Section 511 and this plan's section headings coincide with Section 511's headings.

It is not economically feasible to attempt to provide protection against the largest flood that could occur. Such protection would be too costly for such a rare event. Therefore, governmental and private institutions have agreed that a one-percent flood (1/100) is the most infrequent event to be protected against. 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 – 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 Town received Flood Insurance Rate Maps (FIRM), effective October 20, 2006, resulting from a revised Flood Insurance Study. . .

**Demographic Profile**

Kill Devil Hills has a total population of 6,282, according to the NC Office of Budget and Management, July 1, 2002.

**Table 1. Kill Devil Hills Population Data**

**Source: US Census 2000 Summary File 1**

| Subject | Number | Percent |
|---|---|---|
| **TOTAL POPULATION** | 5,897 | 100.0 |
| Male | 3,021 | 51.2 |
| Female | 2,876 | 48.8 |
| Median Age (years) | 36.7 | (X) |
| Under 5 years | 304 | 5.2 |
| 18 years and over | 4,664 | 79.1 |
| Male | 2,403 | 40.7 |
| Female | 2,261 | 38.3 |
| 65 years and over | 630 | 10.7 |
| | | |
| Under 5 years | 304 | 5.2 |
| 5 to 9 years | 357 | 6.1 |
| 10 to 14 years | 398 | 6.7 |
| 15 to 19 years | 271 | 4.6 |

| Subject | Number | Percent |
|---|---|---|
| 20 to 24 years | 344 | 5.8 |
| 25 to 34 years | 1,077 | 18.3 |
| 35 to 44 years | 1,171 | 19.9 |
| 45 to 54 years | 832 | 14.1 |
| 55 to 59 years | 291 | 4.9 |
| 60 to 64 years | 222 | 3.8 |
| 65 to 74 years | 415 | 7.0 |
| 75 to 84 years | 180 | 3.1 |
| 85 years and over | 35 | 0.6 |
| | | |
| **RACE** | | |
| White | 5,685 | 96.4 |
| Black or African American | 36 | 0.6 |
| Hispanic or Latino | 174 | 3.0 |
| American Indian and Alaska Native | 10 | 0.2 |
| Asian | 35 | 0.6 |
| Native Hawaiian / Pacific Islander | 7 | 0.1 |
| Some other race | 62 | 1.1 |
| Two or more races | 62 | 1.1 |
| | | |
| **SOCIAL CHARACTERISTICS** | | |
| Population 25 years and over | 4,154 | 100.0 |
| High school graduate or higher | 1,109 | 91.3 |
| Bachelor's degree or higher | 815 | 27.0 |
| Disability status (21 to 64 years) | 504 | 13.2 |
| Foreign Born | 196 | 3.3 |
| Now married (population 15 years and over) | 2,482 | 51.9 |
| **Subject** | **Number** | **Percent** |
| Speak a language other than English at home | 282 | 5.1 |
| | | |
| **HOUSING CHARACTERISTICS** | | |
| Total housing units | 5,302 | 100.0 |
| Occupied housing units | 2,585 | 48.8 |
| Owner-occupied housing units | 1,743 | 67.4 |
| Renter-occupied housing units | 842 | 32.6 |
| Vacant housing units | 2,717 | 51.2 |
| | | |
| **YEAR STRUCTURE BUILT** | | |
| 1999 to 2000 | 180 | 3.4 |
| 1995 to 1998 | 416 | 7.9 |
| 1990 to 1994 | 834 | 15.8 |
| 1980 to 1989 | 1,664 | 31.5 |
| 1970 to 1979 | 1,255 | 23.7 |
| 1960 to 1969 | 603 | 11.4 |
| 1940 to 1959 | 320 | 6.1 |
| 1939 or earlier | 14 | 0.3 |
| | | |
| **INCOME IN 1999** | | |
| Median household income | $39,713 | (X) |

| Subject | Number | Percent |
|---|---|---|
| Median family income | $44,681 | (X) |
| Per capita income | $20,679 | (X) |
| Male full-time earnings, year-round workers | $31,431 | (X) |
| Female full-time earnings, year-round workers | $23,206 | (X) |

**Economic Profile**

During the year 2001, 19.2% of the labor force was employed in the arts, entertainment, recreation, and food service industries, with another 17.0% working in retail trade. Another 16.0% were employed in construction.

| Industry | Number | Percent |
|---|---|---|
| Agriculture or Fishing | 59 | 1.7 |
| Construction | 554 | 16.0 |
| Manufacturing | 118 | 3.4 |
| Wholesale Trade | 57 | 1.6 |
| Retail Trade | 590 | 17.1 |
| Transportation/Communications/Public Utilities | 54 | 1.6 |
| Information | 113 | 3.3 |
| Finance/Insurance/Real Estate | 373 | 10.8 |

| Industry | Number | Percent |
|---|---|---|
| Professional, scientific, management, administrative | 225 | 6.5 |
| Educational, health, and social services | 313 | 9.0 |
| Arts, entertainment, recreation, and food services | 664 | 19.2 |
| Other services (except public administration) | 142 | 4.1 |
| Public administration | 199 | 5.7 |
| **TOTAL WORKFORCE** | 3,461 | 100.0 |

**The Planning Process**

*Purpose*

This Hazard Mitigation Plan makes an assessment of our current natural hazard vulnerability risk and sets forth goals to eliminate, reduce, and mitigate this risk.

The purpose of the plan is to establish procedures and actions that can reduce the potential for the loss of life, minimize damage to property and to provide a framework for orderly reconstruction in the event of a hurricane or other natural disaster. Planning is on of the best ways to mitigate damage as a result of natural hazards. The objective of planning is to produce a program of activities that will best tackle the community's hazards and meet other community needs. A well-prepared plan will guide a community's flood, stormwater, and hazard mitigation activities so that they are implemented more economically and in ways more attuned to the needs and objectives of the community and its residents. A well-prepared plan will result in lower hazard losses and improved protection of the floodplain's natural and beneficial functions.

**Incorporation with Existing Plans, Studies, and Reports**

The Hazard Mitigation Plan incorporates existing plans, studies, and reports into the document. The existing plans that were reviewed were:

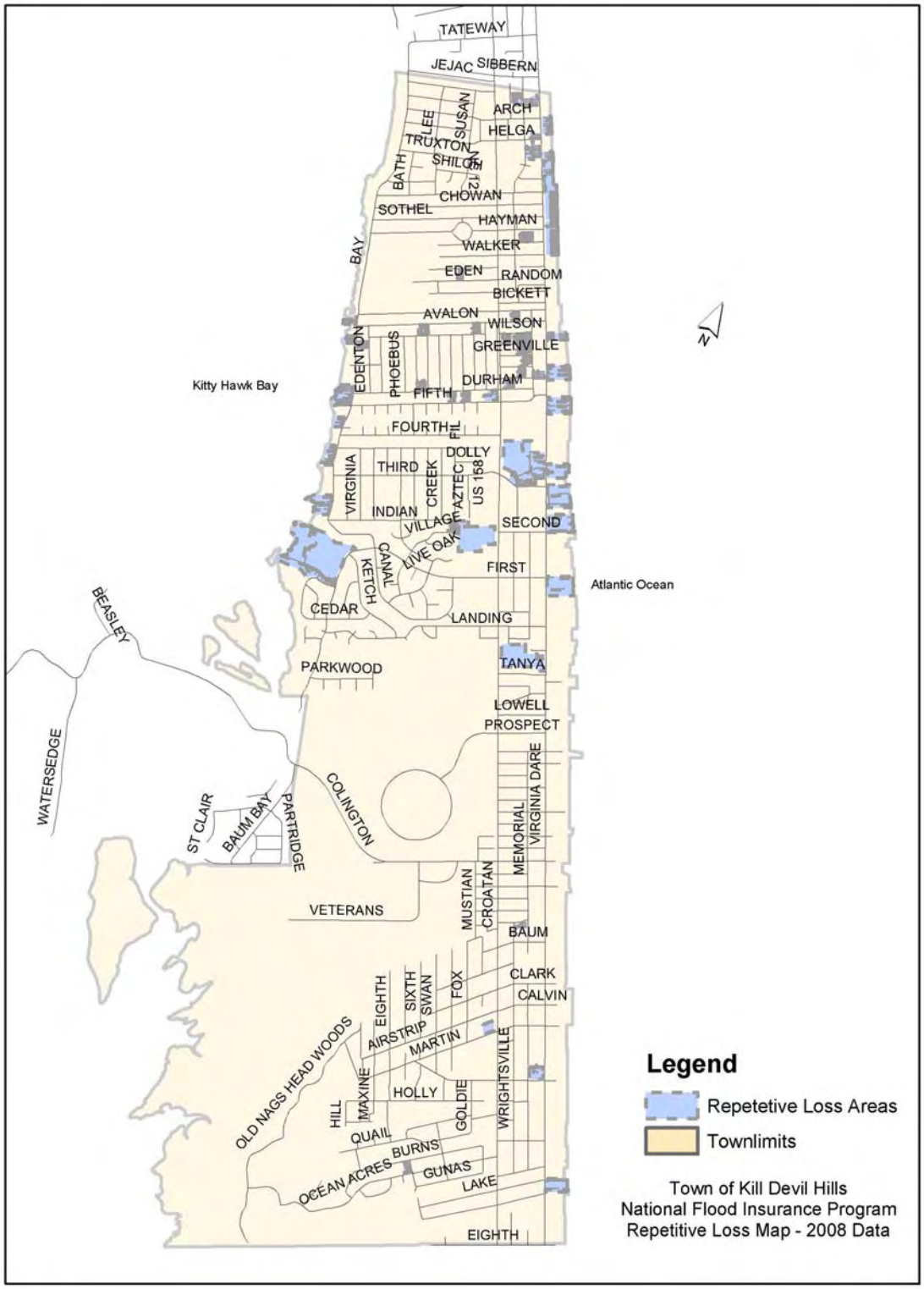
- Kill Devil Hills CAMA Land Use Plan
- Kill Devil Hills Flood Insurance Study
- Kill Devil Hills Floodplain Management Plan
- Kill Devil Hills Stormwater Management Plan
- Street Improvements Master Plan
- Kill Devil Hills Repetitive Loss Plan

**Hazard Assessment**
Kill Devil Hills is located on a barrier island located off the coast of northeastern North Carolina. It is bounded on the east by the Atlantic Ocean, the south by Nags Head, the north by Kitty Hawk and on the west by Albemarle Sound. The Town is approximately 4.6 miles long, north to south, and approximately one mile wide (5.6 square miles). The town of Kill Devil Hills is susceptible to natural and man-made hazards. The Town has comparable hazards as other local municipalities and Dare County. The Town accepts and acknowledges the hazards identified by the county, the description of such hazards, and the risk/vulnerability assessments that the County deems appropriate.

**Repetitive Loss Areas**
Based on a recent NFIP report, the Town of Kill Devil Hills has 97 repetitive loss properties. A repetitive loss property is one for which tow or more NFIP losses of at least $1,000 each have been paid since 1978. Because repetitive flooding accounts for approximately 40% of all flood insurance claims payments, a Category C community (10 or more repetitive loss properties) must submit a repetitive loss plan under the CRS program for credit under this activity.

Because this Floodplain Management Plan is prepared in accordance with CRS guidelines, FEMA has agreed that it will qualify as the Town's Repetitive Loss Plan needed for the CRS. Figure 1 illustrates the location of the repetitive loss areas.

Figure 1 – Repetitive Loss Areas



**Flood Hazard Inventory**
According to FEMA, the Town has 3,774 policies in force.

There are 6,950 properties within the corporate limits of Kill Devil Hills.

There are 508 properties located in Zone VE, of which 442 are developed (87%). In Zone AE, there are 4,771 properties and 4,015 are developed (84%). Zone X (outside the mapped floodplain) contains 1,671 properties and 1,327 developed properties (79%).

**Table 2. Kill Devil Hills Residential Properties By Flood Zone**

| Flood Zone | Total # Properties | Total Improved |
|---|---|---|
| VE | 508 | 442 |
| AE | 4,771 | 4,015 |
| X | 1,671 | 1,327 |
| **Total:** | **6,950** | **5,784** |

Table 3 and 4 illustrate the vulnerability of structures within each zone.

For residential properties, the number of existing residential properties was multiplied by the average number of persons per household (2.3313) according to the 1990 Census. Also, the tax assessment for each property, minus the land value, was included to calculate the potential value of properties located within the flood zone to determine a rough estimate of the potential property damage that may occur. The number of vacant lots in each flood zone was included in the assessment and was multiplied by the average number of persons per household to project how many people would potentially be impacted by a coastal storm event. For projection purpose, each vacant lot was assumed to have one building/structure on it in the future. Additionally, the number of projected residential buildings was multiplied by the average property value, minus the land value, for the existing properties within that particular flood zone. While this method makes the assumption that a flood would destroy all vulnerable property, this is very unlikely. These estimates should be considered as "worst-case scenarios."

The same methodology was used for commercial properties. The linear feet of roads in each flood zone was also calculated and multiplied by $150 per linear foot to determine the potential replacement cost if the roads in the flood zone were adversely impacted.

**Figure 2 – Flood Zones**

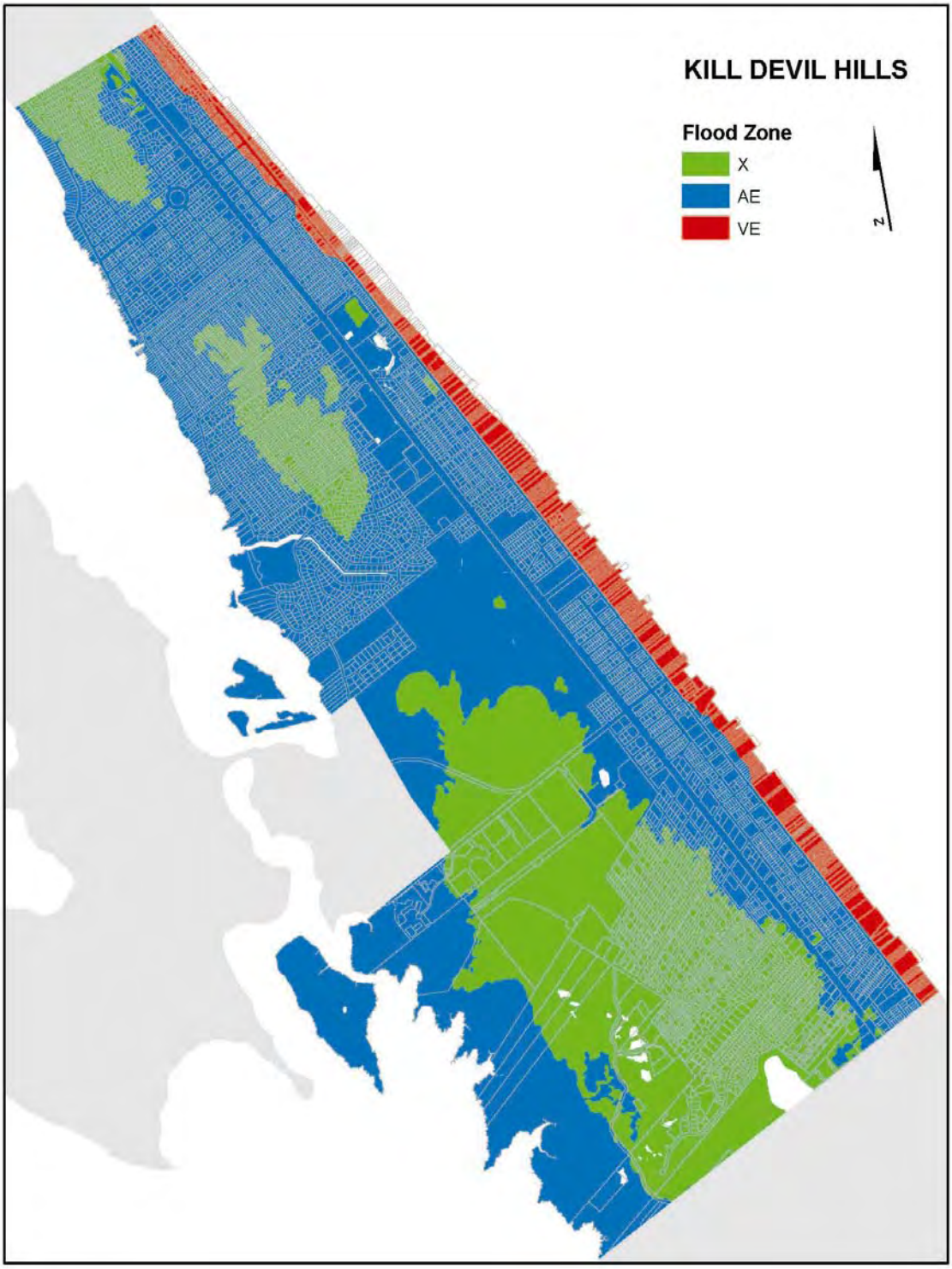


**Figure 3 – Slow-Moving Hurricane Storm Surge**

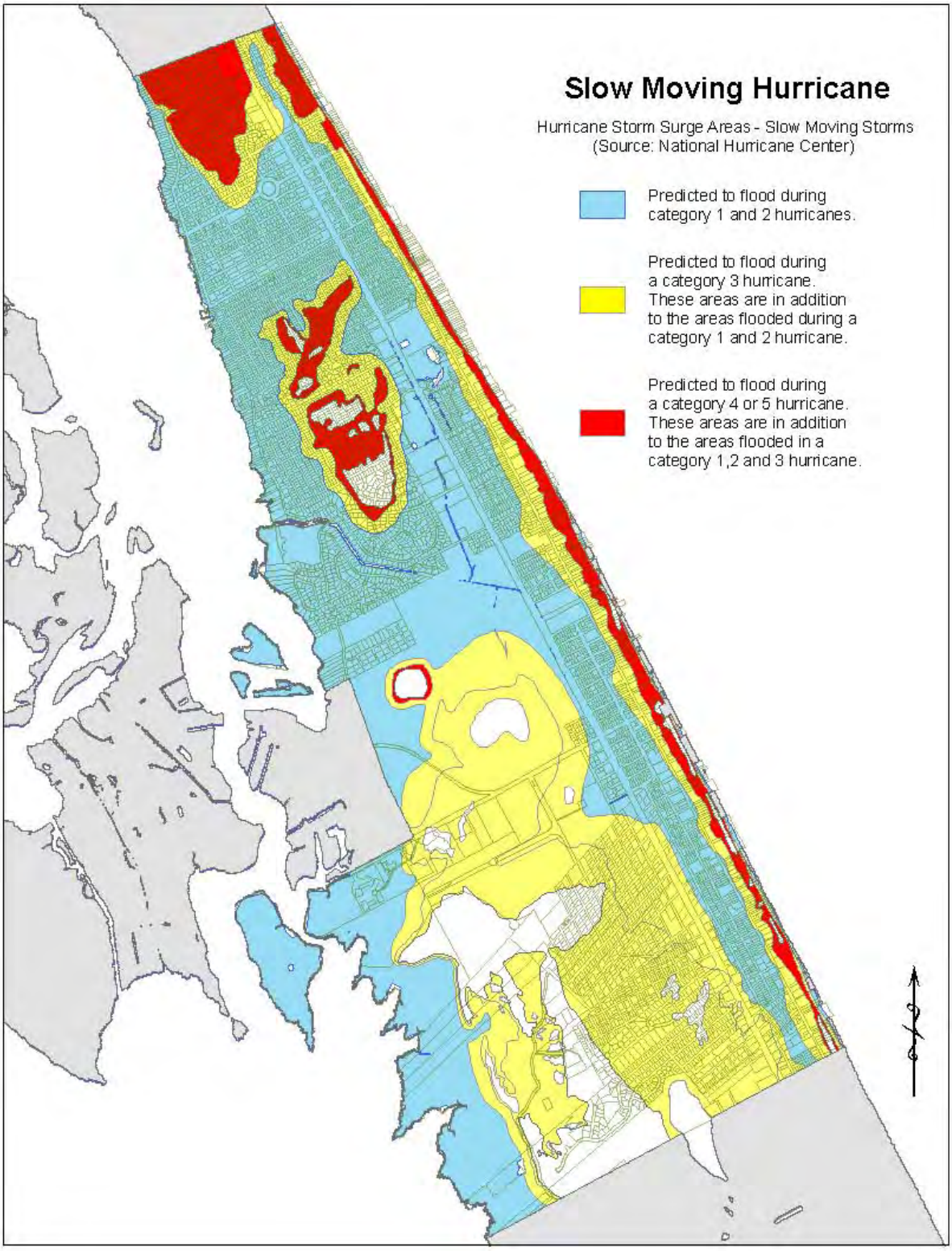


**Figure 3 – Fast-Moving Hurricane Storm Surge**

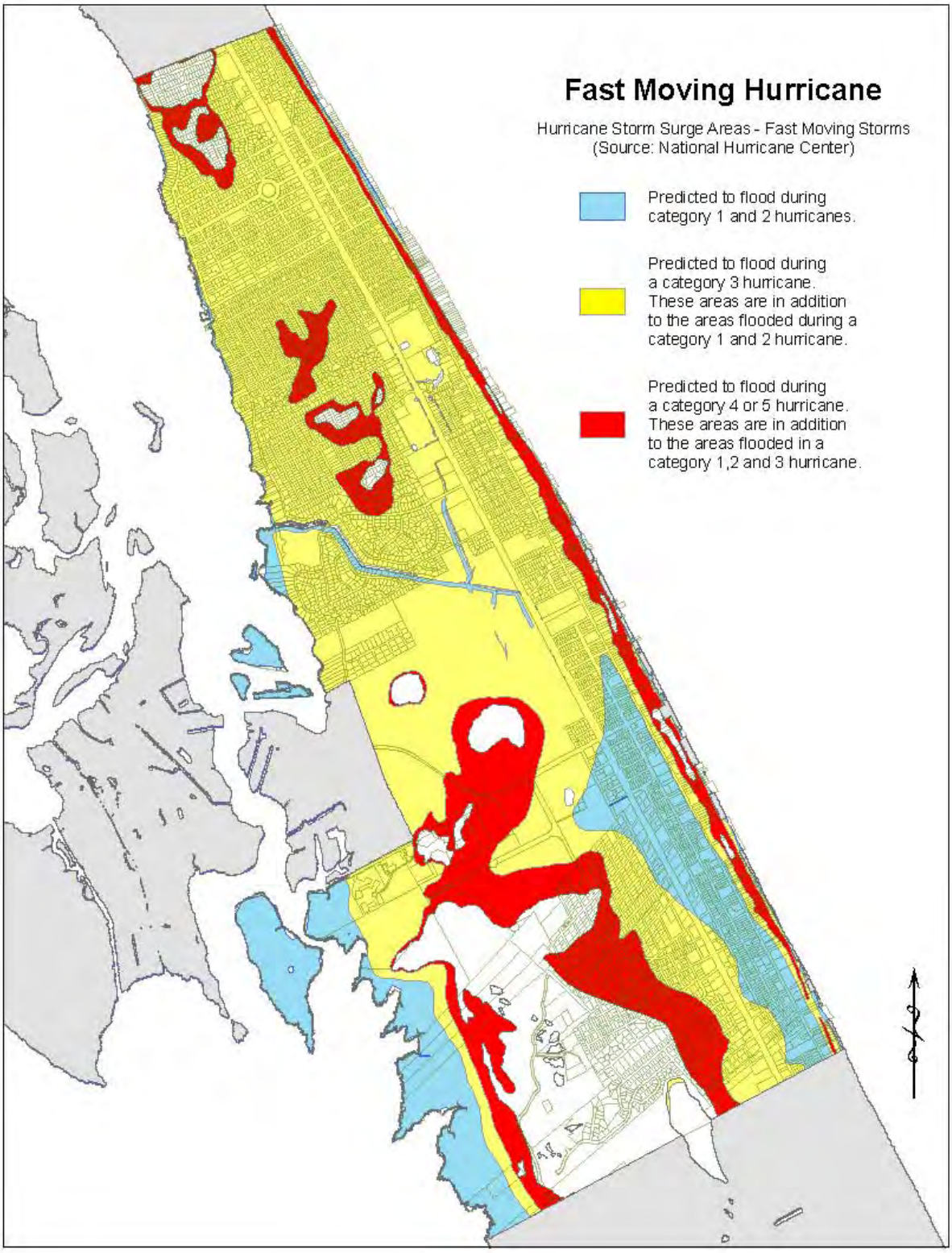



***Table 3. VE Flood Zone Area Vulnerability Assessment***

***Kill Devil Hills Area Vulnerability Assessment***

***Hazard Area Location: VE Zone***

| | Developed Land | | | Undeveloped Land | | |
|---|---|---|---|---|---|---|
| | Number of People | Number of Buildings (from tax records) | Approximate Value (from tax records) | Number of People (if developed under existing policies) | Number of Buildings (if developed under existing policies) | Approximate Value (average current value times the number of buildings from previous columns |
| Residential | 863 | 370 | $104,274,800 | 42 | 18 | $5,072,828 |
| Commercial | | 20 | $35,682,400 | | 22 | $39,250,640 |
| Industrial | | 0 | 0 | | 0 | 0 |
| **Total** | **863** | **390** | **$139,957,200** | | **1** | **$44,323,468** |
| Public Buildings and Critical Facilities | | | Replacement Value | | | |
| *Roads* | | 4,750’ | $712,500 | | | |

**Table 4. AE Flood Zone Area Vulnerability Assessment**

**Kill Devil Hills Area Vulnerability Assessment**
**Hazard Area Location: AE Zone**

| | Developed Land | | | Undeveloped Land | | |
|---|---|---|---|---|---|---|
| | Number of People | Number of Buildings (from tax records) | Approximate Value (from tax records) | Number of People (if developed under existing policies) | Number of Buildings (if developed under existing policies) | Approximate Value (average current value times the number of buildings from previous columns |
| Residential | 8,868 | 3,804 | $492,041,800 | 1,454 | 624 | $80,713,467 |
| Commercial | | 185 | $82,485,900 | | 43 | $19,172,397 |
| Industrial | | 0 | 0 | | 0 | 0 |
| Public Buildings and Critical Facilities | | | Replacement Value | | | |
| *Baum Center* | | 1 | $987,300 | | | |
| *Carolina Telephone substation* | | | $200,000 | | | |
| *Dare County Library and Desalination Water Plant* | | 2 | $2,737,300 | | | |
| | | | | | | |
| *Roads* | | 235,000’ | $35,250,000 | | | |
| | | | | | | |
| *Fire Station and Emergency Operations Center* | | 1 | $1,375,800 | | | |
| | | | | | | |
| *US Post Office* | | 1 | $757,300 | | | |
| | | | | | | |
| **Total** | **8,868** | | **$41,307,700** | **1,371** | **667** | **$99,885,864** |

In the VE Zone, there is $104 million of approximate value used for residential, while $35 million is used for commercial purposes, including multi-family and hotel development. The VE Zone is the area along the oceanfront that is expected to experience breaking waves, in addition to the storm surge. As explained in the methodology, the cost of the land was subtracted from the property value, because the land is expected to remain in the event of a flooding event. However, the methodology does not take into account the amount of the coastal erosion and the effect flooding and erosion and the effect flooding and erosion after a storm may have on whether or not oceanfront properties will be redeveloped, considering the stringent setback requirements along the oceanfront.

In the AE Zone, there is $492 million of approximate value used for residential, while $82 million is used for commercial purposes. There is $40 million in assessed value of public buildings and critical facilities. The Baum Center has a replacement value of $987,300. The Dare County Library and the Desalination Water Plan have

replacement values greater than $2.7 million. The roads located in the AE Zone have a replacement value of over $35 million. There is also a fire station and the emergency operations center that is located in this flood zone, with replacement values greater than $1.3 million.

*Repetitive Loss Properties*
The Town of Kill Devil Hills has two predominate repetitive loss areas, these two areas are located adjacent to the Atlantic Ocean and Kitty Hawk Bay. In addition, some repetitive loss properties are located in scattered low-lying areas between the Ocean and the bay. The Town has been classified by the Federal Emergency Management Agency (FEMA) as a "Repetitive Loss Community," because the Town has ten or more repetitive loss properties. A repetitive loss property is a property for which two or more claims of at least $1,000 have been paid by the National Flood Insurance Program since 1978. The majority of the properties located in the Repetitive Loss Areas are residential, most are single-family residential as well as some multi-family structures.

**Description and Impact of Past or Predicted Flooding**
Kill Devil Hills has experienced a number of severe storms in the past 50 years.

Pre-FRIM Structures
Kill Devil Hills entered the NFIP in 1973. There are 909 structures located in the special flood hazard areas that were constructed prior to 1973. These pre-FIRM structures may be located below the base flood elevation, therefore making them susceptible to flood damage from severe storms.

Impact on infrastructure and Public Health and Safety
Kill Devil Hills, like its neighbors, relies on septic tanks and some package treatment plants for wastewater treatment. Until 1996, Kill Devil Hills, Dare County, and Nags Head shared in the operation of the Dare County Regional Water System. At that time, Nags Head and Kill Devil Hills relinquished ownership rights to the systems' plants and sources. All of these services are at risk during and after a severe weather event.

*Identification of Critical Facilities*
Kill Devil Hills has identified properties in town deemed "critical facilities." By their very definition, "critical facilities' are essential to the health, safety, and viability of a community. These are the buildings, services, and utilities without which residents and businesses cannot survive for long.

Critical facilities include those facilities that are necessary in the daily operation of a community and those that might be hazardous to a community. Certain critical facilities are vital to the response and recovery efforts in the wake of a disaster and others will be critical for long-term recovery operations, resulting from a natural or technological hazard. Identification of critical facilities will make it possible to predict the consequences of disaster, and to expedite the response of necessary resources from outside the area of impact.

These include fire and rescue facilities, schools, Health /Medical Facilities, major thoroughfares and communications facilities.

- Administration Building on Town Hall Drive
- Baum Center
- Embarq Telephone Substation
- Desalination Water Plant
- Emergency Operations Center
- First Flight Airport
- First Flight Schools
- Fire Station
- Dominion Power Substation
- Kill Devil Hills Wastewater Treatment Plant (private)
- Public Works Services Buildings
- Water Administration

Many of these facilities are located in flood hazard areas. However, elevation and other construction techniques have been used to make them more resilient to flooding. Considering that much of Kill Devil Hills' jurisdiction is

located in a mapped flood zone or potential storm inundation area, it would be impractical at this time to relocate these critical facilities to areas outside of mapped flood areas.

Wetlands and Sensitive Areas

Kill Devil Hills, because of its coastal location, is home to a notable percentage of sensitive areas. Along with wetlands, Kill Devil Hills has Areas of Environmental Concern (AECs), as defined by the Coastal Area Management Act (CAMA). The designation of AECs is to protect the State's valuable natural resources. Seven types of AECs in three categories are found in Kill Devil Hills *(Kill Devil Hills 1997 Land Use Plan Update).* These are:

Estuarine System AECs

- Estuarine waters
- Coastal wetlands
- Public trust areas
- Estuarine shorelines

Ocean Hazard AECs

- Ocean erodible areas
- High hazard flood areas

Public Water Supply AECs

- Fresh Pond

Estuarine Systems AECs

The estuarine waters AEC include all waters of the State's bays, sounds, and streams seaward of the dividing line between coastal and inland fishing waters. Kill Devil Hills' estuarine waters AEC include Kitty Hawk Bay, Buzzard Bay, and streams draining into them. The coastal wetlands AEC include any salt marsh or other marsh subject to regular or occasional flooding by tides. Coastal wetlands are important because they provide habitat and produce nutrients that serve as the primary food source for various species of fish and shellfish. Extensive wetlands line Buzzard Bay and Kitty Hawk Bay.

Public trust AEC include all water of the Atlantic Ocean, the lands from the mean high water mark to the seaward limit of State's jurisdiction, and all other bodies of water subject to lunar tides below the mean high water level. In Kill Devil Hills, the public trust AEC covers the waters and submerged lands of the Atlantic Ocean, Buzzard Bay, and Kitty Hawk Bay. The estuarine shoreline AEC consists of non-ocean shorelines that are typically subject to erosion, flooding, and other adverse effects of wind and water. As defined by the Coastal Resources Commission (CRC), the estuarine shoreline AEC extends from the mean high water mark along the estuarine shoreline AEC includes the entire shoreline along Buzzard Bay and Kitty Hawk Bay.

Ocean Hazard AECs

The Atlantic Ocean shoreline is periodically subjected to erosion and other adverse effects of wind and water. Ocean hazard AEC includes beaches, frontal dunes, inlet lands, and other areas in which geologic, vegetative, and soil conditions indicate a substantial possibility of erosion and flooding. Incompatible or poorly positioned development within these areas may create the potential for damage to life and property.

The ocean erodible AEC includes that area in which there exists a substantial possibility of significant erosion and shoreline fluctuation. The seaward boundary of this area is the mean low water line. The landward boundary is determined by a combination of: (1) a distance from the first line of stable natural vegetation to the recession line established by multiplying the long-term annual erosion rate by 60, provided that, where there has been no long-term erosion or the rate is less than two feet per year, this distance shall be set at 120 feet landward from the first line of stable natural vegetation; and (2) the distance landward from the above recession line to a second recession line that would be generated by a storm having a one-percent chance of being equaled or exceeded in any given year.

The high hazard flood AEC is the oceanfront area subject to flooding and high velocity waters. These areas are indicated as VE Zones on the flood hazard map.

Public Water Supply AECs

In the public water supply AEC, the use of underground septic tank and drain field wastewater systems is prohibited within a 500' perimeter of the high water mark of the Fresh Pond. Between 500' and 1,200', septic tank systems are limited to a capacity not greater than the equivalent of a four-bedroom single-family residence and must include a land area of at least 40,000 square feet.

In addition, other fragile areas are Run Hill and the National Park Service property. Run Hill is one of the last live sand dune formations of significant size on the Outer Banks. It is connected to the maritime forest and is part of the barrier island dune system. The National Park Service property is a 428-acre parcel that contains the site of the Wright Brothers National Memorial.

**Development, Redevelopment, and Population Trends**

Development in Kill Devil Hills has followed a trend of retaining a high ratio of residential to non-residential construction within the Town. However, it is important to note that the Town realizes that many of the single family "residential structures' serve a rental business function.

Following a major storm, an important redevelopment objective of the Town is to provide for a post-disaster redevelopment activity that takes maximum advantage of mitigation opportunities. Such opportunities should act to reduce the amount of private property and number of lives at risk and to eliminate or reduce the potential exposure of public investments to a similar hazard. After a storm causing major damages occurs in Kill Devil Hills, the Town will be swamped with requests by individuals to rebuild their structures immediately. Typically, the pressure to rebuild will be great. If there is no contingency mechanism in place to deal with such situations, the Town may find itself in a difficult situation to deal fairly and rationally with such requests. In response to this scenario, the Town adopted the *Storm Hazard Mitigation and Post-Disaster Reconstruction Plan* in 1996.

The *Kill Devil Hills 1997 Land Use Plan Update* projects an average visiting population of 24,284 and a peak visiting population of 40,473 by 2001. The Town projects its 2003 permanent population at 6,100 and projects the peak visiting population plus permanent population in 2004 to be about 48,000. A moderate growth rate that will result in a permanent population of about 8,500 persons by 207 is projected.

**Goals**

On March 6, 2001, the Kill Devil Hills Floodplain Management Advisory Committee conducted a goal-setting session. The Hazard Mitigation Committee, in May 2004, identified the goals of the Town as unchanged. These goals remain the same for the 2009 update. The goals developed by the Committee are:

- Protect human life and health
- Reduce damages to existing and future development
- Assist in maintaining a stable tax base by providing for sound use of land which may be located in storm hazard areas
- Continue to monitor changes in building codes and materials and research the increased Cost Compliance measure
- Minimize losses associated with storm events and provide a framework for storm event reconstruction
- Preserve and restore natural areas while maintaining the function of the floodplain
- Promote rebuilding and reconstruction in a prompt and orderly manner
- Minimize prolonged business interruption, especially involving businesses providing critical supplies and services
- Facilitate a safe and efficient evacuation and where possible reduce damage to existing development
- Restore the community by minimizing difficulties in continuation of essential public and private services
- Implement flood control measures to protect people and property and assure continuation of essential public services
- Inform and advise property owners and visitors about potential damage from flooding.

**Community Capability Assessment**

It is important that the Town consider all possible ways to reduce flood losses and protect the natural areas. Too ensure that the full range of alternatives was reviewed, the Floodplain Management Advisory Committee used the list of strategies and tools recommended by the *CRS Coordinator's Manual.*

The Town Land Use Plan, Stormwater Management Plan, Storm Hazard Mitigation and Post Disaster Recovery Plan and Chapter 153, zoning all support hazard mitigation. There are no documents or community goals that hinder hazard mitigation.

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| 1. Preventive – keep flood problems from getting worse. They are usually administered by building, zoning, planning, and/or code enforcement offices. | | | | |
| Zoning ordinance | Adopted February 28, 2001 | High | Low | High because the zoning regulations restrict development, thereby putting less property at risk |
| Flood Damage Prevention Ordinance | Adopted July 26, 2006 | High | Low | High because the regulations require new construction to be built at or above BFE |
| Dune Protection Ordinance | Adopted February 28, 2001 | High | Low | High because dunes play a vital role in protecting property from storm surge damage |
| 2. Public Information Activities – advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains. | | | | |
| Permitting | N/A | High | Low | High because new development must adhere to Town codes to receive a permit |
| Education Activities | N/A | Medium | Low | Medium because education activities do not always effectively research the target audience |
| Floodplain Mapping | Adopted October 20, 2006 | High | Low | High because mapped areas give property owners an idea of flooding associated with different storm events |
| Library | N/A | Low | Low | Low because people do not take advantage of the library |

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| Technical Assistance | N/A | High | Medium | High because there are a number of local, state, and federal agencies |
| 3. Property Protection – usually undertaken by property owners on a building-by-building or parcel basis. | | | | |
| Building Elevation | Flood Damage Prevention Ordinance | High | Medium | High because the ordinance requires new construction to be built at or above BFE |
| Floodproofing | NC State Building Code Volume 1 | Medium | Low | High because floodwaters actually reduce the pressure exerted by deep water |
| Insurance | National Flood Insurance Program | High | Low | High because well-insured structures can be reconstructed |
| Relocation | N/A | Low | High | Low because this option is not feasible on the Outer Banks |
| Acquisition | N/A | Low | High | Low because while acquisition would remove vulnerable structures from harm, it is not a viable option on the Outer Banks |
| Retrofit | N/A | High | Medium | High because retrofitted structures meet wind and flood resistant construction standards |
| 4. Emergency Services – taken during a flood to minimize its impact. These measures are the responsibility of city or county emergency management staff and the owners of critical facilities. | | | | |
| Flood warning | Dare County Emergency Operation Plan | High | Low | High because the warnings are typically posted on radio and television and reach much of the population |
| Flood response | Dare County Emergency Operations Plan | High | Low | High because the Town and the County effect rapid response |
| Emergency Operations Center | Dare County Emergency Operations Plan | High | Low | High because the Town has procedures for the operation of the center |
| Health and safety maintenance | Dare County Emergency Operations Plan | High | Low | High because health and safety are important to the Town, the evacuation routes are moderately |

| *Policies & Programs* | *Document Reference* | *Effectiveness (High, Medium, Low)* | *Cost (High, Medium, Low)* | *Rationale For Effectiveness* |
|---|---|---|---|---|
| | | | | protected from hazards |
| 5. Natural Resource Protection – preserve or restore natural areas or the natural functions of floodplain and watershed areas. They are usually implemented by Parks and Recreation. | | | | |
| Permitting | N/A | High | Low | High because new development must adhere to Town codes to receive a permit |
| Coastal Barrier Protection (residential) | N/A | Medium | Low | Medium because although these measures can protect property against erosion, they are expensive |
| Wetlands | Section 404 | Medium | Low | Medium because wetlands serve as a flood control measure and provide a natural function of the floodplain |
| 6. Structural Projects – keep floodwaters away from an area with a levee, reservoir, or other flood control measure. They are designed by engineers and managed or maintained by Public Works. | | | | |
| Stormwater Management Regulations | Adopted February 28, 2001 | High | Low | High because the regulations require new developments to provide stormwater management |
| Channel Modifications | N/A | Low | High | Low because channelization can significantly increase runoff |
| Beach Nourishment | Dare Shore Protection Project | High | High | High because such efforts are long-term solutions |
| Storm sewer swales | N/A | High | Low | High because, without storm sewer swales, runoff goes unchecked into the waterways |

The capability assessment evaluates Kill Devil Hills' potential willpower, institutional framework, technical know-how, and ability to pay for mitigation. The capability of all levels of government (local, state, federal, and regional), as well as the contributions made by non-governmental organizations (churches, charities, community relief funds, and Red Cross, hospitals, for profit and non-profit businesses) should be included, with a description of their utility to the local community in terms of hazard mitigation.

Legal Capability – Enabling legislation in North Carolina grants a wide array of powers to its cities, towns and counties. The capability section of the local Hazard Mitigation Plan should analyze each of the powers available to local governments enumerated in the North Carolina General Statutes to identify which can be wielded to craft hazard mitigation measures at the local level, and also assess legislation that may impose limits on certain mitigation efforts.

A. Regulations
    a. General police power
    b. Building codes and building inspections
    c. Land use
        i. Zoning
        ii. Floodway regulation
        iii. Planning
        iv. Subdivision regulations
B. Acquisition
C. Taxation
D. Spending

Institutional Capability – Kill Devil Hills is a chartered community with a local government comprised of a Mayor and Town Commissioners. Key government agencies include:

A. Town Administrator
B. Public Works
C. Legal Department
D. Town Clerk
E. Tax Collector
F. Code Enforcement
G. Planning

Political Capability – The Kill Devil Hills Mayor and Town Commissioners support the concept of hazard mitigation and will promote the economic efficiency and social utility of the mitigation measures contained in this plan.

Fiscal Capability – While federal programs carry out the bulk of disaster relief programs that provide funds for mitigation, local governments are encouraged to open the search field as widely as possible, and include alternative funding sources to supplement the local hazard mitigation budget. For instance, local businesses and organizations will frequently support projects that benefit their customers or employees, or which constitute good public relations.

A. Hazard Mitigation Grant Program (HMGP)
B. Disaster Preparedness Improvement Grant (DPIG)
C. Flood Mitigation Assistance Program (FMAP)
D. Public Assistance Program (PA)
E. Small Business Administration Disaster Assistance Program
F. Community Development Block Grant (CDBG)

Technical Capability – If the concept of hazard mitigation is being introduced to a local community for the first time, or if a more experience community wishes to upgrade its level of mitigation, technical know-how may be at a premium.

**Action Plan**

The plan *goals* describe the overall direction that Kill Devil Hills can take to minimize the impacts of natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations that are outlined in the action items.

The goals are broken down into Activity Areas. This plan includes seven areas of activities. These activities are: preventive, property protection, natural resource protection, reconstruction, life and safety, emergency services, and public information. Each activity area contains at least one goal.

The *action items* are a listing of activities in which the Town and the citizens can be engaged to reduce risk. Each action item includes an estimate of the timetable for implementation.

These mitigation actions address all hazards outlined in this plan.

The mitigation plan identifies action items developed through data collection and research, surveys, and the public participation process. Mitigation plan activities may be considered for funding through federal and state grant programs, and when other funds are made available. To help insure activity implementation, each action item includes information on the timetable and the responsible person(s). Upon implementation, the responsible person(s) may look to partner organizations for resources and technical assistance.

- **Responsible Person.** The responsible person(s) is the person or entity that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Responsible person(s) may include local, county, or regional agencies that are capable of or responsible for implementing activities and programs.

- **Deadline.** Each action item includes an estimate of the timeline for implementation.

- **Funding.** Each action item will include a possible source of funding. Implementation ideas may include grant programs or human resources.

- **Prioritization.** Each action item is prioritized. The selection criteria used to analyze and prioritize each action step are: 1) cost effective; 2) environmentally sound; and 3) technically feasible. If an action item meets all three criteria, it is given a **High** priority; if it meets two criteria, it is given a **Medium** priority; and if it meets one criterion, it is given a **Low** priority. There is an explicit emphasis on cost effectiveness, in light of its possible use in environmental reviews for HMGP, FMAP, and other federal hazard mitigation projects.

Based on the review of the six categories of possible activities, it is recommended that the Town implement the following action plan.

**Kill Devil Hills Hazard Mitigation Action Plan**

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| **Preventive**<br>**Goals: 1. Reduce damages to existing and future development**<br>**2. Assist in maintaining a stable tax base by providing for sound use of land which may be located in storm hazard areas**<br>**3. Continue to monitor changes in building codes and materials and research construction techniques that can mitigate storm damage** | | | | | |
| **Planning and Zoning** – Continue to enforce the zoning ordinance and amend when necessary | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | Planning Dept, Board of Commissioners, Building Inspec. | Ongoing | High |
| **Floodplain Regulations** – Provide technical assistance to customers/citizens and continue to enforce current flood hazard ordinance | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | Planning Dept, Building Inspector, Board of Commissioners | Ongoing | High |
| **Open Space Preservation** – Support efforts to preserve natural areas | Flooding, Hurricanes, Tropical Storms, Nor'easters | N/A | Planning Dept | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| **Stormwater Management** – Continue to implement the stormwater management plan | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | Planning Dept, Public Services | Ongoing | Medium (environmentally sound and technically feasible) |
| **Drainage System Maintenance** – Continue mowing drainage ditches and conduct normal maintenance and storm event driven maintenance | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | Public Services, NC DOT | Ongoing | High |
| | | | | | |
| **Building Code** – Monitor changes to the State Building Code and modify local regulations as necessary to minimize damage | Flooding, Hurricanes, Tropical Storms, Nor'easters | N/A | Planning Dept, Building Inspector | Ongoing | High |
| **Property Protection**<br>**Goal: Minimize losses associated with storm events to individual properties and provide a framework for storm event reconstruction** | | | | | |
| **Relocation** – Expedite permitting for the relocation of repetitive loss situations | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Planning Dept | Ongoing | Low |
| **Acquisition** – Encourage repetitive loss properties to consider acquisition as a possible solution | Flooding, Hurricanes, Tropical Storms, Nor'easters | NC Division of Emergency Management, FEMA | Planning Director, Board of Comm. | Ongoing | Low (environmentally sound and technically feasible) |
| **Building Elevation** – Continue enforcing the base flood elevation requirement of the Town's Flood Damage Prevention Ordinance | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Asst Planning Director, Building Inspector | Ongoing | High |
| **Insurance** – Maintain outreach efforts and continue making flood insurance available to the Town's residents | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Planning Dept, Town Clerk | Ongoing | High |
| | | | | | |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| **Dune and Beach Maintenance** – Continue ongoing beach nourishment efforts | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund, US Army Corps of Engineers | Planning Director, Board of Comm., | Ongoing | High |
| **Natural Resource Protection**<br>**Goal: Preserve and restore natural areas while maintaining the function of the floodplain** | | | | | |
| **Wetlands Protection** – Continue to utilize the zoning ordinance and the Land Use Plan to protect wetlands | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | US Army Corps of Engineers, Planning Dept, NCDENR | Ongoing | High |
| **Coastal Barrier Protection** – Continue to support coastal barrier protection efforts by the State | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | N/A | CAMA, Planning Dept | Ongoing | High |
| **Erosion and Sediment Control** – Continue to enforce local and state regulations | Flooding, Coastal Erosion | General Fund | Planning Dept | Ongoing | High |
| **Areas of Environmental Concern (AECs)** – Support local CAMA officer with compliance efforts within the AECs | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund | CAMA LPO | Ongoing | High |
| **Surface Water Quality** – Preserve surface water quality and enhance water quality through stormwater management and zoning | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | General Fund | Planning Dept, Public Services | Ongoing | Medium (environmentally sound and technically feasible) |
| **Maritime Forest Environmental Zoning District** – Continue to enforce the Maritime Forest Environmental Zoning District | Flooding, Hurricanes, Tropical Storms, Nor'easters, Wildfire | General Fund | Planning Dept | Ongoing | High |
| **Emergency Services**<br>**Goals: 1. Facilitate a safe and efficient evacuation and, where possible, reduce damage**<br>**2. Promote rebuilding and reconstruction in a prompt and orderly manner**<br>**3. Minimize prolonged business interruption, especially involving businesses providing critical supplies and services**<br>**4. Restore the community by minimizing difficulties in continuation of essential public and private services** | | | | | |
| **Flood Warning** – Facilitate evacuation | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | Dare County Control Group | Ongoing | High |
| **Flood Response** – Coordinate efforts to expedite reconstruction and rebuilding efforts in cooperation with Dare County Emergency Management staff | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter | General Fund | Planning Dept | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| | Storms, | | | | |
| **Flood Recovery** – Coordinate efforts to expedite recovery | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms | General Fund | Board of Commissioners, Planning Dept | Ongoing | High |
| **Critical Facilities Protection** – Take appropriate actions to prevent and/or minimize damages to critical facilities | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | Police, Fire & Rescue, Public Works, NC Dominion Power | Ongoing | High |
| **Health and Safety Maintenance** – Develop ongoing protocols to assure the maintenance of critical public services | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | Police, Fire & Rescue, Public Works, Dare County Emergency Management | Ongoing | Medium (environmentally sound and technically feasible) |
| **Structural Projects**<br>**Goal: Implement flood control measures to protect people and property and assure continuation of essential public services** | | | | | |
| **Reservoirs** –<br>1. Continue protection efforts concerning the Fresh Pond<br>2. Maintain liaison with NC Division of Coastal Management concerning the development of the Kill Devil Hills Land Use Plan | Flooding, Hurricanes, Tropical Storms, Nor'easters, Winter Storms | General Fund | Planning Dept, CAMA | Ongoing | High |
| **Stormwater Management** – Continue to update and implement the Stormwater Management Plan | Flooding | General Fund | Public Services | Ongoing | Medium (environmentally sound and technically feasible) |
| **Beach Nourishment** – Encourage beach nourishment as a storm protection measure and search for funding | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion | US Army Corps of Engineers | Board of Commissioners, Dare County Commissioners | Ongoing | High |
| **Public Information**<br>**Goal: 1. Inform and advise property owners and visitors about potential damage from flooding**<br>**2. Use the Town's website to disseminate hazard mitigation information** | | | | | |
| **Map Information** – Maintain updated flood map information for citizens and customers | Flooding, Hurricanes, Tropical Storms, Nor'easters | NC Division of Emergency Management | NC Division of Emergency | Ongoing | High |

| Goals and Actions | Hazard | Funding Sources | Responsibility | Target Completion Date | Priority |
|---|---|---|---|---|---|
| | | | Management, Planning Dept | | |
| **Library** – Compile and maintain current information in the Kill Devil Hills Floodplain Management Library | Flooding, Hurricanes, Tropical Storms, Nor'easters | General Fund | CRS Coordinator | Ongoing | Medium (cost-effective and technically feasible) |
| **Technical Assistance** – Continue to utilize technical assistance from state and federal agencies and private consultants to provide appropriate technical assistance to citizens and customers | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | N/A. | Building Inspector, Planning Dept | Ongoing | High |
| **Outreach Projects** –<br>1. Initiate outreach projects to inform the public on Town and County initiatives that will reduce hazard related losses of property and life<br>2. Work with print, radio, and television media to effectuate outreach efforts in cooperation with Dare County and neighboring municipalities | Flooding, Hurricanes, Tropical Storms, Nor'easters, Coastal Erosion, Winter Storms, Wildfire | General Fund | CRS Coordinator | Ongoing | High |

**Implementation, Evaluation, and Revision**

Implementation of the activities recommended by this plan will be monitored so the deadlines will be met. Where possible, each activity should be monitored in terms of dollar value of its flood loss reduction benefits.

The Planning Department will be responsible for the tracking the activities outlined in this plan. Each person assigned a responsibility in this plan shall report to the Planning Director by October 1st of each year. The Planning Director will report to the Board of Commissioners once a year, on the last week of hurricane season (November 30th). The report should review progress and recommend changes as needed.

This plan will be updated every five years. The Planning Director will be responsible for leading the update team, composed of the Planning Staff and the Hazard Mitigation Committee. At the regular five year update, required by the Disaster Mitigation Act of 2000 (DMA2K), Kill Devil Hills will use the following questions as criteria of assessing the effectiveness and appropriateness of the plan:

- Do the goals and actions 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 the agencies and other partners participate in the plan and the planning process as proposed?

**Annex 6**

# TOWN OF KILL DEVIL HILLS

*Land Where Flight Began*

**RESOLUTION OF THE BOARD OF COMMISSIONERS, KILL DEVIL HILLS, NORTH CAROLINA, REQUESTING ACTION BY THE DARE COUNTY BOARD OF COMMISSIONERS TO MERGE THE HAZARD MITIGATION PLAN FOR THE TOWN OF KILL DEVIL HILLS WITH THE DARE COUNTY HAZARD MITIGATION PLAN**

**THAT WHEREAS**, on October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 to reinforce the importance of pre-disaster mitigation planning to help reduce disaster losses; and

**WHEREAS**, North Carolina Senate Bill 300 requires all local governments to have an approved Hazard Mitigation Plan in order to receive stat public assistance funds (effective for state-declared disasters after November 1, 2004);

**WHEREAS**, the Town of Kill Devil Hills Hazard Mitigation Plan (Plan) was approved August 18, 2004 by the Board of Commissioners of the Town of Kill Devil Hills and subsequently by the Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management (NCEM); and

**WHEREAS**, the Town of Kill Devil Hills now desires to merge said Plan with the Plan of the County of Dare, in accordance with the guidance provided to the Town of Kill Devil Hills by FEMA, NCEM, and the County of Dare.

**NOW, THEREFORE, BE IT RESOLVED** by the Town of Kill Devil Hills Board of Commissioners of the Town of Kill Devil Hills assembled this 28th day of October 2009:

**SECTION 1**. That the "Hazard Mitigation Plan for the Town of Kill Devil Hills" is hereby forwarded to the Dare County Board of Commissioners for adoption as a merge to the Hazard Mitigation Plan for the County of Dare.

**SECTION 2.** That upon adoption, said plan shall continue to serve as a guide for the various departments of The Town of. Kill Devil Hills Government in pre-disaster planning and post-disaster recovery.

**SECTION 3**. That said plan will be reviewed annually or immediately after a natural disaster

**SECTION 4**. That all reports and changes shall be submitted to the North Carolina Division of Emergency Management and the Federal Emergency Management Agency every five years.

Adopted this 28th day of October 2009

SEAL

ATTEST:

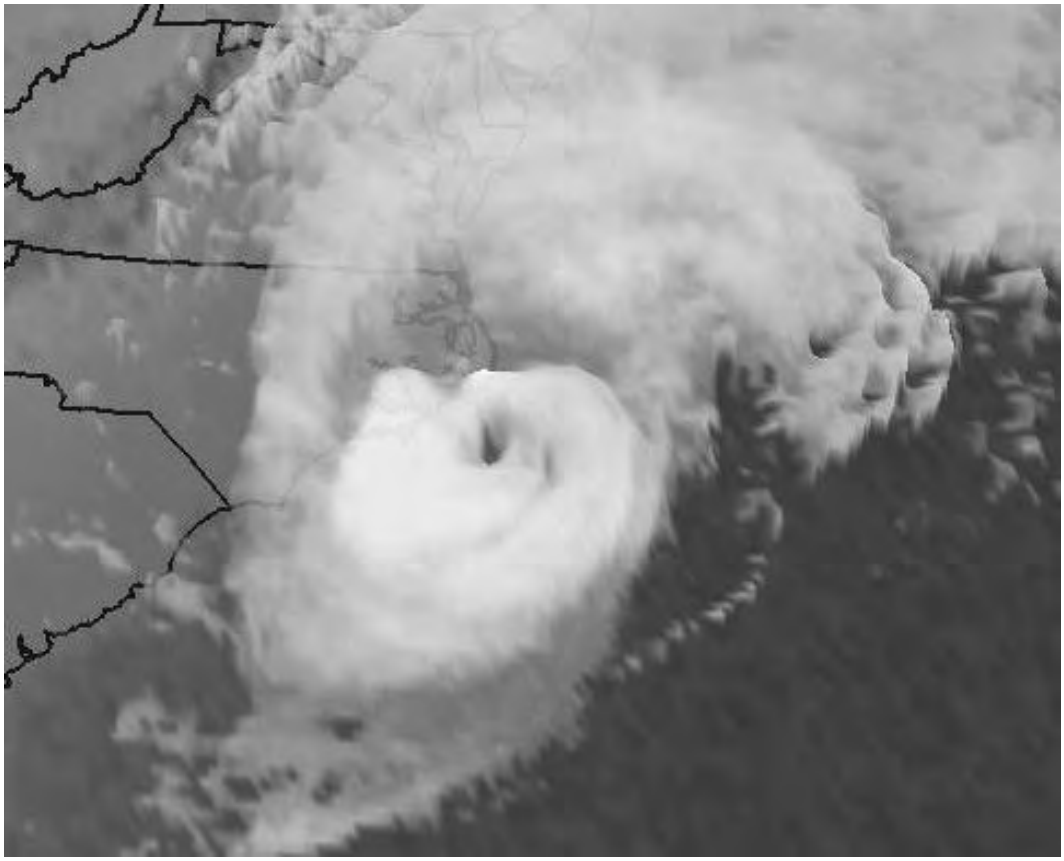
Mayor Raymond P. Sturza II

Harriet B. Banner
Deputy Town Clerk

**Appendix L**

***TOWN OF SOUTHERN SHORES***

***Hazard Mitigation Plan***



Adopted February 15, 2005
Revised September 23, 2008

Technical Assistance Provided By:
NC Department of Commerce
Division of Community Assistance

James T. Fain III, Secretary
Gloria Nance-Sims, Director, Division of Community Assistance
Ruth J. Leggett, Chief Planner, Northeast Regional Office

Lee Padrick, Project Planner
Terria Baynor, GIS Support
**Southern Shores Hazard Mitigation Plan**

*Adopted by the Southern Shores Town Council*
*February 15, 2005*
*Revised September 23, 2008*

*On November 4, 2009, the Southern Shores Town Council voted unanimously to adopt a resolution Requesting that Southern Shores updated plan be included with the Dare County Hazard Mitigation Plan. A copy of the resolution is attached.*

**Southern Shores Town Council**
Don Smith, Mayor
Brian McDonald, Mayor Pro Tem
Jodi Hess
Jim Pfizenmeyer
Kevin Stroud

**Southern Shores Hazard Mitigation Planning Committee**
Alvin Rountree, Chairman
Dan Shields
Jim Pfizenmeyer
Kevin Stroud
George Kowalski
Bob Palombo
Mike Florez
Frans Koeleveled
David Kole
Karl Daniels
Bob Harvey
Richard Perkins
Elizabeth Cubler

**Southern Shores Staff**
Charles Read, Town Manager
Alvin Rountree, Code Enforcement Administrator
David Cowan, Code Enforcement Officer
Pat Forrester, CRS Coordinator / Permit Officer

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**Executive Summary**

This document is the Town of Southern Shores' Hazard Mitigation Plan. It has been prepared to meet the requirements of the federal government's Stafford Act as amended by the Federal Disaster Mitigation Act of 2000 (FDMA2K) and North Carolina Senate Bill 300. The Disaster Mitigation Act of required local governments to have a FEMA-approved and locally adopted hazard mitigation plan in place by November 1, 2004 in order to be eligible for federal disaster funds.

The mission of the Southern Shores Hazard Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss prevention, and identifying activities to guide the town towards building a safer, more sustainable community.

**Goals and Actions**

The plan contains both goals and actions. The plan *goals* describe the overall direction that Southern Shores can take to minimize the impacts of natural hazards. The goals give board direction. The *action items* are a listing of activities in which the town and the citizens can be engaged to reduce risk.

**Implementation**

Implementation of the activities recommended by this plan will be monitored so the deadlines will be met. The Cody Enforcement Administrator will be responsible for tracking the activities outlined in this plan. Each person assigned a responsibility in this plan will report to the Code Enforcement Administrator by the last day of each quarter (March 31, June 30, September 30, December 31). The Code Enforcement Administrator will report to the Town Council twice each year, on the first week and last week of hurricane season (June 1st and November 30th). The report should review progress and recommend changes as needed.

In addition, the Hazard Mitigation Planning Committee will reconvene during the first week of June each year to receive a presentation on the progress of the plan. The Hazard Mitigation Planning Committee will prepare an annual evaluation report that will be submitted to the Town Council.

**Section 1: Introduction**

The state of North Carolina faces extreme consequences from natural hazards, especially those of hurricanes and flooding. Between 1989 and 2007, there were 20 federally declared disasters. Damages from Hurricane Floyd in 1999 reached $3.5 billion and Hurricane Isabel in 2003 reached $3.37 billion. With Hurricane Floyd, 4,117 uninsured and under-insured homes were destroyed. The State's vulnerability to hurricanes and flooding make it crucial that communities and property owners have accurate, up-to-date information about all the risks of damage from flooding and high winds.

This document is the Town of Southern Shores' Hazard Mitigation Plan. It has been prepared to meet the requirements of the federal government's Stafford Act as amended by the Federal Disaster Mitigation Act of 2000 (DMA2K). North Carolina Senate Bill 300 requires local hazard mitigation plans to be in compliance with federal legislation. Senate Bill 300, passed by the NC Legislature in the summer of 2001, required local governments to have an approved and locally adopted hazard mitigation plan in place by August 1, 2002 in order to be eligible for state disaster funds to remedy disasters that occur after August 1, 2002. Additionally, the Disaster Mitigation Act required local governments to have a FEMA-approved and locally adopted hazard mitigation plan in place by November 1, 2004 in order to be eligible for federal disaster funds.

This document identifies the Town's vulnerability to several natural hazards and sets goals to mitigate damage from these hazards. The planning process used for this plan is made up of three parts: the *Mission, Goals,* and *Action Items*.

**Why Develop a Mitigation Plan?**

Planning is one of the best ways to anticipate and mitigate the destructive impact of identified hazards. The objective of planning is to produce a program of activities that will best tackle the community's hazard problems and meet other community needs. A well-prepared plan will guide a community's regulatory, educational and infrastructure efforts so that they are implemented more economically and in ways more attuned to the needs and objectives of the community and its residents. A well-prepared and executed plan should result in reduced losses. Risks not eliminated or mitigated through construction techniques have traditionally been offset through insurance (flood, wind and fire). However, the magnitude of losses faced by the insurance industry in recent years and resulting policy premium increases warrant reevaluation insured risk.

Originally, this document was prepared to qualify as a "Floodplain Management Plan" to be credited by Insurance Services Office (ISO) Community Rating System (CRS) program of the National Flood Insurance Program (NFIP). The NFIP provides federally supported flood insurance in communities that regulate development in their floodplains. The CRS reduces flood insurance premiums in those communities that do more than implement the minimum regulatory requirements. The Town of Southern Shores participates in the NFIP and is currently certified under the CRS as a Class 8 Community (effective 10/01/07). The Town has developed this plan in order to limit life and property losses due to a major flood and higher standards were not adopted for wind. Additional credit is provided if the activities are implemented based on a hazard mitigation plan that meets the criteria in Section 511 of the *CRS Coordinator's Manual*. The approach selected for preparing this plan was taken from Section 511 and some of this plan's section headings coincide with Section 511's headings.

Since then, there have been state and federal requirements placed on municipalities regarding hazard mitigation. This planning document strives to meet those requirements.

The mission of the Southern Shores Hazard Mitigation plan is *to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards*. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss prevention, and identifying activities to guide the town towards building a safer, more sustainable community.

**Plan Methodology**

*Who Was Involved*

The North Carolina Division of Community Assistance provided the Town with a professional planner to draft this plan for its initial adoption, with input from a planning committee, the Floodplain Management Plan Committee, established by the Town Council. This Floodplain Management Plan Committee has been renamed the Hazard Mitigation Planning Committee, for purposes of this plan. A number of the committee members are in positions to implement the majority of the plan's recommendations. The Committee membership for 2008 included:

- Alvin Rountree, Code Enforcement Administrator, Chairman
- Jim Pfizenmayer, Elected Official
- Kevin Stroud, Elected Official
- Charlie Read, Town Manager
- Bob Palombo, Planning Board Member
- Mike Florez, Planning Board Member
- Frans Koeleveld, Board of Adjustment Member
- David Kole, Police Chief
- Bob Harvey, Fire Chief
- Dan Shields, Southern Shores Civic Association
- Karl Daniels, Chicahauk Property Owners Association
- Richard Perkins, Real Estate
- Pat Forrester, CRS Coordinator
- Elizabeth Cubler, Construction

The planning process used for this plan is made up of three parts: the *Mission*, *Goals*, and *Action Items*. The *Mission* of the plan is a statement that articulates the reasons for Southern Shores to engage in hazard mitigation planning. The *Goals* describe the overall direction that Southern Shores can take to minimize the impact of natural hazards. The *Action Items* are a listing of activities in which the town and the citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation.

The Plan Committee was asked to develop these three parts of the plan. They used different techniques to develop the plan parts; including brainstorming and evaluating other planning documents such as the land use plan and floodplain management plan. Many of the goals and action items listed were adapted from the land use plan, the floodplain management plan, and the hazard mitigation plan.

CRS credit is based on a 10-step planning process. The 10 steps are:

- Step 1: Organize.
- Step 2: Involve the Public.
- Step 3: Coordinate with Agencies and Organizations.
- Step 4: Assess the Hazard.
- Step 5: Evaluate the Problem
- Step 6: Set Goals
- Step 7: Review Mitigation Strategies
- Step 8: Draft an Action Plan
- Step 9: Adopt the Plan
- Step 10: Implement, Evaluate, Revise

Each of these ten steps was included in the three part planning process: *Mission*, *Goals*, and *Action Items*.

**Public Comments and Participation**

The Committee held two committee meetings, on January 21, 2004 and March 10, 2004, during the preparation of the plan update. At the January 21, 2004 meeting, the Plan Committee reviewed the action plan from the town's floodplain management and hazard mitigation plans. At the March 10, 2004 meeting, the Plan Committee met immediately after the public input meeting, discussed ideas and comments collected at the public meeting, and recommended the plan be sent to the Planning Board and Town Council for consideration of approval. All Plan Committee meetings were open to the public.

Elements of the public participation plan included:

- Holding a public information meeting on March 10, 2004 at 9:00 a.m. to describe the planning process to interested citizens and listen to citizen suggestions and concerns;
- Copies of the Draft Hazard Mitigation Plan were made available at the Southern Shores Town Hall for public review on February 15, 2004; and
- On August 03, 2004, a public hearing was held on the amended Hazard Mitigation Plan. The Town Council of Southern Shores officially adopted the plan at that time. That meeting was advertised in the local newspaper (Coastland Times). No public comment received.

At the public information meeting, the public was given the opportunity to contribute ideas and concerns about hazard mitigation activities in Southern Shores. Some significant ideas were offered, and some action items were generated or changed to address these comments. A cross-section of the community attended the public information meetings, including residents, business leaders, and government agency officials.

In Spring 2003 the town distributed a hazard mitigation questionnaire to all property owners of record. The questionnaire was sent to 2,896 property owners and the Committee received 894 completed surveys, for a return rate of 31 percent. The questionnaire included a written comment and recommendation section.

Using the mailed survey, the public informational meeting, and the public hearing prior to adoption, citizens of Southern Shores were given ample opportunity to comment on the plan prior to adoption.

**Southern Shores Hazard Mitigation Survey Results – 5/12/03**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. Are you a permanent or seasonal resident?** | | | | | | |
| Permanent – 54% | Seasonal – 44% | Don't Know – 2% | | | | |
| **2. What natural hazards threaten your property?** | | | | | | |
| Fire- 2% | Flood –4% | Wind – 19% | Don't Know – 2% | Wind/Fire – 29% | Wind /Flood – 43% | Flood / Fire – 1% |
| **3. Which is the greatest threat?** | | | | | | |
| Fire – 11% | Flood – 13% | Wind – 71% | Wind / Flood – 2% | Don't Know – 21% | | |
| **4. Has your property suffered damage from natural hazards in the past?** | | | | | | |
| Yes – 26% | No – 60% | Don't Know – 14% | | | | |
| **5. If YES, then what hazard(s)?** | | | | | | |
| Yes - 190 | Wind – 81% | Flood – 11% | Wind/Fire – 4% | Wind / Flood – 2% | | |
| **6. Do you know where to find information on making your property more resistant to natural hazards?** | | | | | | |
| WIND | Yes – 44% | No – 50% | Don't Know – 6% | | | |
| FLOOD | Yes – 43% | No – 41% | Don't Know – 16% | | | |
| FIRE | Yes – 47% | No – 42% | Don't Know – 11% | | | |
| **7. Do you have adequate insurance for each hazard?** | | | | | | |
| Yes – 80% | No – 4% | Don't Know – 16% | | | | |
| **8. Has your Homeowners Insurance or Flood Insurance premium increased recently?** | | | | | | |
| Yes – 63% | No – 18% | Don't Know – 19% | | | | |
| **9. If YES** | | | | | | |
| <10% - 14% | 10-25% - 27% | 26-50% - 14% | >50% - 5% | Don't Know – 40% | | |
| **10. Are you aware that local flood ordinances that exceed FEMA minimum standards contribute to the community's 20% discount on flood insurance policies?** | | | | | | |
| Yes – 35% | No – 40% | Don't Know – 25% | | | | |
| **11. Would you support similar ordinances for Fire and Wind if such discounts were available?** | | | | | | |
| Yes – 85% | No – 4% | Don't Know – 21% | | | | |
| **12. Are you aware that the Forest Service recommends 30 feet of lawn area surrounding your home to mitigate wildfire damage?** | | | | | | |
| Yes – 24% | No – 60% | Don't Know – 16% | | | | |
| **13. Would you like more information or have the Fire Inspector make an on-site assessment of your property?** | | | | | | |
| Yes – 28% | No – 72% | | | | | |

**Coordination With Other Agencies**

There are two reasons to involve agencies and private organizations in planning efforts. First, they may be implementing or planning to implement activities that can affect flood damage or some of the other interests and concerns. The Committee wanted to make sure that their efforts were not going to be in conflict with a government program or duplicate the efforts of another organization. Second, the Committee wanted to involve other agencies to see if they could assist their efforts. Help may be in the form of flood hazard data, technical information on various measures, guidance on regulatory requirements, advice and assistance in the planning effort, implementation of a recommended measure, and financial assistance to help implement a recommended measure.

During the initial research period at the beginning of the planning process, the Committee members discussed various outside agencies to contact. The planning process included an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development, as well as businesses, academia, and other private and non-profit interests to be involved. The parties invited include:

- US Army Corps of Engineers
- Dare County Emergency Management
- Dare County Floodplain Manager
- Dare County Management Information Specialist
- Town of Kitty Hawk
- Town of Kill Devil Hills
- Town of Nags Head
- Town of Duck
- Town of Manteo
- Soil and Water Conservation District
- NC Power
- Outer Banks Association of Realtors
- Outer Banks Homebuilders Association
- Association of Insurance Agents
- NC Division of Coastal Management
- Dare County Board of Education
- NC Division of Emergency Management
- Sprint
- Charter Communications
- Dare County Water System
- Build the Bridge Committee
- Outer Banks Chamber of Commerce
- Currituck County
- Regional Medical Center
- Outer Banks Hospital
- Dare County Sheriff
- NC Department of Transportation

These agencies were sent an e-mail notice of the public input meeting and were invited to attend.

In addition to coordination with outside agencies, the Town of Southern Shores reviewed existing plans, studies, reports, and technical information to assist in the preparation of this plan. These existing resources included:

- Southern Shores Land Use Plan
- Flood Insurance Study
- Flood Insurance Rate Maps
- Flood Damage Prevention Ordinance
- Southern Shores Floodplain Management Plan

- Zoning Ordinance

The Town has begun a two year process of updating its Land Use Plan in 2007. The Coastal Area Management Act planning guidelines require that the topic of hazard mitigation be addressed in the Land Use Plan. The Town will ensure that the hazard mitigation section of the Land Use Plan is complementary of the Hazard Mitigation Plan.

Additionally, Dare County and the municipalities received updated flood insurance rate maps effective 09/20/06. These maps included changes to base flood elevation in some parts of the town. This update of the Hazard Mitigation Plan will reflect the changes depicted on the new flood maps. The Flood Damage Prevention Ordinance was amended at the time of adoption of the new flood maps. The NC Division of Emergency Management promulgates a model ordinance for coastal communities, and this model was considered for adoption, with modifications, at the time of consideration for the new maps. Any conflicts between the Hazard Mitigation Plan and the amended Flood Damage Prevention Ordinance were addressed during this year's update of the plan.

The Southern Shores Floodplain Management Plan meets the requirements of the Community Rating System. Southern Shores originally was required to adopt a floodplain management plan because the Town had 10 or more repetitive loss properties. The majority of these repetitive loss properties were located in Martin's Point, a subdivision outside the Town's corporate limits and located in the extraterritorial jurisdiction. Since the adoption of the floodplain management plan, Martin's Point residential has been removed from the Town's extraterritorial jurisdiction and is regulated by Dare County's Flood Damage Prevention Ordinance. This document will serve as the floodplain management plan for Southern Shores and the Martin's Point commercial area.

The Zoning Ordinance contains a number of regulations that pertain to density within the Town. While not a tool used explicitly for hazard mitigation, the density limitations of the Zoning Ordinance control the land uses and types and numbers of structures within the Town, thereby limiting the number of structures that may be susceptible to natural hazards.

**How Do I Use the Plan?**

Each section of the mitigation plan provides information and resources to assist people in understanding the town and the hazard-related issues facing citizens, businesses, and the environment. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The structure of the plan enables people to use a section of interest to them. It also allows the town to review and update sections when new data becomes available. The ability to update individual sections of the mitigation plan places less of a financial burden on the town. Decision-makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Southern Shores.

**Section 2: Community Profile**

**Why Plan for Natural Hazards in Southern Shores?**

Natural hazards impact citizens, visitors, property, the environment, and the economy of Southern Shores. Flooding, hurricanes, nor'easters, wildfire, thunderstorms, tornadoes, heat waves, and coastal erosion have exposed Southern Shores' residents and businesses to the financial and emotional costs of recovering after natural disasters. The risk associated with natural hazards increases as more people move to areas affected by natural hazards. The inevitability of natural hazards, and the growing population and activity within the town create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events. Identifying risks posed by natural hazards, and developing strategies to reduce the impact of a hazard event can assist in protecting life and property of citizens and communities. Local residents and businesses can work together with the town to create a natural hazards mitigation plan that addresses the potential impacts of hazard events.

**Geography and the Environment**

With a 2006 permanent population of 2620 (North Carolina State Demographics), Southern Shores is located on a barrier island off the coast of northeastern North Carolina. It is bounded on the east by the Atlantic Ocean, the south by NC 158 (North Croatan Highway) and on the west by Currituck Sound and Jean Guite Creek (Ginguite Bay).

The Town of Southern Shores was incorporated in 1979. The area encompassed by the town was a real estate development of the Kitty Hawk Land Company. The town is four miles long, north to south, and approximately one mile wide and has an area of 4.2 square miles. A Southern Shores Civic Association, initially established by the developer, was instrumental in obtaining the Town's municipal incorporation. The first Town Council, appointed after its incorporation by the legislature, drew its membership from the Civic Association.

Elevations in the town range from below sea level to 48 feet above mean sea level. There is high ground greater than 20 feet above mean sea level along a dune ridge that runs the length of the community and which serves to separate the maritime forest from the low-lying oceanside dune and swale area. The beach along the oceanfront is defined by the Coastal Area Management Act (CAMA) as an Ocean Erodible Area. This Area of Environmental Concern (AEC) extends from the first line of stable natural vegetation landward 60 times the long term erosion rate, which is 2 feet per year, plus 35 feet, or 155 feet. There is a setback for single family residences from the first line of stable vegetation of 60 feet. The minimum setback is 60 feet from the first line of stable vegetation for lots platted before 1979.

**Demographic Profile**

Southern Shores has a total population of 2,201, according to the US Census Bureau, 2000.

**Table 1. Southern Shores Population Data (2000 Census)**

| Subject | Number | Percent |
|---|---|---|
| **TOTAL POPULATION** | 2,201 | 100.0 |
| Male | 1,086 | 49.3 |
| Female | 1,115 | 50.7 |
| Median Age (years) | 51.4 | |
| Under 5 years | 101 | 4.6 |
| 18 years and over | 1,791 | 81.4 |
| Male | 864 | 39.3 |
| Female | 927 | 42.1 |
| 65 years and over | 547 | 24.9 |
| | | |
| Under 5 years | 101 | 4.6 |
| 5 to 9 years | 104 | 4.7 |
| 10 to 14 years | 131 | 6.0 |
| 15 to 19 years | 108 | 4.9 |
| 20 to 24 years | 25 | 1.1 |
| 25 to 34 years | 100 | 4.5 |
| 35 to 44 years | 282 | 12.8 |
| 45 to 54 years | 413 | 18.8 |
| 55 to 59 years | 200 | 9.1 |
| 60 to 64 years | 190 | 8.6 |
| 65 to 74 years | 341 | 15.5 |
| 75 to 84 years | 182 | 8.3 |
| 85 years and over | 24 | 1.1 |
| | | |
| **RACE** | 2,190 | 99.5 |
| White | 2,162 | 98.2 |
| Black or African American | 2 | 0.1 |

| Subject | Number | Percent |
|---|---|---|
| Hispanic or Latino | 34 | 1.5 |
| American Indian and Alaska Native | 5 | 0.2 |
| Asian | 5 | 0.2 |
| Native Hawaiian / Pacific Islander | 2 | 0.1 |
| Some other race | 14 | 0.6 |
| Two or more races | 11 | 0.5 |
| | | |
| **SOCIAL CHARACTERISTICS** | | |
| Population 25 years and over | 1,739 | 100.0 |
| High school graduate or higher | 281 | 96.7 |
| Bachelor's degree or higher | 527 | 48.9 |
| Disability status (21 to 64 years) | 161 | 13.0 |
| Foreign Born | 86 | 3.9 |
| Now married (population 15 years and over) | 1,375 | 73.6 |
| Speak a language other than English at home | 99 | 4.7 |
| | | |
| **HOUSING CHARACTERISTICS** | | |
| **Total housing units** | 1,921 | 100.0 |
| Occupied housing units | 946 | 49.2 |
| Owner-occupied housing units | 886 | 93.7 |
| Renter-occupied housing units | 60 | 6.3 |
| Vacant housing units | 975 | 50.8 |
| | | |
| **YEAR STRUCTURE BUILT** | | |
| 1999 to 2000 | 160 | 8.3 |
| 1995 to 1998 | 493 | 25.5 |
| 1990 to 1994 | 445 | 23.0 |
| 1980 to 1989 | 554 | 28.7 |
| 1970 to 1979 | 209 | 10.8 |
| 1960 to 1969 | 38 | 2.0 |
| 1940 to 1959 | 29 | 1.5 |
| 1939 or earlier | 4 | 0.2 |

Source: US Census 2000 Summary File 1

**Economic Profile**

During the year 2001, 43.6% of the labor force was employed in management, professional and related occupations, with another 30.7% working in sales and office occupations. Another 11.5% were employed in service occupations.

**Table 2. Southern Shores Workforce By Industry (2001)**

| **Occupation** | Number | **Percent** |
|---|---|---|
| Employed civilian population 16 years and older | 922 | 100.0 |
| Management, professional, and related | 402 | 43.6 |
| Service | 106 | 11.5 |
| Sales and office occupations | 283 | 30.7 |
| Farming, fishing, and forestry | 4 | 0.4 |
| Construction, extraction, and maintenance | 92 | 10.0 |
| Production, transportation, and material moving | 35 | 3.8 |

*Source: NC State Data Center*

In 2000, the town's median household income was $61,676. The median family income was $68,250 and the per capita income was $35,933.

There were 834 single-family owner-occupied homes. The median home value was $221,500. Of these homes, 1,432 had a mortgage, and 346 did not.

**Development Trends**

Southern Shores, with an area of approximately 2,600 acres, is predominantly low-density, single-family dwellings. As a tourist and retirement community, there are three types of buildings, generally characterized as Permanent Resident, Investment/Rental, and Commercial. In 1984, the Zoning Ordinance changed minimum building lot size from 10,000 square feet (50' frontage) to 20,000 square feet (100' frontage), thus reducing the number of buildable lots to insure effective sewage treatment.

*Homeowner Associations*

There are two (2) principle associations (Southern Shores Civic Association (SSCA) and Chicahauk Property Owners Association (CPOA)) and several smaller associations. The Architectural Review Boards of these two associations contribute to the control of natural vegetation, dune protection, height and view restrictions, public access to beaches, and a higher general quality of construction.

Oceanfront raw property values of $800,000 are typical. New homes built on these lots begin at $250,000. Custom-built, luxurious five-bedroom homes with all amenities are economically feasible investments for out of state owners due to the continuing strong demand for rentals. The rental season spans 20 to 30 weeks per year. In-season rates for these homes can reach $12,000 per week. The fact that these residences are usually custom designed homes contributes to more carefully detailed joints and closer controls during the construction process. Coastal and floodplain construction standards now require all oceanfront homes to be built on pilings. Wave loadings on pilings and breakaway walls for carports/storage require engineering design. However, grade beams as recommended in the Army Corps of Engineers' Coastal Construction Manual are not normally included in design. Cathedral ceilings in particular are a popular feature and require an engineer's certification for wind loads.

Due to the large number of people renting these homes during the prime hurricane season (June – November), the septic tank fields are stressed to capacity. Any saltwater flooding in these areas would pose sanitary problems. Low pressure systems are installed in Pelican Watch subdivision. This is the only oceanfront duplex complex in the Town, and has been completely built out with 24 units.

Sound and canal front development is characterized by water access structures such as piers and bulkheads. These are permitted by CAMA regulations.

There has been moderate commercial development in the town in recent years. All commercial development is located along North Croatan Highway (US 158). One private wastewater treatment facility serving residential units operates in Town.

Due to development pressures and the rising cost of land in Southern Shores, much of the future development will be in the form of redeveloping existing lots; smaller, older homes will be demolished making way for larger homes. The increase in size of new structures will place more people within the hazard areas, thereby making these properties and people more susceptible to hazard events.

*State Regulations*
Coastal Area Management Act (CAMA) – The Area of Environmental Concern (AEC) along the oceanfront is defined by CAMA as an ocean erodible area extending from the mean low water line landward 60 times the long term erosion rate, which is 2' per year, plus 35 feet or 155 feet. This translates to a setback for buildings from the first line of stable vegetation of 60'. CAMA regulations and the Coastal Resources Commission prohibit any form of beach hardening in the form of seawalls, bulkheads, riprap, groins, and the like along the oceanfront. A small section (100') of bulkhead and sandbags exist between the beach and several duplexes in Pelican Watch. The Town acknowledges the natural processes and dynamics of the ocean shoreline and manages growth accordingly. Improper development along the estuarine shoreline will pollute or destroy adjacent waters and wetlands. Estuarine shorelines are vulnerable to erosion and flooding. The State achieves the objective of soil conservation by permitting bulkheading and riprap along the estuarine shoreline. The Town manages this development through the building permit process. The Town uses its zoning ordinance building setbacks for sedimentation control.

*Federal Regulations*
The National Flood Insurance Act of 1968, Flood Disaster Protection Act of 1973, National Flood Insurance, and Mitigation and Erosion Management Act of 1991, and National Flood Insurance Reform Act of 1994 play pivotal roles in the Town's floodplain management. Any development work in a flood hazard area needs local permits prior to the work to ensure the work will not aggravate the effects of flooding and that structures are flood damage resistant. Elevation certificates are required for all new residences. All residences in Zone AE and VE must have the lowest horizontal member 2 feet above the base flood elevation.

Clean Water Act – U.S. Army Corps of Engineers defines "wetlands" and regulates development. All development in "wetlands" must meet local zoning. Local zoning limits the intensity and types of uses allowed. As the availability of land areas decreases, the Town can expect to see proposals for development over wetlands. All such development would have to be on pilings or fill permits issued and, while costly now, this situation may become more cost-effective as land becomes more limited and land prices increase.

*Zoning*
Building height limits in residential and commercial zones are 35' measured from the lowest Natural grade elevation or finished grade whichever is greater. Many builders have commented that the town's 2' freeboard requirement above the BFE for homes in the floodplain restricts the size of homes that can be built to one story in some cases. In this way the houses are being squeezed from the top and the bottom. Recommendations from studies conducted in cooperation with the Blue Sky program led to the adoption of the 35' height limit to accommodate a safer roof pitch. The Zoning Ordinance has been amended to include a Hurricane and Storm Reconstruction and Redevelopment and General Use Standards for Ocean Hazard Areas (September 3, 1991). The Land Use Plan for Southern Shores recommends no increase in commercial land uses within the Town's jurisdiction. The Town does not have any hotels or motels or a traditional commercial district. The Town seeks to provide services for the permanent population, rather than a transient population. The majority of the Town is RS-1, Single-Family Residential Zoning District. There is a 30 percent maximum allowable lot coverage; this coverage may be increased to 60 percent with on-site stormwater detention for commercial property only.

*Wastewater Treatment*
The Town has no municipal sewage collection or treatment facility. The Town relies on septic tank systems with gravity flow or low pressure systems. One on-site wastewater treatment plant has been constructed to serve a residential Planned Unit Development and adjacent commercial properties. Most soils in town are suitable for septic tank usage on lots of 20,000 square feet or greater. There is concern that flooded or malfunctioning septic systems can pollute groundwater or estuarine waters. The Town conducts periodic water quality testing. Homesites are effectively limited by lot coverage requirements and septic tank capacity.

*Water Resources Access and Use*
The Town's ocean, sound, and canal shorelines attract people to the community and provide the basic recreational and aesthetic amenities fundamental to Southern Shores. The SSCA owns and maintains many common areas throughout the town. Use of these facilities, such as the marina, soundside wading beach, and ocean access crossovers is enjoyed through membership in the Association. As growth continues in the town, the pressures placed upon the use and development of these shorelines may increase. The Town's role in managing and protecting these shoreline resources is by CAMA and the Zoning Ordinance. The Town has ~~two~~ CAMA Local Permit Officers. The NC Coastal Area Management Act has established Areas of Environmental Concern (AEC) for ocean and estuarine areas and regulations for each type of AEC.

*Stormwater Runoff*
The town, through its Zoning Ordinance, regulates the extent of impervious surface on lots at 30% coverage for residential and 60% coverage for commercial property. Attention is directed to prevent runoff problems from property before a building permit is issued through an on-site, predevelopment meeting and lot disturbance permit. Existing problem areas are being actively addressed and a mutual solution is being sought.

**Stormwater Implementation**

**Figure 1. Base Map of Southern Shores**

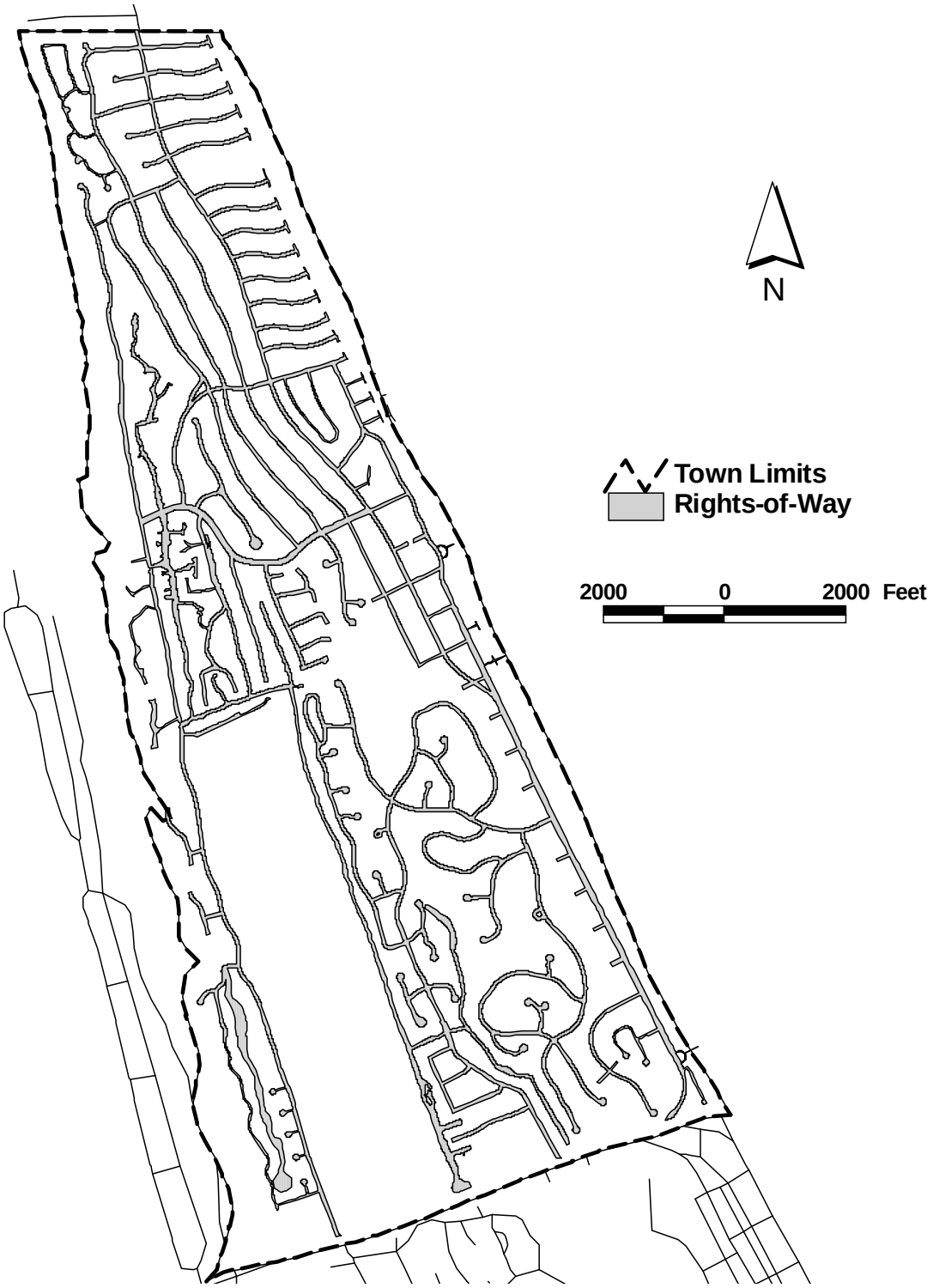


**Figure 2. Existing Land Use and Flood Zones (F.I.R.M .)**

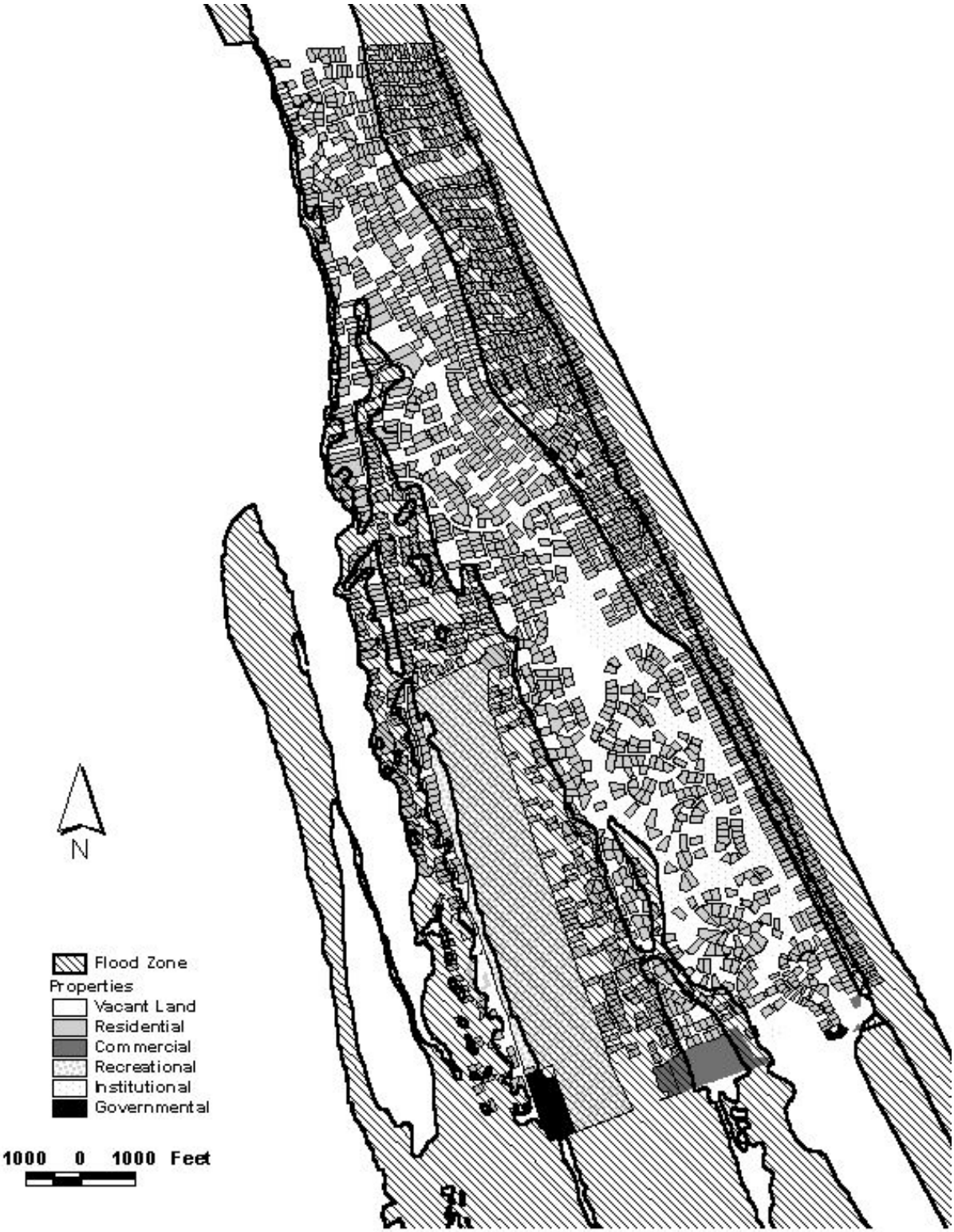
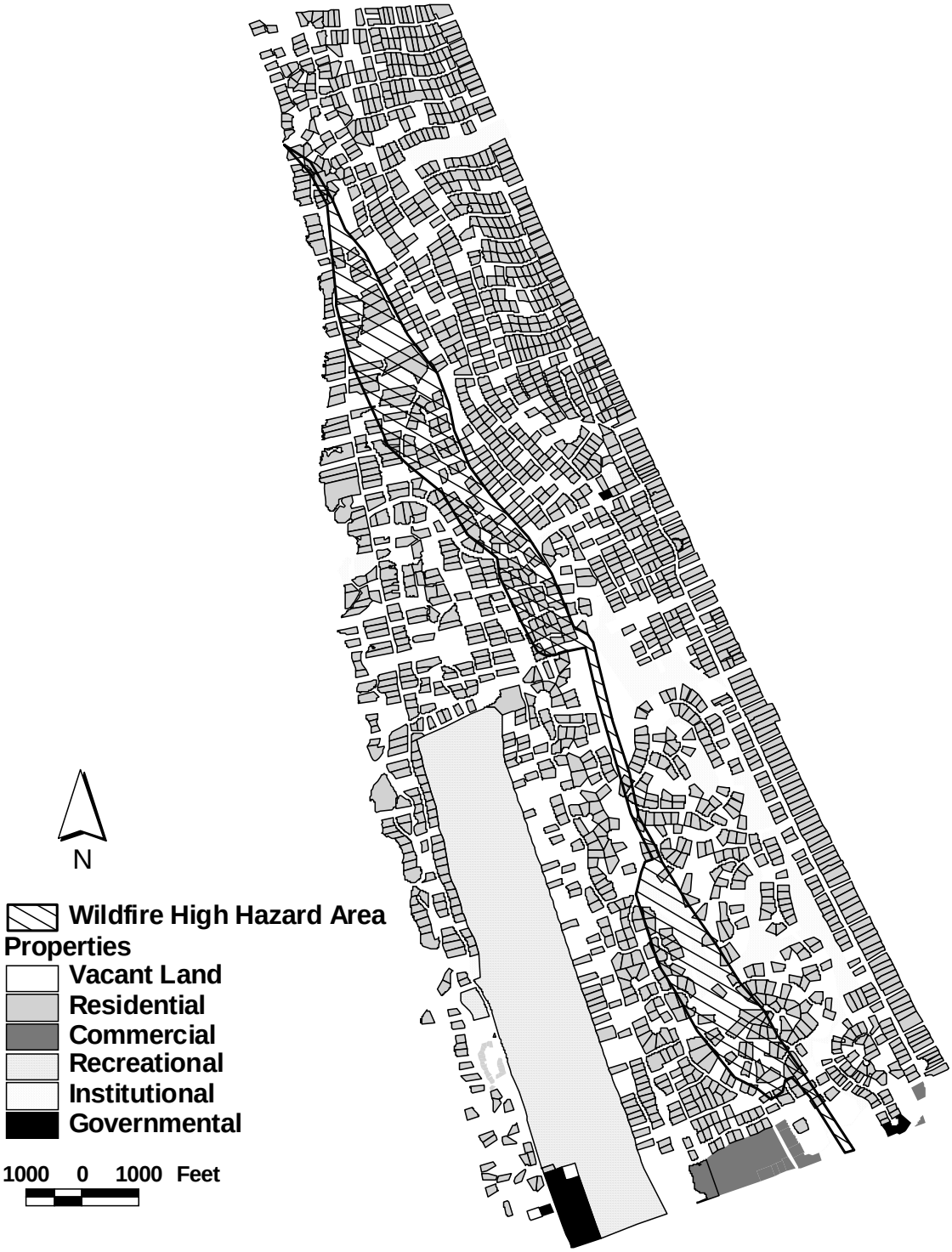


**Figure 3. Existing Land Uses and Slow Moving Storm Inundation**

**Figure 4. Existing Land Uses and Fast Moving Storm Inundation**

**Figure 5. Existing Land Uses and Wildfire Hazard Areas**



## Section 3: Risk Assessment

### What is a Risk Assessment?

Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Specifically, the five levels of a risk assessment are as follows:

1 – ***Hazard Identification*** identifies the geographic extent and intensity of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Southern Shores identified several major hazards that consistently affect this geographic area. These hazards were identified through an extensive process that utilized input from the Hazard Mitigation Planning Committee, as well as recommendations from North Carolina Emergency Management.

2 – ***Profiling Hazard Events*** describes the causes and characteristics of each hazard, how it has affected Southern Shores in the past, and what part of Southern Shores' population, infrastructure, and environment has historically been vulnerable to each specific hazard. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard section. Previous hazard events have not been mapped, due to the relative small size of Southern Shores' jurisdiction.

3 – ***Vulnerability Assessment/Inventorying Assets*** combines hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard. Critical facilities are of particular concern because these entities provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the town and fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities have been identified and mapped.

4 – ***Risk Analysis/Estimating Potential Losses*** involves estimating the damage, injuries, and financial losses likely to be sustained in a geographic area over a given period of time. Describing vulnerability in terms of dollar losses provides the community with a common framework to measure the effects of hazards on assets. For each hazard where data was available, quantitative estimates for potential losses are included in the hazard assessment.

5 – ***Assessing Vulnerability/Analyzing Development Trends*** provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use decisions. Analyzing these trends can help in identifying potential problem areas and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

***Note:*** *The information on the maps in this plan was derived from Dare County's GIS. Care was taken in the creation of these maps, but is provided "as is." Southern Shores cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products (the maps). Although information from land surveys may have been used in the creation of these products, in no way does this product represent or constitute a land survey. Users are cautioned to field verify information on this product before making any decisions.*

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from local, county, state, or federal agency sources.

Southern Shores conducted a vulnerability assessment for the flood hazard using Geographic Information Systems (GIS) to identify the geographic extent of the hazard and assess the land use and value at risk from the flood hazard. Insufficient data exists to conduct vulnerability assessments and risk analyses for all the hazards listed and addressed in the plan.

Regardless of the data available for hazard assessments, there are numerous strategies the town can take to reduce risk. These strategies are described in the action items detailed in each hazard section of this plan. Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items throughout the hazard sections provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

**Table 3. Federal Criteria for Risk Assessment**

| Section 322 Requirement | How is This Addressed? |
|---|---|
| Identifying Hazards | Each hazard section includes an inventory of the best available data sources that identify hazard areas. To the extent GIS data are available, the town developed maps identifying the location of the hazard in the town. The Risk Assessment sectionsof the plan include a list of the hazard maps. |
| Profiling Hazard Events | Each hazard section includes documentation of the history, and causes and characteristics of the hazard in the town. |
| Assessing Vulnerability: Identifying Assets | Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section also identifies potential mitigation strategies. |
| Assessing Vulnerability: Estimating Potential Losses | The Risk Assessment Section of this mitigation plan identifies key critical facilities and lifelines in the town and includes a map of these facilities. Vulnerability assessments have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available. |
| Assessing Vulnerability: Analyzing Development Trends | The Southern Shores Community Profile Section of this plan provides a description of the development trends in the town, including the geography and environment, population, and land use and development. |

**Profiling Hazard Events**

Southern Shores incorporated in 1979. In the history of the town, there have been few minor natural hazards that have directly impacted Southern Shores. However, several major hazards, such as hurricanes and nor'easters, have impacted Dare County as a whole, including Southern Shores. Detailed data concerning the history of hazard events is not available for Southern Shores. However, there is good data for hazard events at the county level.

Dare County has seen a significant number of hazard events over the past 50 years. The probability of future events is assumed to be the same as the past 50 years.

**Table 4. Summary of Reported Storm-Related Damage and Casualties in Dare County prior to Hurricane Isabel.**

*Source: NOAA, National Climatic Data Center (Reports from National Weather Service in Categories)*
Period of Record: Storms (1/1993-7/1999,except 6-7/1993); Tornadoes (1/1950-12/1992); Wind and hail (1/1959-12/1992)
Hurricane, tropical storm, and winter storm damages are multi-county estimates and storm-specific

| Events | *Numbers* | *Deaths* | *Injuries* | **Property Damage* | **Crop Damage* | **Total Damage* |
|---|---|---|---|---|---|---|
| Dare | | | | | | |
| Extreme Cold | 1 | 0 | 0 | $0 | $385,064 | $385,064 |
| Hail | 19 | 0 | 0 | $0 | $0 | $0 |
| Floods | 3 | 0 | 0 | $0 | $0 | $0 |
| Thunderstorm Wind | 66 | 0 | 0 | $541,435 | $0 | $541,435 |
| High Winds | 4 | 0 | 0 | $36,585 | $0 | $36,585 |
| Rip Currents | 3 | 2 | 3 | $0 | $0 | $0 |
| Waterspouts | 12 | 0 | 1 | $106,745 | $0 | $106,745 |
| Funnel Cloud | 1 | 0 | 0 | $0 | $0 | $0 |
| Tornado | 29 | 1 | 19 | $9,934,283 | $0 | $9,934,283 |
| Subtotal | 138 | 4 | 23 | $10,619,047 | $385,064 | $11,004,111 |
| Hurricanes, Tropical Storms & Winter Storms (multi-county events that affected Dare) | | | | | | |
| Hurricanes | 8 | 19 | 14 | $1,450,556,400 | $566,399,842 | $2,016,956,241 |
| Tropical Storms | 5 | 0 | 0 | $24,125,687 | $43,052,156 | $67,177,844 |
| Winter Storms | 4 | 0 | 0 | $25,438,518 | $0 | $25,438,518 |
| Subtotal | 17 | 19 | 14 | $1,500,120,605 | $609,451,998 | $2,109,572,603 |

*Damages are in 2004 US dollars, adjusted using the consumer price index (US Bureau of Labor Statistics, March 2002, USDL-02-222, http://www.bls.gov/news.release/cpi.nr0.htm)

**Vulnerable Populations**

Southern Shores does not contain any specified vulnerable populations, such as day care centers, assisted living facilities, or hospitals.

**Critical Facilities and Infrastructure**

Critical and essential facilities are those facilities that are vital to the continued delivery of key government services or that may significantly impact the public's ability to recover from the emergency. The following figure illustrates the critical facilities, essential facilities, public infrastructure, and emergency transportation routes within Southern Shores.

**Figure 6. Critical Facilities and F.I.R.M. 1993 Flood Zones**

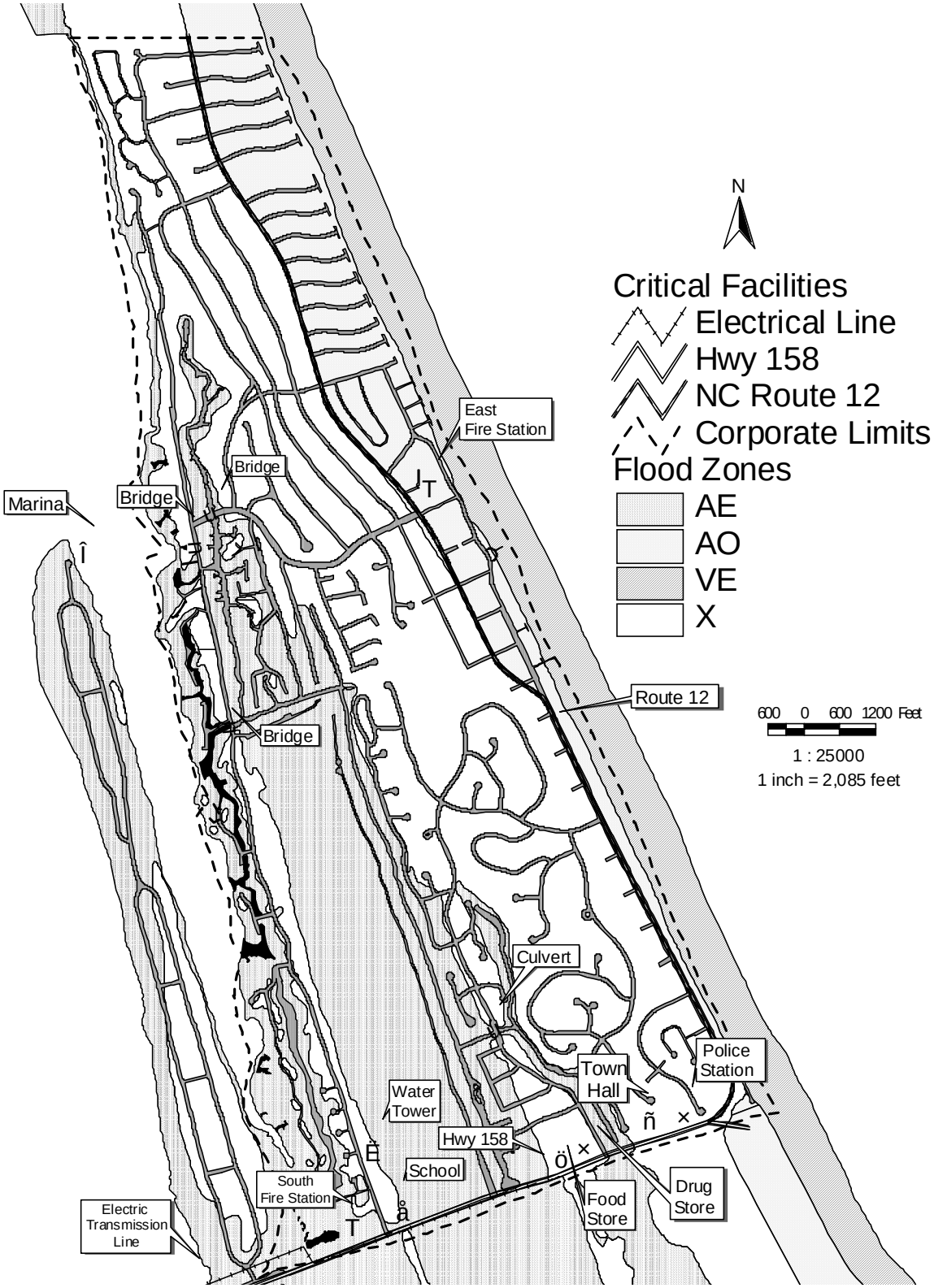


**Figure 7. Critical Facilities and Slow (<15 mph) Moving Storm Surge Inundation**

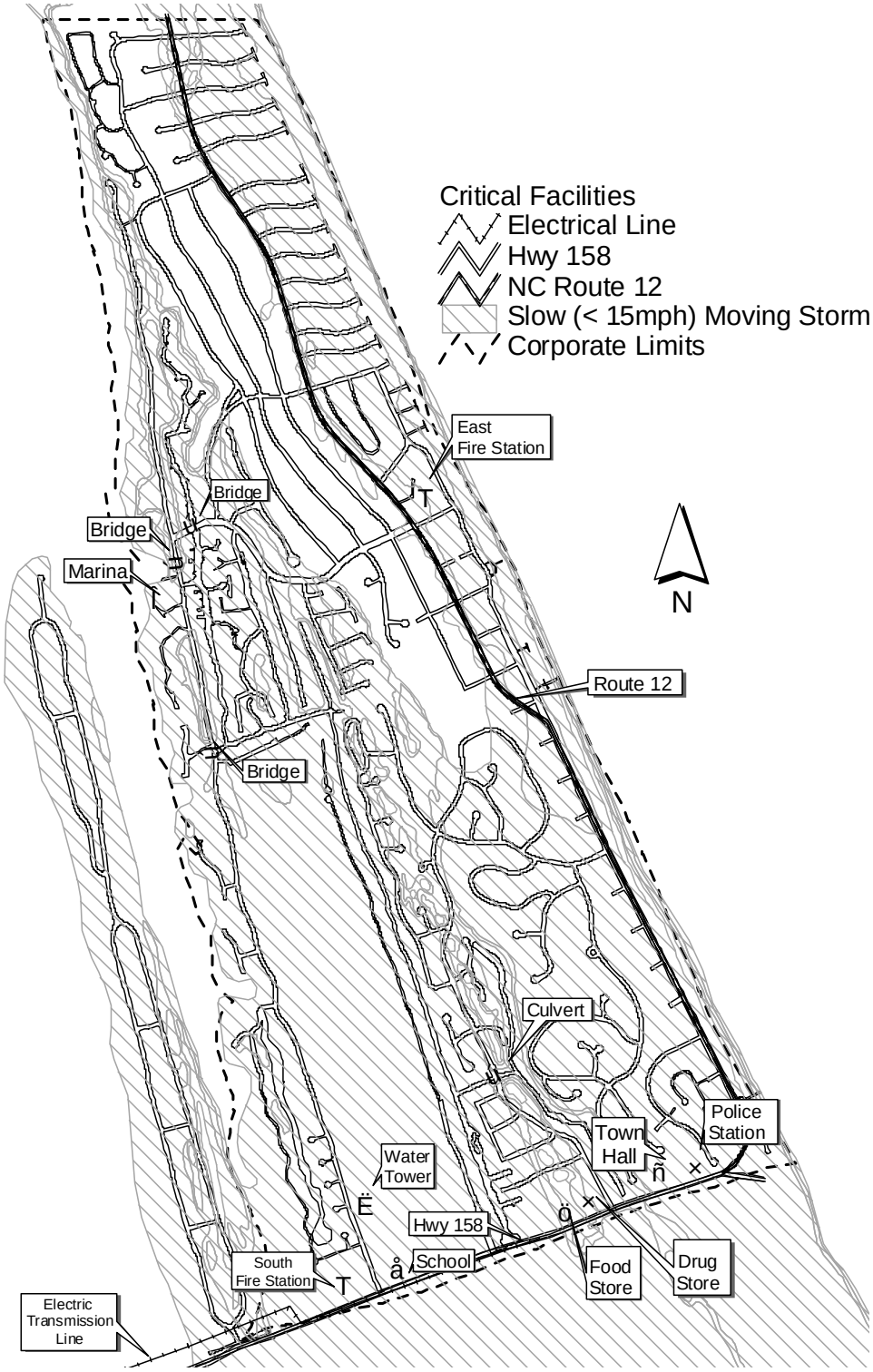


**Figure 8. Critical Facilities and Fast (15 mph or >) Moving Storm Surge Inundation**

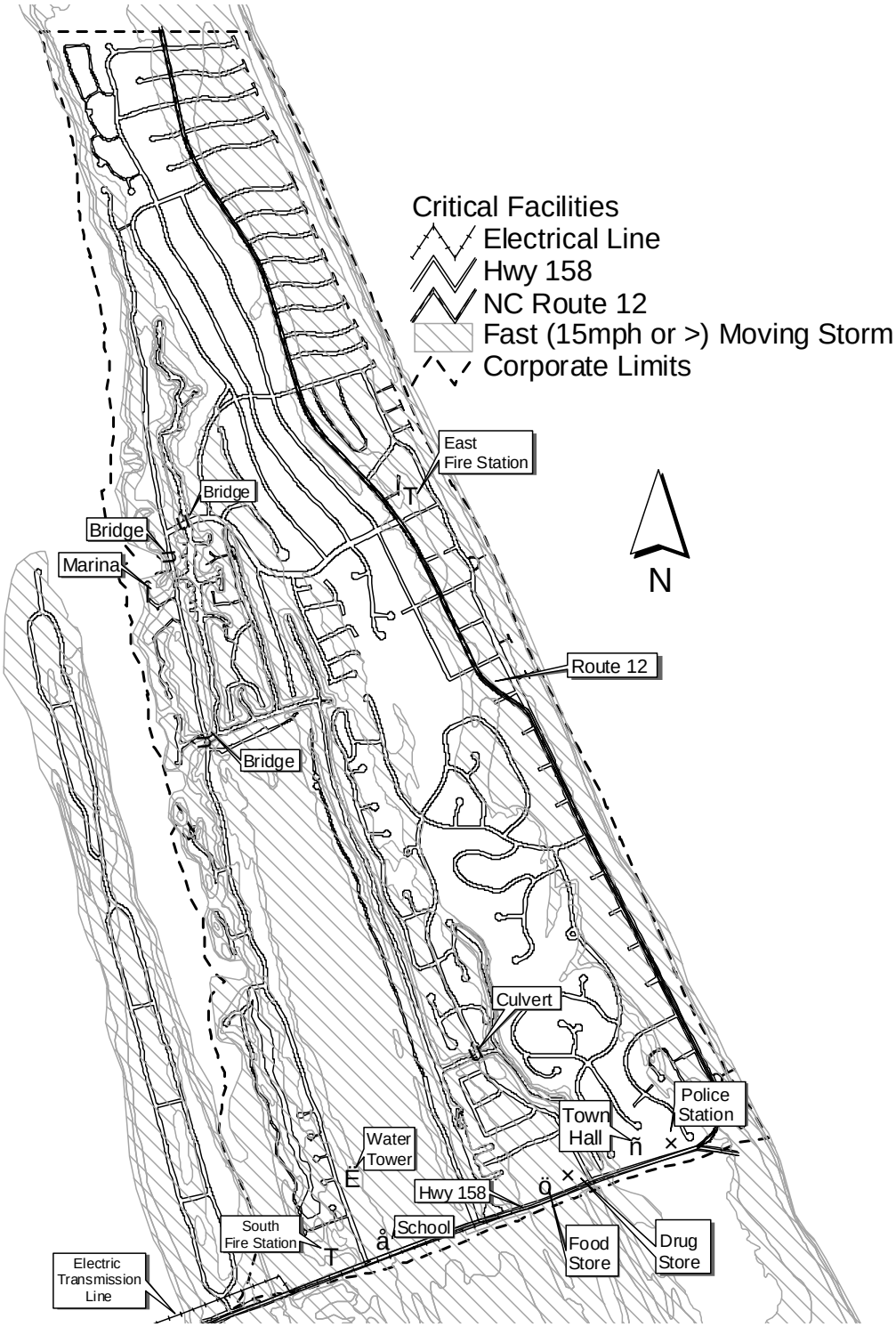
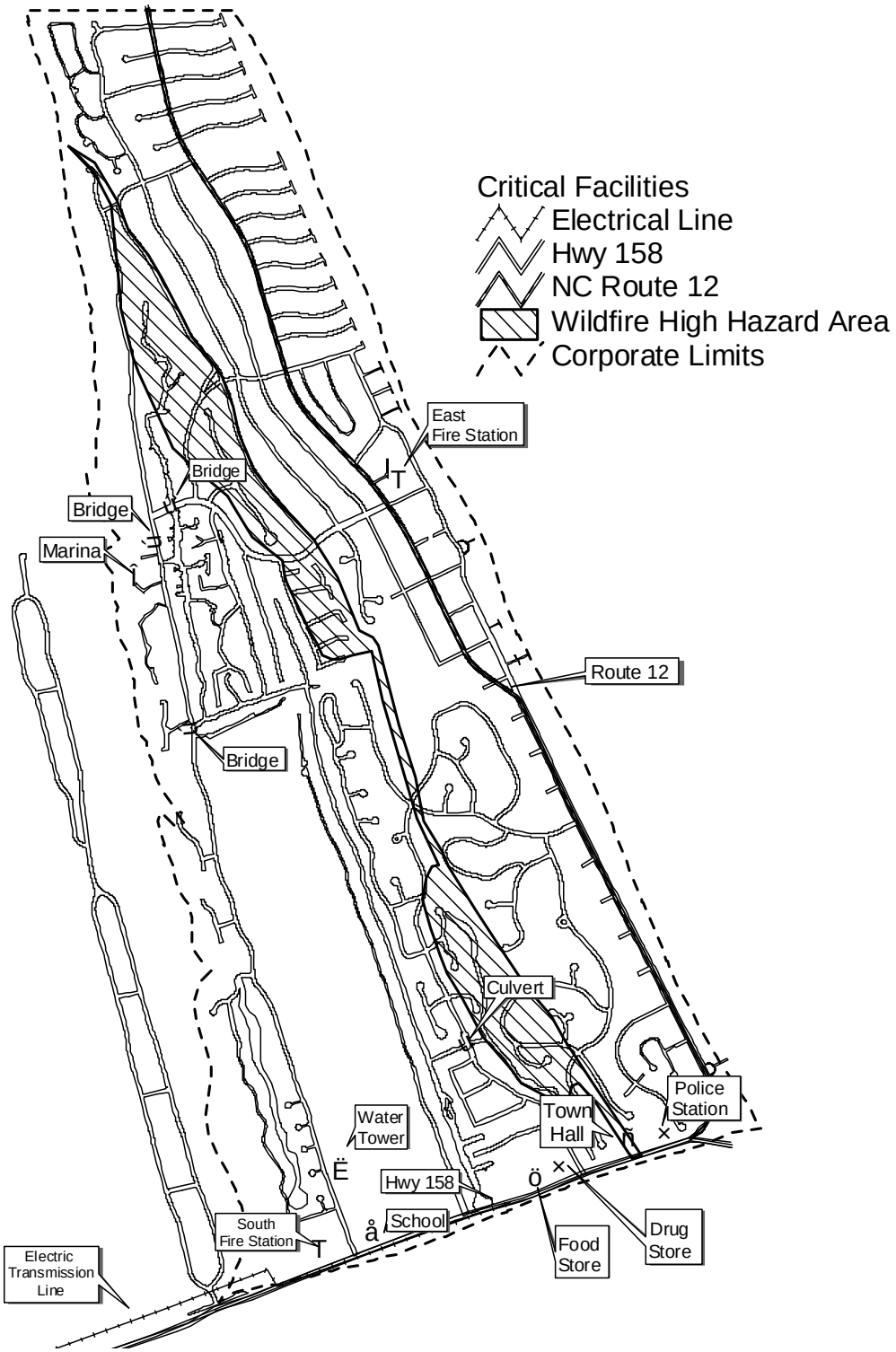


**Figure 9. Critical Facilities and Wildfire High Hazard Areas**



The East and South Fire Stations are located within flood hazard areas. However, at this time it is impractical to consider moving the stations.

**Identifying Hazards**

The Hazard Mitigation Plan Committee identified and analyzed each of the hazards by:

1- the *type* of natural hazards that threaten the community;
2- the *likelihood of occurrence* of the hazards;
3- the *locations* in the community that are most vulnerable;
4- the *impact* of the hazard; and
5- the strength of the hazard, scored by a *Hazard Index*.

The types of natural hazards that threaten the community are hurricanes, nor'easters, wildfires, thunderstorm/lightning, coastal erosion, tornadoes, heat waves/droughts, landslides/sinkholes, severe winter storms, and earthquakes/tsunamis.

The *likelihood of occurrence* estimates the likelihood of each type of hazard occurring in the Southern Shores area.

- Highly Likely = near 100% probability in the next year
- Likely = between 10% and 100% probability in the next year
- Possible = between 1% and 10% probability in the next year
- Unlikely = less than 1% probability in the next year

The *location* criterion measures whether the hazard covers a small, medium, or large proportion of the community.

The *impact* measure is a combination of the severity of the event, its magnitude, and the density of human activity in the affected area.

- Catastrophic = >50% magnitude, multiple deaths, complete shutdown of critical facilities for >30 days, >50% of property is severely damaged
- Critical = 25% to 50% magnitude, multiple severe injuries, complete shutdown of critical facilities for >14 days, >25% of property is severely damaged
- Limited = 10 % to 25% magnitude, some injuries, complete shutdown of critical facilities for >7 days, >10% of property is severely damaged
- Negligible = <10% magnitude, minor injuries, shutdown of critical facilities for <24 hours, <10% of property is severely damaged

The *hazard index* is a scoring system based on a 1 to 5 scale, with 5 being the highest possible score and 1 being the lowest. The score is obtained by how much impact and how frequently this hazard affects the community.

Table 5 represents the Hazard Identification and Analysis matrix and the corresponding Hazard Index scores.

| *Hazard* | *Likelihood of Occurrence (ex. highly likely, likely, possible, unlikely )* | *Location (ex. small, medium, large)* | *Impacts (ex. catastrophic, critical, limited, negligible )* | *Hazard Index* |
|---|---|---|---|---|
| *Hurricane* | *Likely* | *Large* | *Limited* | *5* |
| *Nor'easter* | *Highly Likely* | *Large* | *Limited* | *5* |
| *Wildfire* | *Possible* | *Small* | *Limited* | *3* |
| *Thunderstorm / Lightning* | *Highly Likely* | *Medium* | *Negligible* | *3* |
| *Coastal Erosion* | *Highly Likely* | *Medium* | *Negligible* | *3* |
| *Tornado* | *Possible* | *Small* | *Limited* | *2* |
| *Heat Wave / Drought* | *Possible* | *Large* | *Negligible* | *2* |
| *Landslide / Sinkhole* | *Unlikely* | *Small* | *Negligible* | *1* |
| *Severe Winter Storm* | *Possible* | *Large* | *Negligible* | *1* |
| *Earthquake / Tsunami* | *Unlikely* | *Large* | *Catastrophic* | *1* |

**Table 5. Hazard Identification and Analysis**

**Risk Assessment Summary**

The Hazard Index allowed the Hazard Mitigation Committee to prioritize the natural hazards in Southern Shores. Hurricanes and nor'easters were determined to be the major threat, mainly because of flooding concerns. Wildfire and thunderstorms/lightning constitute the other major natural hazard that affect the town. All natural hazards listed will be discussed, but emphasis on planning will focus on these high-ranking natural hazards.

**Community Capability**

The capability assessment evaluates Southern Shores' political willpower, institutional framework, technical know-how, and ability to pay for mitigation. The capability of all levels of government (local, state, federal, and regional), as well as the contributions made by non-governmental organizations (churches, charities, community relief funds, the Red Cross, hospitals, for profit and non-profit businesses) should be included, with a description of their utility to the local community in terms of hazard mitigation.

*Legal Capability*

Enabling legislation in North Carolina grants a wide array of powers to its cities, towns and counties. The capability section of the local hazard mitigation plan analyzes each of the powers available to local governments enumerated in the North Carolina General Statutes to identify which can be wielded to craft hazard mitigation measures at the local level, and also assess legislation that may impose limits on certain mitigation efforts.

The various legal tools available to the town are:

- General police power
- Building codes and building inspections
- Land use
- Zoning
- Floodway regulation
- Planning
- Subdivision regulations
- Acquisition
- Taxation
- Spending

*Institutional Capability*

Southern Shores is a chartered community with a local government comprised of a Mayor and Town Council. Key government agencies include:

- Town Manager
- Public Works
- Town Attorney
- Town Clerk
- Code Enforcement Officer/Planning
- Police
- Fire

*Political Capability*

The Southern Shores Mayor and Town Council support the concept of hazard mitigation and will promote the economic efficiency and social utility of the mitigation measures contained in this plan.

*Fiscal Capability*
While federal programs carry out the bulk of disaster relief programs that provide funds for mitigation, local governments are encouraged to open the search field as widely as possible, and include alternative funding sources to supplement the local hazard mitigation budget. For instance, local businesses and organizations will frequently support projects that benefit their customers or employees, or which constitute good public relations.

- Hazard Mitigation Grant Program (HMGP)
- Disaster Preparedness Improvement Grant (DPIG)
- Flood Mitigation Assistance Program (FMAP)
- Public Assistance Program (PA)
- Small Business Administration Disaster Assistance Program
- Community Development Block Grant (CDBG)

*Technical Capability*
If the concept of hazard mitigation is being introduced to a local community for the first time, or if a more experienced community wishes to upgrade its level of mitigation, technical know-how may be at a premium.

## Section 4: Multi-Hazard Goals and Action Items

This section provides information on the process used to develop goals and action items that pertain to the natural hazards addressed in the mitigation plan. It also describes the framework that focuses the plan on developing successful mitigation strategies. The framework is made up of three parts: the *Mission, Goals,* and *Action Items*.

### Mission

The mission of the Southern Shores Hazard Mitigation plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss prevention, and identifying activities to guide the town towards building a safer, more sustainable community.

### Goals

The plan *goals* describe the overall direction that Southern Shores can take to minimize the impacts of natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations that are outlined in the action items.

The goals are broken down into Activity Areas. This plan includes seven areas of activities. These activities are: preventive, property protection, natural resource protection, reconstruction, life and safety, emergency services, and public information. Each activity area contains at least one goal.

Action Items
The *action items* are a listing of activities in which the town and the citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation.

The mitigation plan identifies action items developed through data collection and research, surveys, and the public participation process. Mitigation plan activities may be considered for funding through federal and state grant programs, and when other funds are made available. To help insure activity implementation, each

action item includes information on the timeline and the responsible party. Upon implementation, the responsible person(s) may look to partner organizations for resources and technical assistance.

- **Responsible Person.** The responsible person(s) is the person or entity that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Responsible person(s) may include local, county, or regional agencies that are capable of or responsible for implementing activities and programs.
- **Deadline.** Each action item includes an estimate of the timeline for implementation.
- **Funding.** Each action item will include a possible source of funding. Implementation ideas may include grant programs or human resources.
- **Prioritization.** Each action item is prioritized. The selection criteria used to analyze and prioritize each action step are: 1) cost effective; 2) environmentally sound; and 3) technically feasible. If an action item meets all three criteria, it is given a **High** priority; if it meets two criteria, it is given a **Medium** priority; and if it meets one criterion, it is given a **Low** priority. There is an explicit emphasis on cost effectiveness, in light of its possible use in environmental reviews for HMGP, FMA, and other federal hazard mitigation projects.

**Southern Shores Hazard Mitigation Plan**

1. PREVENTIVE ACTIVITIES

*GOAL: INCREASE FLOOD AWARENESS*

The Town of Southern Shores has a number of preventive activities in place that affect floodplain management and will continue these activities. The Town has a Zoning Ordinance, a Flood Damage Prevention Ordinance, open space preservation, stormwater management, and conducts a drainage system maintenance program.

*Action: Continue enforcement of the zoning ordinance as a hazard mitigation tool*

*Responsible Person: Code Enforcement*
*Deadline: ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Zoning Ordinance contains provisions for low density zoning. Approximately 98% of the oceanfront lots are zoned RS-1, low-density residential zoning. The ordinance also contains provisions for minimum lot coverage. The Town has restrictive development regulations that include building setback lines and a low density zoning area in the form of a golf course.

*Action: Identify "at risk" X Zone properties for added emphasis on flood risks and notify the responsible agencies about discrepancies between floodplain maps (FIRM versus SLOSH).*

*Responsible Person: Code Enforcement Officer*
*Deadline: December 2004*
*Funding: General operating budget*
*Prioritization: High*

In the southeast corner of the town's jurisdiction, there is an area that lies outside the 100-year floodplain, as established by the FIRM, but is predicted by the S.L.O.S.H. models to be inundated during Category 3 storm events. This action step proposes to pursue whether or not to add these properties to the locally adopted flood map and settle this discrepancy.

*Action: Continue enforcement of the Flood Damage Prevention Ordinance*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Flood Damage Prevention Ordinance protects property to a level greater than the NFIP's minimum requirement. This ordinance requires 2 feet of freeboard above the base flood elevation shown on the FIRM in all zones. Additionally, the Flood Damage Prevention Ordinance requires property owners that wish to improve their property by greater than 50% of the current structure value must conform with the current flood damage regulations.

*Action: Implement stormwater management regulations*

*Responsible Person: Planning Board*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Town has reviewed the need for stormwater management regulations and will implement recommendations. Standing water after heavy rains presents a safety hazard.

*GOAL: REDUCE THE TOWN'S VULNERABILITY TO WILDFIRES*

*Action: Continue the enforcement of the NC State Fire Prevention Code, referenced by the Town Fire Code*

*Responsible Person: Fire Official*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The North Carolina State Fire Prevention Code, as referenced by the Town Fire Code, requires vacant and improved property to be kept clear of combustible vegetative waste. Owners may be issued civil citations.

*Action: Continue enforcing the Lot Disturbance provisions of the Zoning Ordinance*

*Responsible Person: Code Enforcement ~~Administrator~~ Officer*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

Originally established to require documentation of natural grade elevations prior to grading and filling, this item ensures that a site visit is made of all property prior to land clearing activities. Inspections staff reviews potential development impact to vegetation in Town right-of-way and possible stormwater runoff issues. Site plan vegetation removals are evaluated for wildfire potential.

*Action: Continue the periodic controlled burns of marshland to reduce wildfire fuels*

*Responsible Person: Fire Chief*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: Medium (environmentally sound and technically feasible).*

The town periodically undertakes controlled burns of marshland, with technical assistance from the North Carolina Division of Forest Resources. These burns reduce the amount of wildfire fuels.

*Action: Continue testing the fire hydrants once a year and recording data*

*Responsible Person: Fire Chief*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The yearly hydrant testing program insures that the fire department has the necessary resources to combat urban fires. Collecting and recording the data provides the town with the necessary information to deal with any potential problems and minimize their effects on fire fighting ability.

2. PROPERTY PROTECTION ACTIVITIES

*GOAL: MINIMIZE AND MITIGATE POTENTIAL DAMAGES TO INDIVIDUAL PROPERTIES FROM NATURAL HAZARDS*

*Action: Continue implementation of the Waterway Ordinance*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Town Waterway Ordinance requires property owners to keep their banks clear of growth and debris. The North Carolina Department of Transportation routinely inspects and clears debris from the drainage system on State maintained roads such as Route 12 and US 158. The Town amended its solid waste and waterway ordinances to specifically prohibit dumping in the drainage system.

*Action: Seek the maximum points available from the Community Rating System to keep flood insurance costs to the citizens as low as possible*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*

*Funding: General operating budget*
*Prioritization: Medium (environmentally sound and technically feasible)*

The town will continue the current mitigation activities and seek the maximum points available from the Community Rating System for the prescribed activities. CRS Credit is given for the town's Zoning Ordinance, which contains low density zoning provisions, recognized under Activity 430 (Higher Regulatory Standards) and a Flood Damage Prevention Ordinance, also recognized under Activity 430 (Higher Regulatory Standards). Open space preservation is credited under Activity 430 (Open Space Preservation). The drainage system maintenance program is credited under Activity 540 (Drainage System Maintenance).

*Action: Conduct the Canal Inspection and Debris Removal program twice a year*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

Twice a year, the Town conducts a Canal Inspection and Debris Removal Program. This covers all navigable canals, lagoons, and inlets serving the community to ensure they are clear to drain flood waters. There are 19 such bodies of water that empty into the Currituck Sound and Ginguite Bay.

*Action: Continue enforcement of the state building code, including wind load requirements*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The town presently enforces the state building code and associated wind load requirements for coastal areas.

*Action: Provide property owners and developers with information regarding the construction of FEMA "Safe Rooms" from the effects of tornadoes and severe storms*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

An increasing number of homeowners are building safe rooms to protect their families from the high winds of hurricanes, or because they are unsure whether they will be able to safely evacuate an area. However, homeowners in flood-prone or storm surge areas should evacuate to provide safety for themselves or their families when a hurricane threatens.

3. NATURAL RESOURCE PROTECTION

*GOAL: INTEGRATE NATURAL RESOURCE PROTECTION POLICIES WITH PROPERTY PROTECTION MEASURES*

*Action: Continue enforcement of the Dune Protection Ordinance*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Town has developed some regulatory standards for the special hazard areas of coastal dunes and beaches. The Town has designated dune and beach areas as open space. Town ordinance prohibits driving on sand dunes and requires construction of walkways over dunes. CAMA setback regulations prohibit buildings within 60 feet of the first line of stable natural vegetation.

*Action: Coordinate wildfire prevention efforts with tree preservation policies*

*Responsible Person: Planning Board*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: Low (technically sound)*

The town has adopted tree preservation policies, which may be in conflict with efforts to prevent wildfire. These two conflicting policies need to be addressed together, and a single policy statement for the town should be developed.

*Action: Continue enforcing Coastal Area Management Act (CAMA) regulations*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Town of Southern Shores participates in the North Carolina Coastal Area Management Program and is claiming special hazard credit points for the following coastal erosion management activities:

- Mapping the erosion-prone area to developing erosion rates;
- Regulating new development to reduce the susceptibility of buildings to erosion damage;
- Maintaining data on shoreline erosion; and
- Maintaining programs, such as bluff stabilization and beach nourishment that affect the rate of erosion.

*Action: Continue enforcing the state Erosion and Sedimentation Control regulations*

*Responsible Person: Code Enforcement Officer*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

If a property owner disturbs more than 1 acre, they must submit an Erosion and Sedimentation Control plan. Erosion and sedimentation control is credited under Activity 430 (Higher Regulatory Standards).

4. RECONSTRUCTION

*GOAL: ESTABLISH PLANS TO SUPPORT RECONSTRUCTION EFFORTS AFTER A NATURAL HAZARD*

*Action: Continue to have a standing Reconstruction Task Force*

*Responsible Person: Reconstruction Task Force*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The town has a standing Reconstruction Task Force that is on call and ready to serve in a post-disaster environment. The Reconstruction Task Force relies heavily on the Southern Shores Master Emergency Plan, which establishes post-disaster mitigation policies and procedures.

*Action: Develop guidelines for reconstruction efforts*

*Responsible Person: Reconstruction Task Force*
*Deadline: June 2005*
*Funding: General operating budget*
*Prioritization: Medium (environmentally sound and technically feasible)*

A responsibility for the standing Reconstruction Task Force is to develop guidelines to expedite reconstruction efforts. A major portion of the guidelines may be already detailed in the Southern Shores Master Emergency Plan.

*Action: Communicate with citizens about plans and the problems of providing services after a storm event*

*Responsible Person: Reconstruction Task Force*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: Medium (cost effective and technically feasible)*

The Reconstruction Task Force needs to consider public information activities that will communicate to citizens the procedures in place after storm events.

5. LIFE AND SAFETY

*GOAL: IMPLEMENT ACTIVITIES THAT ASSIST IN PROTECTING LIVES FROM THE EFFECTS OF NATURAL HAZARDS*

*Action: Develop a better flood warning system*

*Responsible Person: Reconstruction Task Force*
*Deadline: July 2008*
*Funding: General operating budget*
*Prioritization: Low (technically feasible)*

The town's primary flood threat recognition system is operated by the National Weather Service which issues National Hurricane Center tracking reports. The town has adopted, and participates in, the Dare County Hurricane Evacuation Plan which provides for emergency warning dissemination. The town also has the capability to produce GIS maps using SLOSH inundation maps to convert a forecast from the National Hurricane Center to a predicted area of inundation throughout the community. Other response efforts include preparedness training programs and disaster drills. Southern Shores Master Emergency Plan includes warning and coordinating with critical facilities.

*Action: Continue to monitor NC Turnpike Authority plans for the Mid-Currituck Bridge to expedite evacuation*

*Responsible Person: Town Council*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The Transportation Improvement Program (TIP), published by the NC Department of Transportation, has the Mid-Currituck Bridge, from Coinjock to Corolla, scheduled for completion 2013.

6. EMERGENCY SERVICES

*GOAL: COORDINATE EMERGENCY PLANS FROM IMPACTED SERVICES (I.E., WATER, TELEPHONE, ELECTRIC, FIRE, RESCUE, AND MEDICAL)*

*Action: Encourage food stores and pharmacies within the town to have alternative power supplies during and after storm events*

*Responsible Person: Reconstruction Task Force*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: Low (technically feasible)*

Many people in the community depend on the local grocery stores and pharmacies for sustenance and medical needs. The Reconstruction Task Force should work with these businesses to ensure that alternative power supplies are available so that these businesses may reopen in the event of a disaster.

*Action: Continue to provide an Emergency Operations Center*

*Responsible Person: Town Council*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

The town should maintain an Emergency Operations Center, in order to implement the Master Emergency Operations Plan.

*Action: Keep emergency plans current and provide staff with continuing education opportunities*

*Responsible Person: Town Council*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

Southern Shores participates regularly in regional meetings on emergency preparedness.

7. PUBLIC INFORMATION

*GOAL: COMMUNICATE WITH CITIZENS ABOUT THE SUSCEPTIBILITY TO NATURAL HAZARDS AND THEIR EFFECTS*

*Action: Educate citizens on expected impacts of hazards on daily lives*

*Responsible Person: Code Enforcement*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

Southern Shores implements many public information activities. Among the activities implemented are floodplain mapping information, outreach projects, real estate disclosure, and a floodplain library.

Southern Shores provides assistance on flood protection analysis. The Building Inspector provides assistance by reviewing plans, making site visits before, as well as during, and after construction. A list of contractors that have built homes in Southern Shores is available.

*Action: Continue current public information outreach efforts regarding flooding*

*Responsible Person: Code Enforcement Officer*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: High*

Each year, the Town mails a brochure to every property owner describing the flood hazard. A separate brochure is mailed to every resident in the SFHA advising them of the potential flood hazard, the availability of flood insurance and flood protection methods. A list of properties in the floodplain is submitted to FEMA annually.

The town maintains and publicizes documents related to flood insurance, flood protection, flood proofing structures, and floodplain management. The Town assists the Kill Devil Hills branch of the Dare County Library with floodplain materials. Documents prepared locally and keyed to local conditions are the Town's Flood Insurance Study and the photographic account by David Stick, *The Ash Wednesday Storm*.

*Action: Continue e-mail and website services*

*Responsible Person: Executive Assistant*
*Deadline: Ongoing*
*Funding: General operating budget*
*Prioritization: Medium (cost effective and technically feasible)*

The widespread availability of internet access has allowed the town to use online services to disseminate public information to citizens and property owners.

**Section 5: Plan Maintenance**

The plan maintenance section of this document details the formal process that will ensure that the Southern Shores Hazard Mitigation Plan remains an active and relevant document.

**Plan Maintenance Process**

The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing a plan revision every five years. This section describes how the town will integrate public participation throughout the plan maintenance process.

**Plan Adoption**

The Town Council of Southern Shores will be responsible for adopting the Southern Shores Hazard Mitigation Plan. This governing body has the authority to promote sound public policy regarding natural hazards. Once the plan has been adopted, the Code Enforcement Officer will be responsible for submitting it to the State Hazard Mitigation Officer at the North Carolina Division of Emergency Management. NC Emergency Management will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, Southern Shores will remain eligible for Hazard Mitigation Grant Program funds.

**Monitoring, Evaluating and Updating the Plan**

Implementation of the activities recommended by this plan will be monitored so the deadlines will be met. Where possible, each activity should be monitored in terms of dollar value of its flood loss reduction benefits.

The Code Enforcement Administration will be responsible for the tracking the activities outlined in this plan. Each person assigned a responsibility in this plan shall report to the Code Enforcement Administration by the last day of each quarter (March 31, June 30, September 30, December 31). The Code Enforcement Administration will report to the Town Council twice each year, on the first week and last week of hurricane season (June 1$^{st}$ and November 30$^{th}$). The report should review progress and recommend changes as needed.

In addition, the Hazard Mitigation Planning Committee will reconvene during the first week of June each year to receive a presentation on the progress of the plan. The Hazard Mitigation Planning Committee will prepare an annual evaluation report that will be submitted to the Town Council.

The criteria the Hazard Mitigation Planning Committee will use in evaluating the plan are:

- Do the goals and actions 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 the agencies and other partners participate in the plan and planning process as proposed?

**Implementation Through Existing Programs**

Southern Shores will incorporate the requirements of this hazard mitigation plan into other local plans. During the planning process for new and updated local planning documents, such as a comprehensive plan, CAMA land use plan, capital improvement plan, or emergency management plan, to name a few examples, the

Code Enforcement Administration will provide a copy of the hazard mitigation plan to each respective advisory committee member. The Code Enforcement Administration will recommend the advisory committee members ensure that all goals and actions of new and updated local planning documents are consistent with the hazard mitigation plan and will not contribute to increased hazards in the jurisdiction.

**Continued Public Involvement**

Southern Shores is dedicated to involving the public directly in review and updates of the Hazard Mitigation Plan. Any amendment to the Hazard Mitigation Plan must be made by the Town Council. A public hearing will be required before any consideration of an amendment to the plan can be made. The Town's current outreach methods will be used to disseminate hazard mitigation information to citizens and property owners.

**Section 6: Hurricanes and Nor'easters**

The major threats faced by Southern Shores are hurricanes and coastal storms (northeasters), in addition to flooding. The Federal Emergency Management Agency's (FEMA) 1987 and 1992 Flood Insurance Studies state that the dominant source of flooding in the Town of Southern Shores is storm surge generated in the Atlantic Ocean. The Town experiences hurricanes, tropical storms, and severe extratropical cyclones, commonly referred to as nor'easters. Unlike a hurricane that may pass over a coastal location in a fraction of a day, a nor'easter may blow from the same direction and over long distances for several days. Although nor'easters (winter storms) are more diffuse and less intense than hurricanes, they occur more frequently and cover larger areas and longer coastal reaches at one time.

These storms present three types of hazards: wind, storm surge, and rain. The following is a description of these three hazards:

- High winds: Storms with wind speed ranging from over 74 mph up to 155 + mph are classified as hurricanes. These winds can blow roofs off of buildings and destroy mobile homes. All evacuation activities must be completed prior to onshore winds reaching tropical storm status (40 mph).
  [Refer to Appendix B for the Dare County evacuation procedures]

A related problem is tornadoes spawned by hurricanes, which will develop fast, inflict tremendous destruction, and vanish as fast as they appeared.

- Storm surge: This is a great dome of water caused by winds and pressure differences in the air. Areas are flooded by water that can be up to 18 feet higher than normal sea levels. On the Outer Banks, the maximum storm surge is experienced north of where the hurricane's eye makes landfall. This surge, especially when coupled with the breaking waves, causes great destruction and accounts for most hurricane deaths.

- Rainfall: Six to twelve inches of rainfall generally accompanies a hurricane. This causes flooding of streets before and during the worst part of a hurricane and river flooding inland after the storm passes. Flooding can be aggravated where drainage ways are blocked by hurricane-blown debris.

**Hurricanes**

*Hurricanes* are tropical cyclones with winds that exceed 74 miles per hour (mph) and circulate counter-clockwise about their centers in the Northern Hemisphere (clockwise in the Southern Hemisphere). Hurricanes are formed from simple complexes of thunderstorms, commonly known as convection. However, these thunderstorms can only grow to hurricane strength with cooperation from both the ocean and the atmosphere. First, the ocean water itself must be warmer than 81 degrees Fahrenheit. The heat and moisture from this warm water is ultimately the source of energy for hurricanes. Hurricanes will weaken rapidly when they travel over land or colder ocean waters -- locations with insufficient heat and/or moisture.

***Hurricane Categories (Saffir-Simpson scale)***

Category 1: Winds 74-95 mph. Damage to shrubbery, trees, unanchored mobile homes, and some signs. Storm surge 5-7 feet above normal. Some damage to piers, exposed small craft, and low-lying buildings.

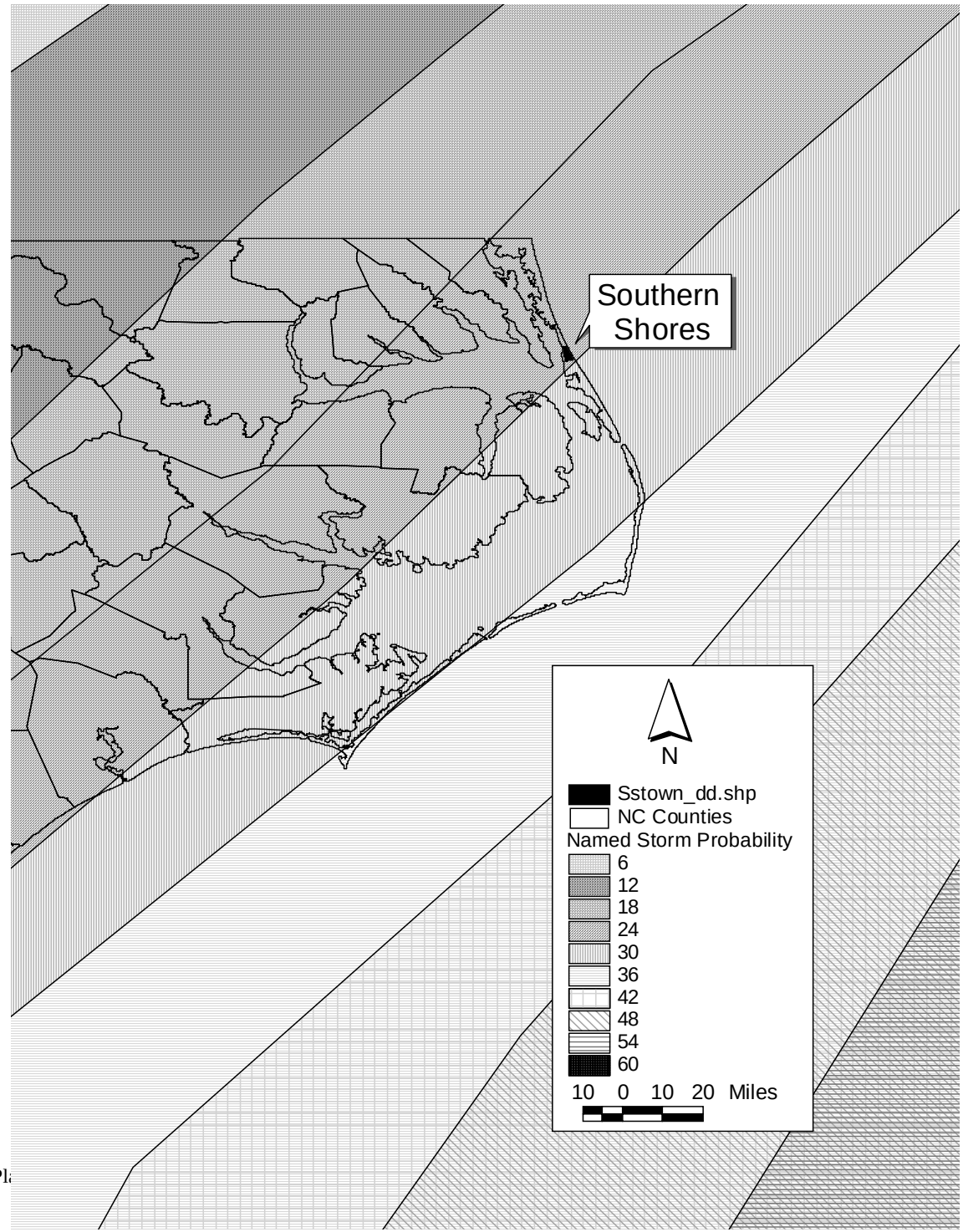
Category 2: Winds 96-110 mph. Some trees blown down. Major damage to mobile homes and signs. Some damage to building roofs and windows. Storm surge 8-10 feet. Considerable damage to piers, marinas, small craft, and low-lying buildings.

Category 3: Winds 111-130 mph. Large trees and many signs blown down. Mobile homes substantially damaged. Some structural damage to small buildings. Storm surge 11-12 feet. In addition to water damage, structures severely damaged by waves and floating debris.

Category 4: Winds 131-155 mph. All signs blown down. Mobile homes destroyed. Extensive damage to roofing, windows, and doors. Storm surge of 13-18 feet above normal water levels.

Category 5: Winds over 155 mph. Some complete building failures. Storm surge over 18 feet. Major damage to structures less than 15 feet above sea level within 500 yards of shore.

**Figure 10. Hurricane Probability Map**




***Probability of Future Events***

Southern Shores has a 24 percent probability of a tropical storm or hurricane's center passing within 60 nautical miles of the town's jurisdiction, as shown on Figure 10. However, the 36 percent boundary is only a few miles to the south of the town. Therefore, the probability in any given year of a named storm passing within 60 nautical miles of the town's jurisdiction is 24-36 percent (**Medium** likelihood of occurrence).

Hurricanes, when threatening Southern Shores, impact a **Large** proportion of the town's jurisdiction.

Impact of a hurricane on the town would be **Limited.**

Since Southern Shores incorporated in 1979, there have been a number of hurricanes.

Hurricane Emily, a Category 3 hurricane, grazed Hatteras Island on August 31, 1993. The eye of the hurricane came within 20 miles of Cape Hatteras, but did not pass over the Outer Banks. When the winds shifted from the northeast to the northwest, water was forced onto the island from Pamlico Sound, washing several homes from their foundations south of Southern Shores. Wind measuring equipment recorded wind gusts of up to 107 miles per hour.

Hurricane Isabel, a Category 2 storm, made landfall north of Cape Lookout on September 16, 2003. Southern Shores fared well as hurricane force winds moved through the area. There was no flood damage reported. However, wind damage and clean up after the storm was estimated at $1 million.

Neither of these storms caused significant structural damage in Southern Shores.

**Nor'easters**

Unlike a hurricane that may pass over a coastal location in less than a day, a nor'easter, or a severe extratropical cyclone, may blow from the same direction and over long distances for several days. Although nor'easters are more diffuse and less intense than hurricanes, they occur more frequently and cover larger areas and longer coastal reaches at one time. Nor'easters form near the Atlantic coast, generally over coastal areas where there is a large temperature gradient in wintertime between air over a cold landmass and air over relatively warm ocean waters. 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. This is particularly true off the North Carolina coastline where, on average, the Gulf Stream is closest to land north of 32 degrees latitude. 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.

When jet stream disturbances (which create lift) move over this temperature gradient, surface low-pressure systems can form. Because of the abundant moisture from the ocean and temperature gradient of the coastal front, these storms can develop explosively.

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.

The coastal counties of North Carolina are most vulnerable to the impacts of nor'easters. Since the storms 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.

A scale, similar to the Saffir-Simpson scale for hurricanes, has been developed by Robert Davis and Robert Dolan (1993). The Dolan-Davis scale is shown below.

**Table 6. Dolan-Davis Nor'easter Scale**

| Storm Class | Beach Erosion | Dune Erosion | Overwash | Property Damage | Duration (measured in number of tidal cycles) |
|---|---|---|---|---|---|
| I (Weak) | Minor changes | None | No | No | Up to 1 tide |
| II (Moderate) | Modest; mostly to lower beach | Minor | No | Modest | Up to 2 tides |
| III (Significant) | Erosion extends across beach | Can be significant | No | Loss of many structures at local level | 2 to 3 tides |
| IV (Severe) | Severe beach erosion and recession | Severe dune erosion or destruction | On low beaches | Loss of structures at community- scale | 3 to 4 tides |

| Storm Class | Beach Erosion | Dune Erosion | Overwash | Property Damage | Duration (measured in number of tidal cycles) |
|---|---|---|---|---|---|
| V (Extreme) | Extreme beach erosion | Dunes destroyed over extensive areas | Massive in sheets and channels | Extensive at regional-scale; millions of dollars | 4 to 5 tides |

**Table 7. Nor'easters from 1942 to 1984**

| Storm Class | Number of Storms | Percentage of Total |
|---|---|---|
| I – Weak | 670 | 49.7 |
| II– Moderate | 340 | 25.2 |
| III – Significant | 298 | 22.1 |
| IV – Severe | 32 | 2.4 |
| V - Extreme | 7 | 0.1 |

Source: Dolan, Robert and Robert E. Davis. "An Intensity Scale For Atlantic Coast Northeast Storms." *Journal of Coastal Research*. Vol. 8:4, pp. 840-853.

***Probability of Future Events***

Each year, there is an average of 22 to 35 nor'easters that have a minor impact along the mid-Atlantic coast, according to research based on 50 years of data by Dolan and Davis. Over the past 10 years, there has been an average of 2 to 3 Class IV and V nor'easters. This rate is expected to remain the same for the near future. (**Highly Likely** likelihood of occurrence).

Nor'easters, when threatening Southern Shores, impact a **Large** proportion of the town's jurisdiction. The weaker storms, Classes I, II, and III – are most common from December to April. The stronger nor'easters, Classes IV and V, typically occur in October, January, and March.

Impact of a nor'easter on the town would be **Limited.**

The area in and around Southern Shores has experienced several major nor'easters.

The Ash Wednesday Storm of 1962 produced the most extensive damage recorded to date along this section of the Outer Banks. Water inundated Sea Crest Village and was impounded by the dune for 10 days. David Stick's account, *The Ash Wednesday Storm*, is filled with photographs of the storm damage.

The Halloween Storm in 1991 had a storm surge measurement of less than 3', but the wave period was 18-21 seconds versus the 8-12 seconds typical of northeasters. This is rare for the Atlantic. The unusually long wave periods allowed the run-up to reach much higher elevations and to deposit overwash sand higher and farther inland than has been seen in several decades. The result was extensive flooding between the beach road and the bypass in Kitty Hawk and Kill Devil Hills. The higher run-up pumped water over the beach road into the low areas between the two roads. Unofficial reports of water marks indicate that in some areas the inland flooding may have reached three times higher than the ocean surge elevations (Spencer Rogers – Sea Grant).

The March 1993 "Storm of the Century" caused extensive flooding along soundfront properties on North Dogwood Trail in Southern Shores. This storm pummeled soundside residents with gale force winds for over 12 hours causing flooding and debris removal problems for over a month after the event. It generated water levels up to 7.5 feet above mean sea level.

When the Town of Southern Shores encounters either a hurricane, thunderstorm or tornado, there will also be high winds associated with these types of storms. In order to limit damage, in terms of property, personal injuries and loss of life, which can result from high winds, the Town of Southern Shores has the following policies and programs in place:

***North Carolina Building Code***
The Town of Southern Shores has adopted the North Carolina Building Code that includes construction requirements for High Winds and Coastal Flooding and the International Building and International Residential Code which sets forth the building requirements as they pertain to the construction of buildings and houses in regards to their ability to withstand substantial winds.

Additionally, the Town participates in the Building Code Effectiveness Grading Schedule by ISO. New homeowners are informed of FEMA's Safe Room concept as a shelter of last resort within their home. A copy of the FEMA manual is in our office and contains construction details for various configurations.

***Subdivision regulations as they deal with underground wiring***
The Town of Southern Shores subdivision regulations require that the electrical wiring, telephone wiring and television cable in all new subdivisions be installed underground. This will eliminate the adverse effects that high winds normally have on exposed wiring and cables during hurricanes, thunderstorms and tornadoes.

***Dominion NC Power line maintenance program***
Dominion NC Power has a routine line maintenance program in place in which tree limbs located near power lines are trimmed and removed which dramatically reduces the occurrence of power line damage and power outages during periods of high wind activity which is associated with hurricanes, thunderstorms and tornadoes.

***Inclement weather policy***
In order to maximize the Town resources of manpower during an actual and/or expected hurricane, thunderstorm or tornado, the Town of Southern Shores has developed an inclement weather policy to insure that employees are properly notified and given job directions and instructions prior to and during times of inclement weather.

***High Winds Policy***
Wind borne debris protection for all glazed openings such as windows is included in the Building and Residential Codes adopted by the state and the Town of Southern Shores.

***Technical & Fiscal Capabilities***
The Town has the in-house technical expertise to enforce the Building Code.

**Section 7: Wildfire**

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around. 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 meet or intermingle with wildland or vegetative fuels.

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.

North Carolina, with its large amount of wooded areas, is included among the states with a high risk of wildfire. As development has spread into areas of North Carolina which were previously rural, new residents have been relatively unaware of the hazards posed by wildfires and have used highly flammable material for constructing buildings. This has increased the threat of loss of life and property, and has also resulted in a greater population of people less prepared to cope with wildfire hazards. The southern coastal plain is particularly vulnerable to the wildfire hazard. The mountain region has also experienced wildfires.

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.

Topography (slope) is important because it affects the movement of air (and thus the fire) over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. In general terms, the steeper the slope of the land, the faster a fire can spread up the slope. A topographic map can help identify areas of the community with slopes less than 40%, between 41% and 60%, and greater than 61%, corresponding to low, moderate and steep gradients relative to the spread of wildfires.

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. The average number of days per year of critical fire weather experienced in the community can be obtained from the local or state fire marshal, forestry department, or department of natural resources. The National Weather Service or NOAA Websites can help determine past weather conditions.

To determine fire hazard severity for the community, the Fire Hazard Severity Table below was used. There may be more than one classification in the community depending on the degrees of the slope and fuel models.

**Table 8. Fire Hazard Severity**

| **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 | 41-60 | >61 | <40 | 41-60 | >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 |

**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)*

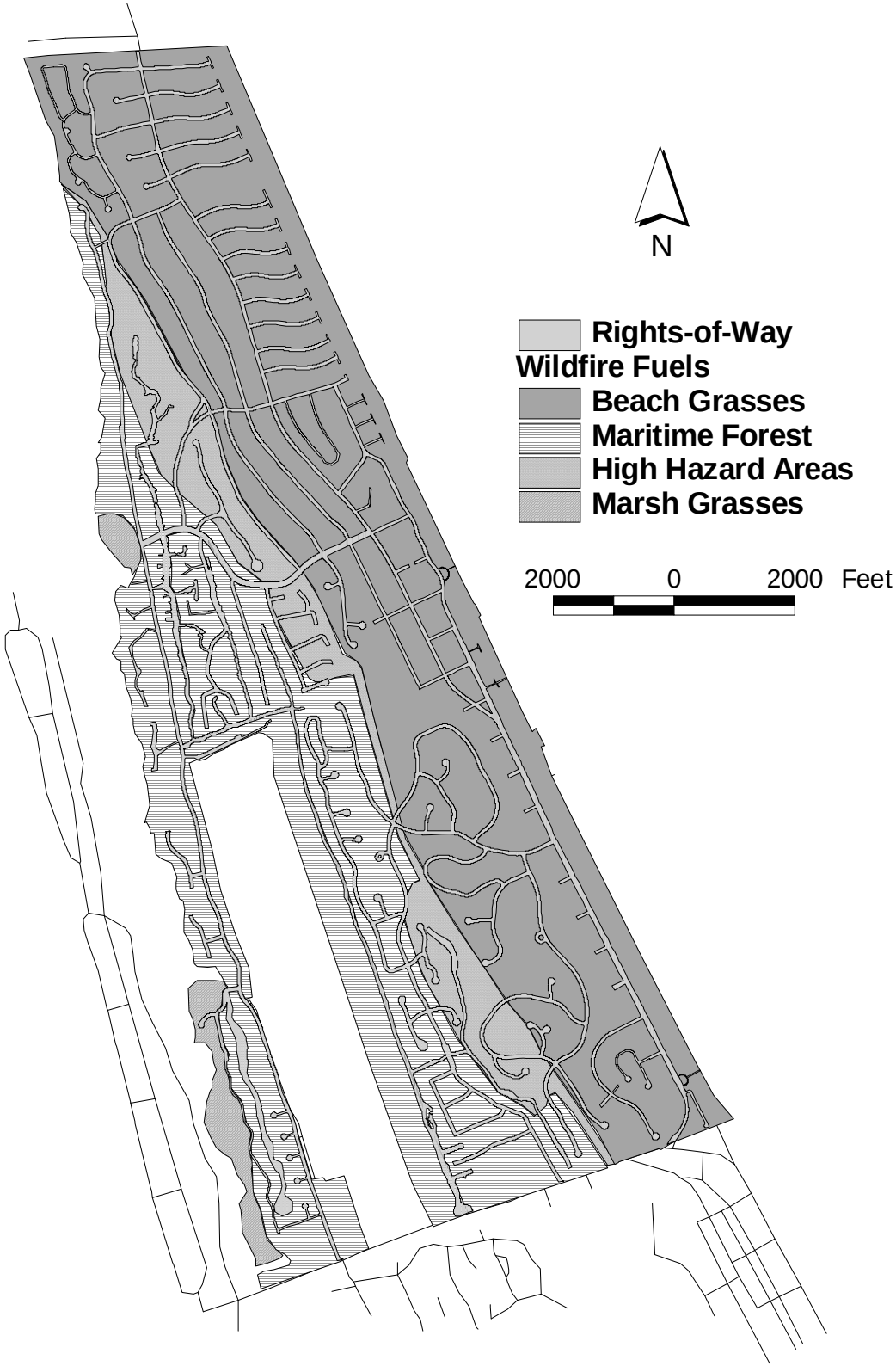
In Southern Shores, the types of vegetative fuels are cropland and pasture, forested lands, wetlands, and rangeland. The following table is a vulnerability assessment of the county, in regard to wildfire.

**Table 9. Wildfire Vulnerability**

| Type of Fuel | Number of Persons / (2.3266 per acre) | Number of Households | Property Value at Risk |
|---|---|---|---|
| Beach grasses | 2,729 | 1,173 | $141,770,100 |
| Maritime forest | 1,296 | 557 | $ 93,114,900 |
| High hazard areas | 351 | 151 | $ 19,124,900 |
| Marsh grasses | 21 | 9 | $ 1,217,700 |

Using Dare County's GIS data, the type of fuels' map was compared with the property values map. All properties with a building value greater than $ 0 were selected from each fuel type and the building value sum of each fuel type was calculated. The number of households was multiplied by the number of persons per acre (according to the 2000 Census) to estimate the number of persons affected. These estimates do not take into account Southern Shores' average occupancy rates.

**Figure 11. Wildfire Fuels**



***Probability of Future Events***
Southern Shores has a **Possible** likelihood of occurrence. This trend is expected to continue.

Wildfires, when threatening Southern Shores, impact a **Small** proportion of the town's jurisdiction.

Impact of a wildfire on the town would be **Limited.**

There have been no recorded wildfires in the town's jurisdiction since incorporation in 1979.

**Section 8: Thunderstorms**

*Thunderstorms*
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-troposphere (~50,000 feet) divergence of air (rising air parcels can also result from air flows over mountainous areas). 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. The half million tons of condensed water release 300 trillion calories of energy, equivalent to about 100 million kilowatt-hours of electricity, or several Hiroshima-sized atomic bombs.

According to the National Weather service, a severe thunderstorm is one that produces tornadoes, hail of 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 super cooled 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. (Source: Eugene Chillieni, National Weather Service)

Thunderstorms are common throughout North Carolina and have occurred in all months of the year. Thunderstorm-related deaths and injuries in North Carolina peak during July and August. Visitors fishing on the open waters, golfing or swimming at the beach are at risk.

***Probability of Future Events***
Southern Shores has a **Highly Likely** likelihood of occurrence. Each year, thunderstorms occur in the town. This trend is expected to continue.

Thunderstorms, when threatening Southern Shores, impact a **Medium** proportion of the town's jurisdiction.

Impact of a thunderstorm on the town would be **Negligible.**

There has been 1 reported thunderstorm wind in the town that impacted the town (1995) and caused $1,000 in property damages.

**Section 9: Coastal Erosion**

When property owners choose to build or buy on the oceanfront, they take risks. Those risks may come in the form of dramatic storms such as nor'easters or hurricanes that can destroy a home in a matter of hours. The risks may also develop more gradually, caused by the daily forces of winds, waves, and tides. These forces cause North Carolina's beaches to shift. A beach may lose sand (erosion) or gain it (accretion).

Erosion tends to occur faster in some areas than in others, especially near inlets and capes, where sand shifts rapidly. An eroding beach may lose several feet of sand a year. In spite of these risks, many people want to build along the ocean shore. The NC Coastal Resources Commission (CRC) has established rules and development standards to reduce the risk to life and property. These rules include erosion setbacks for oceanfront construction. These setbacks are based on average long-term erosion rates that reflect changes in the shoreline over nearly half a century.

North Carolina first evaluated long-term average erosion rates for the state's 300 mile ocean coastline in 1979. The Division of Coastal Management evaluates these erosion rates about every five years. It is an exacting process that takes about a year to complete. Coastal Management begins each update by obtaining new aerial photographs of the ocean shoreline. The photographs have been taken under specific conditions to ensure that the coast is in a normal a condition as possible. The photos show the shoreline – defined as the high water line, or the edge of the wet sand visible in the photographs. The shoreline is marked, and its position (relative to a fixed shoreline baseline) is added to an existing database. A sophisticated computer program corrects for distortion created by the aerial photographs.

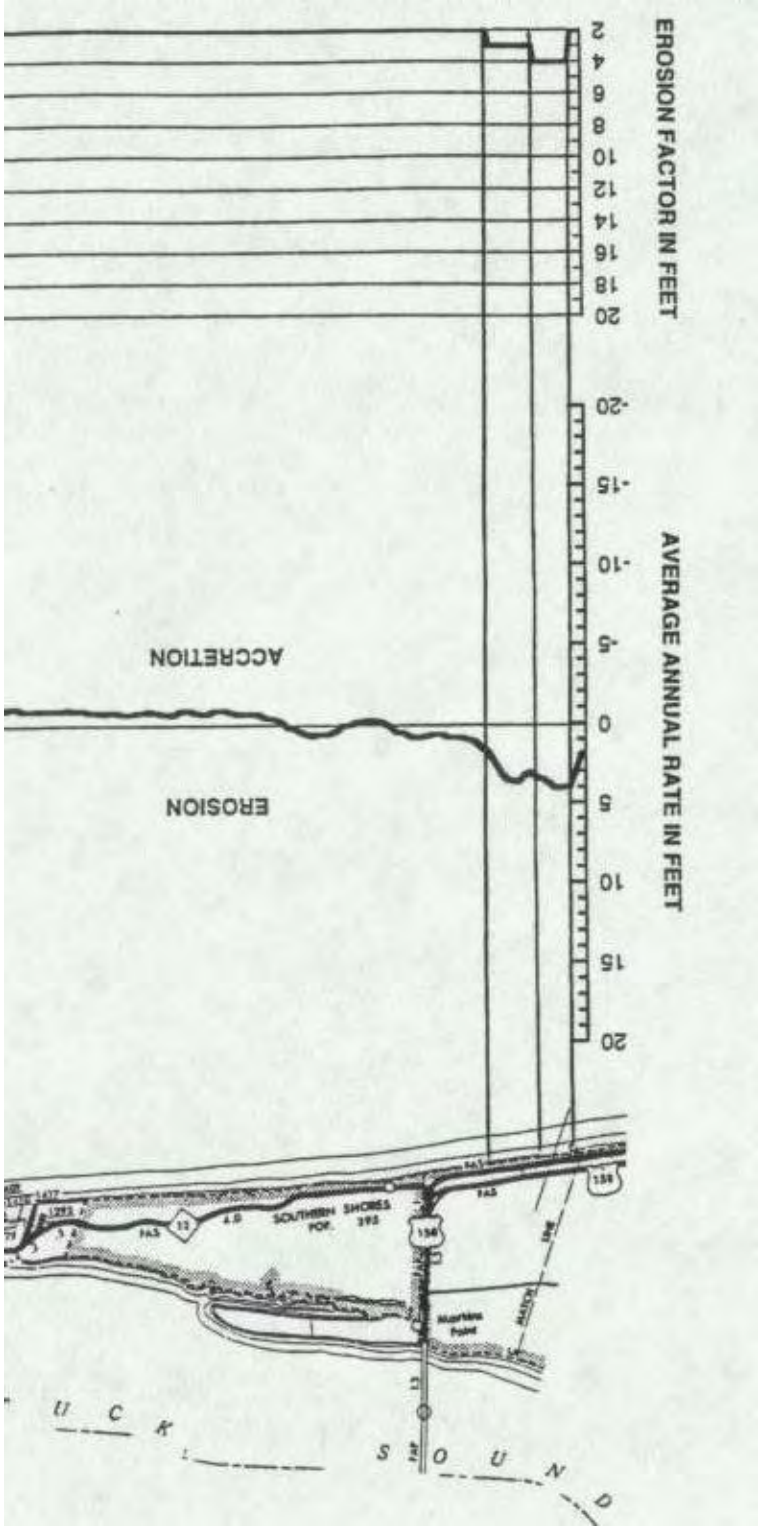
Another computer program determines an average long-term erosion rate by comparing the current shoreline position to the earliest available position and dividing the distance between them by the number of years that have passed between the dates the photographs were taken. For example, if the 1992 shoreline is compared with the 1942 shoreline, the distance the shoreline has moved is divided by 50. If the difference between 1942 and 1992 is 100 feet, the long-term average erosion rate is 2 feet per year.

These erosion rates are not predictors. If the long-term average erosion at a certain location is 2 feet per year, it does not mean that the beach will lose 2 feet of sand this year. It might lose less than 2 feet, or more than 2 feet. The rates are useful for giving an idea of what has happened in the past.

The beach along the oceanfront is defined by the Coastal Area Management Act (CAMA) as an Ocean Erodible Area. The Area of Environmental Concern (AEC) extends from the mean low water line to the first line of stable natural vegetation plus, landward, 60 times the long-term erosion rate (which is 2 feet per year) plus 35 feet, or 155 feet. There is a minimum setback for single-family residences (small structures) from the first line of stable vegetation of 60 feet (30 yrs x 2 ft/yr). As it proceeds landward the beach area gives way to frontal and primary dunes of varying heights. A substantial dune ridge extends North and South through the middle of Town reaching elevations from 30' to 60' above mean sea level.

In the late 1930's, a Civilian Conservation Corps program constructed the beach dunes as an Erosion/Flood Protection System. It was stabilized with beach grass plantings. The grass trapped windblown sand and has allowed a substantial dune buildup that is essentially intact for the length of the Town along the Atlantic oceanfront.

**Figure 12. Long Term Annual Shoreline Changes**
(Source: NC Division of Coastal Management)



***Probability of Future Events***
Southern Shores has a **Highly Likely** likelihood of occurrence. This trend is expected to continue.

Coastal erosion, when threatening Southern Shores, impacts a **Medium** proportion of the town's jurisdiction.

Impact of coastal erosion on the town would be **Negligible.**

There has been a long-term erosion rate of 2 feet per year.

**Section 10: Tornadoes**

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.

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.

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

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

The mountains and northern piedmont of North Carolina experience the lowest frequency of tornadoes because of less favorable conditions for severe thunderstorm activity in those regions. The highest frequency of tornadoes historically has occurred in the southeastern portion of the State.

Tornadoes are characterized by damage pattern, FO through F5 on the Fujita-Pearson Tornado Scale. The table below shows the tornado category, expected damages, and corresponding wind speed.

**Table 10. Fujita-Pearson Tornado Scale**

| F-Scale | Damage | Winds (mph) | Path Length (miles) | Mean Width (miles) |
|---|---|---|---|---|
| F0 (Weak) | Light | 40-72 | < 1 | < 0.01 |
| F1 (Weak) | Moderate | 73-112 | 1-3.1 | 0.01-0.03 |
| F2 (Strong) | Considerable | 113-157 | 3.2-9.9 | 0.04-0.09 |

| | | | | |
|---|---|---|---|---|
| F3 (Strong) | Severe | 158-206 | 10-31 | 0.1-0.31 |
| F4 (Violent) | Devastating | 207-260 | 32-99 | 0.32-0.99 |
| F5 (Violent) | Incredible | 261-318 | ≥ 100 | > 1.0 |

***Probability of Future Events***
Southern Shores has a **Possible** likelihood of occurrence. This trend is expected to continue.

Tornadoes, when threatening Southern Shores, impact a **Small** proportion of the town's jurisdiction.

Impact of tornadoes on the town would be **Limited.**

There have been no tornadoes in Southern Shores' jurisdiction since the town was incorporated in 1979.

**Section 11: Landslides**

Common throughout the mountainous Appalachian region, landslides are described as downward movement of a slope and materials under the force of gravity. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (mining and construction of buildings, railroads, and highways), and natural factors (geology, precipitation, and topography).

Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or "slurry." Slurry can flow rapidly down slopes or through channels and can strike with little or no warning at avalanche speeds. Slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. Other types of landslides include: rock slides, slumps, mudslides, and earthflows. All of these differ in terms of content and flow.

Landslides occur when masses of rock, earth, or debris move down a slope. Therefore, gravity acting on an overly steep slope is the primary cause of a landslide. They are activated by storms, fires, and by human modifications to the land. New landslides occur as a result of rainstorms, earthquakes, and various human activities.

The best predictor of future landslides is past landslides because they tend to occur in the same places. Existing or old landslides may be found in the following areas:

- On or at the base of slopes;
- In or at the base of minor drainage hollows;
- At the base or top of an old fill slope;
- At the base or top of a steep cut slope; or
- Developed hillsides where leach field septic systems are used.

The following conditions may exacerbate the effects of landslides:

- Erosion: Erosion caused by rivers, glaciers, or ocean waves created by overly steep slopes.
- Unstable Slopes: Rock and soil slopes are weakened through saturation by snowmelt or heavy rains.
- Earthquakes: The shaking from earthquakes creates stress that makes weak slopes fail.
- Vibrations: Machinery, traffic, blasting, and even thunder may cause vibrations that trigger failure of weak slopes.
- Increase of Load: Weight of rain/snow, fills, vegetation, stockpiling of rock or ore from waste piles, or from man-made structures may cause weak slopes to fail.
- Hydrologic Factors: Rain, high water tables, little or no ground cover, numerous freeze/thaw cycles may cause weak slopes to fail.
- Human Activity: These include development activities such as cutting and filling along roads and removal of forest vegetation. Such activities are

capable of greatly altering slope form and ground water conditions which can cause weak slopes to fail.

- Removal of Lateral and Underlying Support: Erosion, previous slides, road cuts and quarries can trigger failure of weak slopes.
- Increase of Lateral Pressures: Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- Regional Tilting: Geologic movements can trigger weak slopes to fail.

The three most useful types of landslide maps are: 1) landslide inventories; 2) landslide susceptibility maps; and 3) landslide hazard maps.

- Landslide Inventories: Landslide inventories identify areas that appear to have failed due to landslides, including debris flows and cut-and-fill failures. Detailed inventories depict and classify each landslide and show scarps, zones of depletion and accumulation, active versus inactive slides, geological age, rate of movement, and other pertinent data on the depth and type of materials involved in sliding. Overlaying a geologic map with an inventory map that shows existing landslides can identify specific landslide-prone geologic units. For this reason, a landslide inventory is essential for preparing a landslide susceptibility map.
- Landslide Susceptibility Maps: Landslide susceptibility maps depict areas that have the potential for landslides by correlating some of the principal factors that contribute to landslides - steep slopes, geologic units that lose strength when saturated, and poorly drained rock or soil - with the past distribution of landslides. These maps indicate the relative stability of slopes; however, they do not make absolute predictions. More complex maps may include additional information such as slope angle, and drainage.
- Landslide Hazard Maps: Landslide hazard maps show the real extent of the threat: where landslides have occurred in the past, where they are likely to occur now, and where they could occur in the future. They contain detailed information on the types of landslides, extent of slope subject to failure, and probable maximum extent of ground movement. These maps can be used to predict the relative degree of hazard in a landslide area.

**Landslide Areas in Southern Shores**

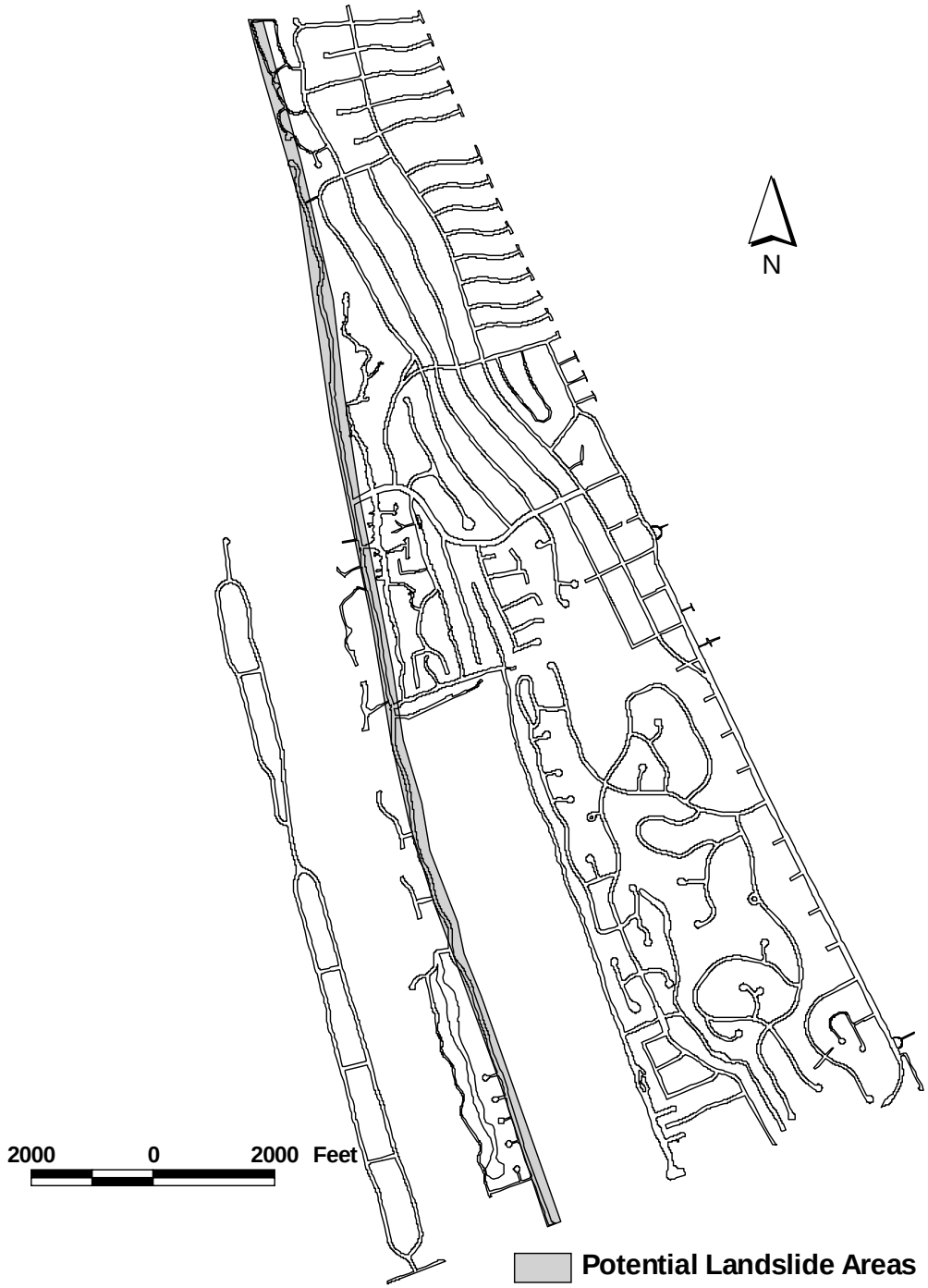
Sound front property along the Northern portion of North Dogwood, Kingfisher, and Soundview Trails and North Dune Loop is susceptible to landslides. These properties are characterized by high bluffs at the waters edge. Storms cause elevated water levels and damaging waves in Albemarle and Currituck Sound. Breaking waves can overtop existing bulkheads and rip rap. Older bulkheads can be undermined with an associated loss of backfill.

The potential landslide areas identified in Southern Shores are not the typical landslide areas found in other regions with more topographic variation. In Southern Shores, these high bluffs along the sound are not expected to erode to the point of endangering principal structures on the properties.

Sinkholes do not threaten Southern Shores.

The following figure shows the areas along the sound that are identified as ‘landslide areas’ for purposes of this plan.

**Figure 13. Landslide Areas**



***Probability of Future Events***
Southern Shores has an **Unlikely** likelihood of occurrence. Soundside erosion, responsible for landslides within Southern Shores, is expected to continue, but no source of long term erosion rate is available for the soundside shoreline.

Landslides, when threatening Southern Shores, impact a **Small** proportion of the town's jurisdiction.

Impact of landslides on the town would be **Negligible.**

There have been no landslides since Southern Shores was incorporated.

**Section 12: Severe Winter Storms**

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

While the frequency and magnitude of snow events are highest in the mountains due to elevation, the geographical orientation of the mountains and Piedmont contribute to a regular occurrence of freezing precipitation events (e.g., ice pellets and freezing rain) in the Piedmont. Such ice events (up to and including ice storms) are often the result of cold air damming (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).

***Probability of Future Events***
Southern Shores has a **Possible** likelihood of occurrence.

Severe winter storms, when threatening Southern Shores, impact a **Large** proportion of the town's jurisdiction.

Impact of severe winter storms on the town would be **Negligible.**

There have been no severe winter storms since Southern Shores was incorporated.

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

Cold air damming contributes to elevated freezing rain and ice storm events in the Piedmont of North Carolina. These events occur at least as often as moderate or severe snow events in this region.

The mountains of North Carolina usually receive several snowfalls of 4 to 6 inches in a given winter weather season. There has been at least one severe winter storm at some location in the mountains each year for the past several decades. The western area of the state is more likely to experience greater and more frequent snowfalls and blizzards than other locations in the state. The mountains also have the highest number of extreme one-day snowfalls.

When the Town encounters severe winter weather it may also experience either an accumulation of ice, snow or both. In order to reduce or eliminate the damage, in terms of property, personal injuries and loss of life, which can result from an accumulation of ice, the Town of Southern Shores has the following policies in place:

***North Carolina Building Code***
The Town has adopted the North Carolina Building Code, Volume 7, chapter 8, and the International Building Code which sets forth the building requirements as they pertain to the construction of buildings and houses in regards to the weight requirements for their roofs. One of the intents of this requirement is to insure that the roof can withstand the weight of ice accumulation.

***Subdivision regulations as they deal with underground wiring***
The Town of Southern Shores subdivision regulations require that the electrical wiring, telephone wiring and television cable in all new subdivisions be installed underground. This will eliminate the adverse effects that the accumulation of ice can have on exposed wiring and cables during severe winter weather.

***NC Dominion Power line maintenance program***
*NC Dominion Power has a routine line maintenance program in place in which tree limbs located near power lines are trimmed and removed which dramatically reduces the occurrence of power line damage and power outage during periods of ice accumulation which is associated with severe winter weather.*

***Gaps, Shortfalls or Conflicts with Severe Winter Storms Policy***
Due to the expense of such equipment, the Town is unable to purchase ice removal equipment in order to have the streets and sidewalks cleared of ice. In addition, the Town is unable to subcontract with anyone for ice removal.

***Technical & Fiscal Capabilities***
The Town has the in-house technical expertise through the Code Enforcement Department and the town engineer to enforce the policies, programs and ordinances which are under the authority of the Town as they deal with mitigating damage related to the accumulation of ice associated with severe winter weather.

There are existing overhead lines in Seacrest Village and along Ocean Boulevard, with transformers on poles near the oceanfront in sections of town from early development. Most homes have electric heat pumps for power and may or may not have LP gas for back up heat. Loss of electric power in the community for an extended period of time would be a problem. Another problem with the Town's large number of rental homes (which may be unoccupied in the winter) is that some might be improperly winterized or those on pilings may be improperly insulated. These situations could lead to costly homeowner insurance claims when frozen pipes thaw out causing water damage.

**Section 13: Earthquakes**

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.

<u>Ground motion</u> 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.

<u>Surface faulting</u> 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.

Earthquakes are measured in terms of their magnitude and intensity. There are several different scales that are commonly used, including Richter Magnitude, Modified Mercalli Intensity (MMI), Moment Magnitude and Peak Ground Acceleration (PGA), 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). A detailed description of the Modified Mercalli Scale of Earthquake Intensity (and its correspondence to the Richter Scale) is below.

Earthquakes are relatively infrequent but not uncommon in North Carolina. Epicenters of North 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.

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

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

**Table 11. Modified Mercalli Scale of Earthquake Intensity**

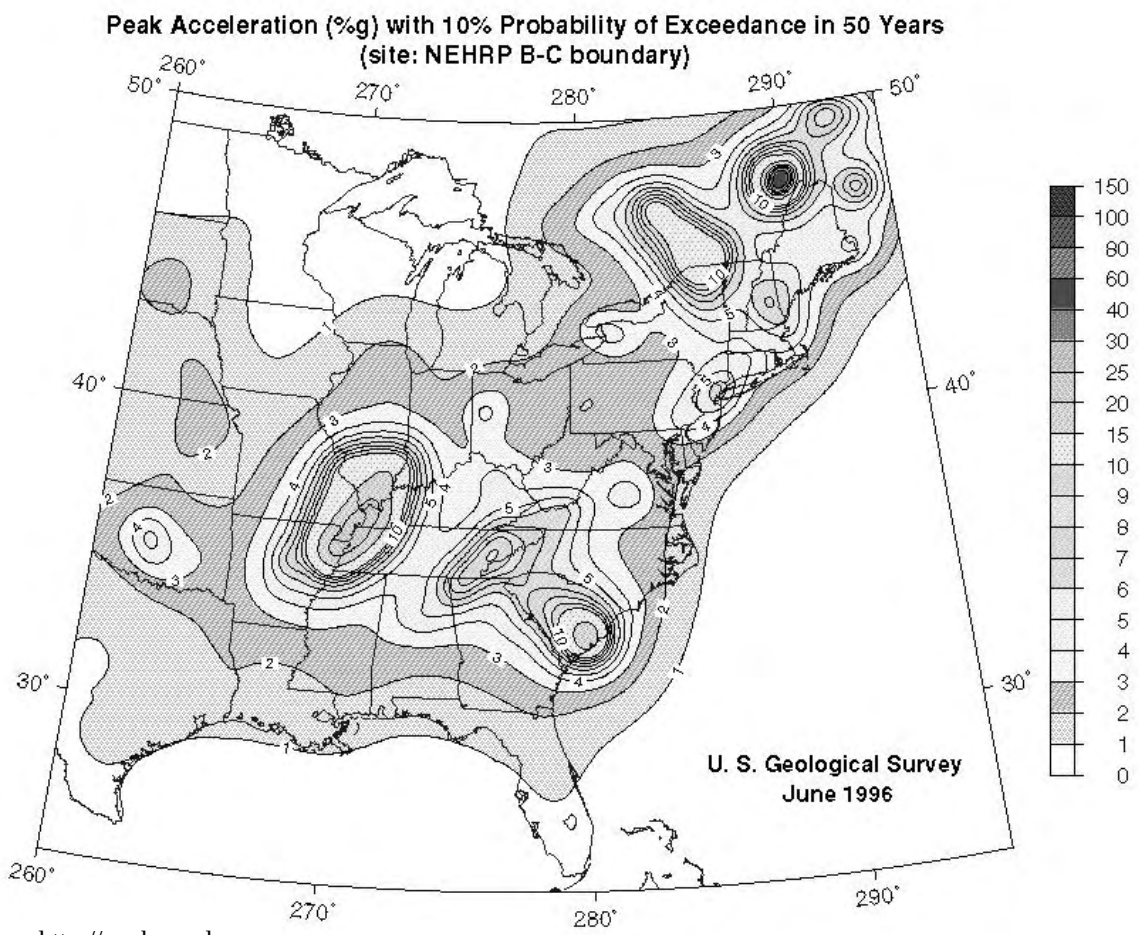
| Scale | Intensity | Description of Effects | Maximum Acceleration (mm/sec) | Corresponding Richter Scale |
|---|---|---|---|---|
| I | Instrumental | Detected only on seismographs | <10 | |
| II | Feeble | Some people feel it | <25 | <4.2 |
| III | Slight | Felt by people resting; like a truck rumbling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

One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. If you're standing on the surface of the earth and drop an object (ignoring wind resistance), it will fall toward the earth faster and faster, until it reaches terminal velocity. This principle is known as acceleration and represents the rate at which speed is increasing. The acceleration due to gravity is often called "g", a term you may have heard associated with roller coasters, rockets, or even stock car racing. The acceleration due to gravity at the earth's surface is 9.8 meters (980 centimeters) per second squared. That means that every second that something falls toward the surface of earth its velocity increases 9.8 meters per second. A 100% g earthquake is very severe.

An analogy would be if you floor your car's gas pedal and your groceries get smashed against the back of the trunk. The quicker you press on the gas, the more eggs are likely to get broken. That's because the quick acceleration caused the contents of your trunk to shift rapidly and violently, not slowly and smoothly. In fact, the eggs might not have moved at all if you had sped up slowly. The same thing is true in an earthquake. If ground acceleration is rapid, more things tend to break than if the shaking is relatively slow, even if the ground moves the same distance.

The map shows the national Peak Ground Acceleration (PGA) values for the United States with a 10% chance of being exceeded over 50 years. This is a common earthquake measurement that shows three things: the geographic area affected, the probability of an earthquake of each given level of severity (10% chance in 50 years), and the severity.

**Figure 14. Peak Acceleration (%g) with 10% Probability of Exceedance in 50 Years**




Source: http://geohazards.cr.usgs.gov

***Probability of Future Events***

Southern Shores has an **Unlikely** likelihood of occurrence. There is a 10% chance of an earthquake exceeding 1% g in a 50 year period.

Earthquakes, when threatening Southern Shores, impact a **Large** proportion of the town's jurisdiction.

Impact of earthquakes on the town would be **Catastrophic.**

There have been no earthquakes since Southern Shores was incorporated.

**Section 14: Flooding**

Tropical systems and nor'easters are the primary source of flooding in Southern Shores. The extent to which areas within the Town of Southern Shores will be flooded is determined by modeling of predicted events against the elevation of lands being flooded. The Town topography features a sand beach along the Atlantic Ocean, manmade dune line, ocean overwash area, prominent dune ridge and maritime forest / bluff area on Currituck Sound.

One representation of the Town's flood hazard area is illustrated by the Flood Insurance Rate Map (FIRM). Flood hazard areas in coastal regions are determined using statistical analyses of records of storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. A FIRM usually is issued following a flood risk assessment conducted in connection with the community's conversion to the Regular Phase of the NFIP. If a detailed assessment, termed a Flood Insurance Study, has been performed, the FIRM will show base flood elevations and insurance risk zones in addition to floodplain boundaries. After the effective date of the FIRM, the community's floodplain management ordinance must be in compliance with appropriate Regular Phase requirements. Actuarial rates, based on the risk zone designations shown on the FIRM, are then applied for newly constructed, substantially improved, and substantially damaged buildings.

The 1993 FIRM designates three types of floodplain within the jurisdiction of Southern Shores. *This map represents a 1% (one-percent flood - 1/100) as the most infrequent event to be protected against. A one-percent flood, formerly called a 100-year flood, is a flood that would be exceeded in severity only once every hundred years on average*:

- VE Zone: (BFE 18') Oceanfront property is predicted to experience breaking waves;
- AO Zone: (1' depth) Oceanfront property in shallow flooding areas, no velocity. Ocean overwash from breached dunes; and
- AE Zone: (BFE 8') Soundside property flooded by rising water to a depth of 8 feet or more.

The FIRM designates the X Zone as an area beyond the reach of the 1% flood.

Base flood elevations (BFE) along the oceanfront on the FIRM, effective September 20, 2006, are 12' along virtually all of the eastern edge of town. This VE Zone boundary abuts an the - AE zones with base flood of 9' and 9.4', which flows across parts of Ocean Blvd and Duck Road in places

Base flood elevations along the soundside are 7' - on the FIRM effective September 20, 2006 in the AE Zone.

Figure 15 shows the current FIRM 2006 flood zones. Figure 16 shows the FIRM 1993 flood zones. It should be noted that the FIRM does not include the impact of long-term erosion anticipated by the State of North Carolina's CAMA regulations.

Additionally, the Town's vulnerability to inundation by specific hurricane Categories has been assessed using the National Weather Service's SLOSH model. SLOSH (Sea, Lake and Overland Surges from Hurricanes) is a computerized model run by the National Hurricane Center (NHC) to model storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account the following variables:

- Pressure
- Size
- Forward speed
- Track
- Winds

Graphical output from the model displays color-coded storm surge heights for a particular area in feet above the model's reference level, the National Geodetic Vertical Datum (NGVD), which is the elevation reference for most maps. The calculations are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads and other physical features.

There is a difference between the FIRM and the SLOSH models.

The SLOSH model is generally accurate within plus or minus 20 percent. For example, if the model calculates a peak 10 foot storm surge for the event, you can expect the observed peak to range from 8 to 12 feet. The model accounts for astronomical tides (which can add significantly to the water height) by specifying an initial tide level, but does not include rainfall amounts, river flow, or wind-driven waves. However, this information is combined with the model results in the final analysis of at-risk areas.

The point of a hurricane's landfall is crucial to determining which areas will be inundated by the storm surge. Where the hurricane forecast track is inaccurate, SLOSH model results will be inaccurate. *The SLOSH model, therefore, is best used for defining the potential maximum surge for a location*.

Two versions of the SLOSH model exist: (1) a slow moving hurricane model (less than 15 mph); and (2) a fast moving hurricane model (15 mph or greater). Typically, hurricanes move through the area at 15 mph or greater. Figures 17 and 18 depict both the slow and fast versions of the SLOSH model. The contribution from nor'easters to the overall storm-surge elevation in the area of the Town of Southern Shores can be significant, resulting in erosion to the beach and dune line. The wave action associated with storm surge can be much more damaging than the high water level.

Storms which produce flooding conditions along the oceanfront may not necessarily inundate property along the sound or canals. By the same token, a hurricane that comes up the Pamlico, Albemarle, and Currituck Sounds may create a storm surge that floods most canal front portions of Southern Shores.

Seawater impounded behind the frontal dune after a storm event can adversely impact septic drain fields and may block traffic on NC 12, the only road to the northern beach developments of Duck, Sanderling, Palmers Island, Ocean Sands, Corolla, Monterey Shores, etc. Any breach in the dune system will probably flood this road; halt traffic, and strand residents and tourists. Any significant damage to the dune system will require rebuilding at significant cost.

**Figure 15. FIRM 2006**

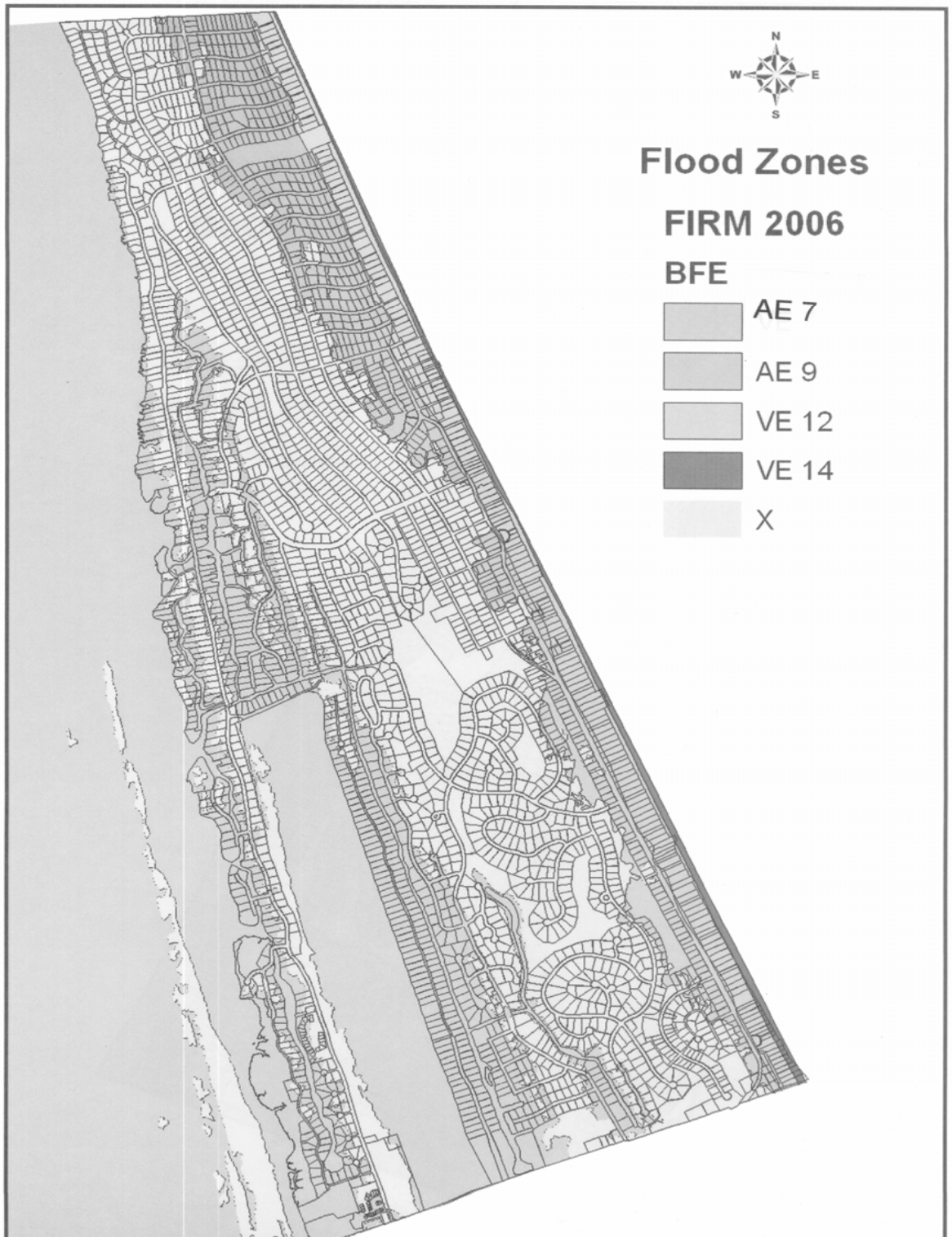

N
W
E
S
Flood Zones
FIRM 2006
BFE
AE 7
AE 9
VE 12
VE 14
X

**Figure 16. FIRM (100 Year) Flood Map 1993**

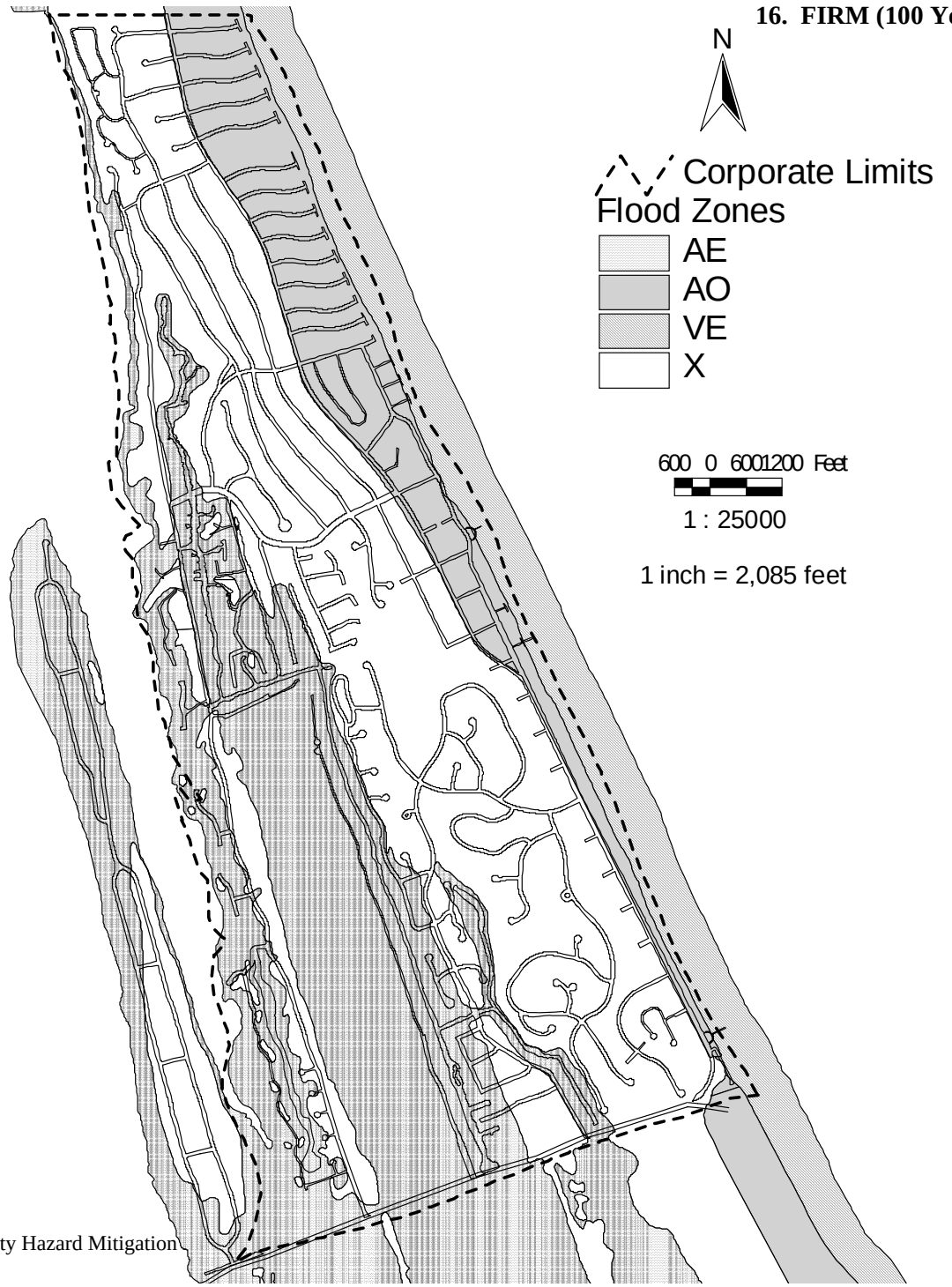


**Figure 17. SLOSH Model – Slow Moving Storm**

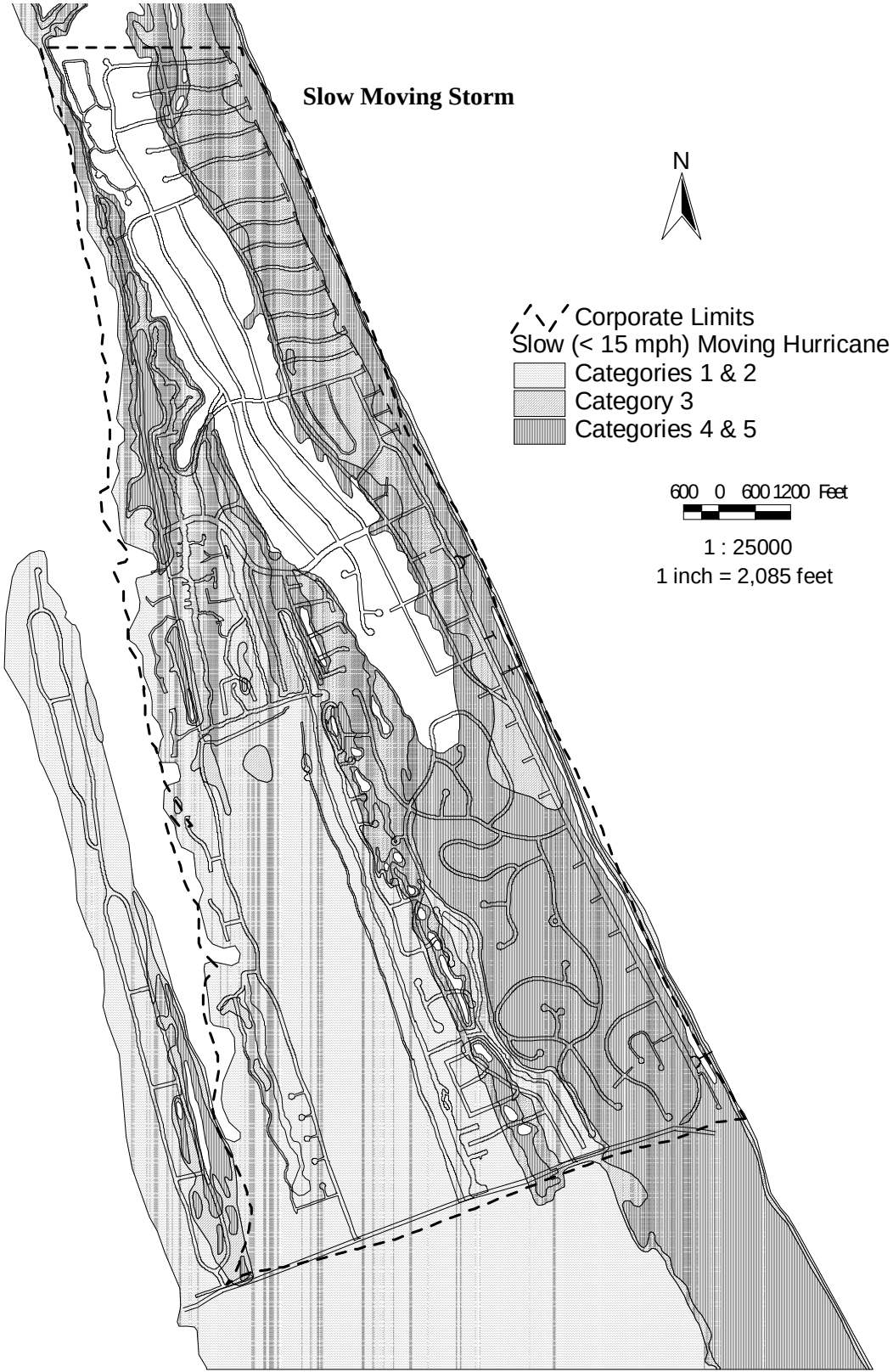
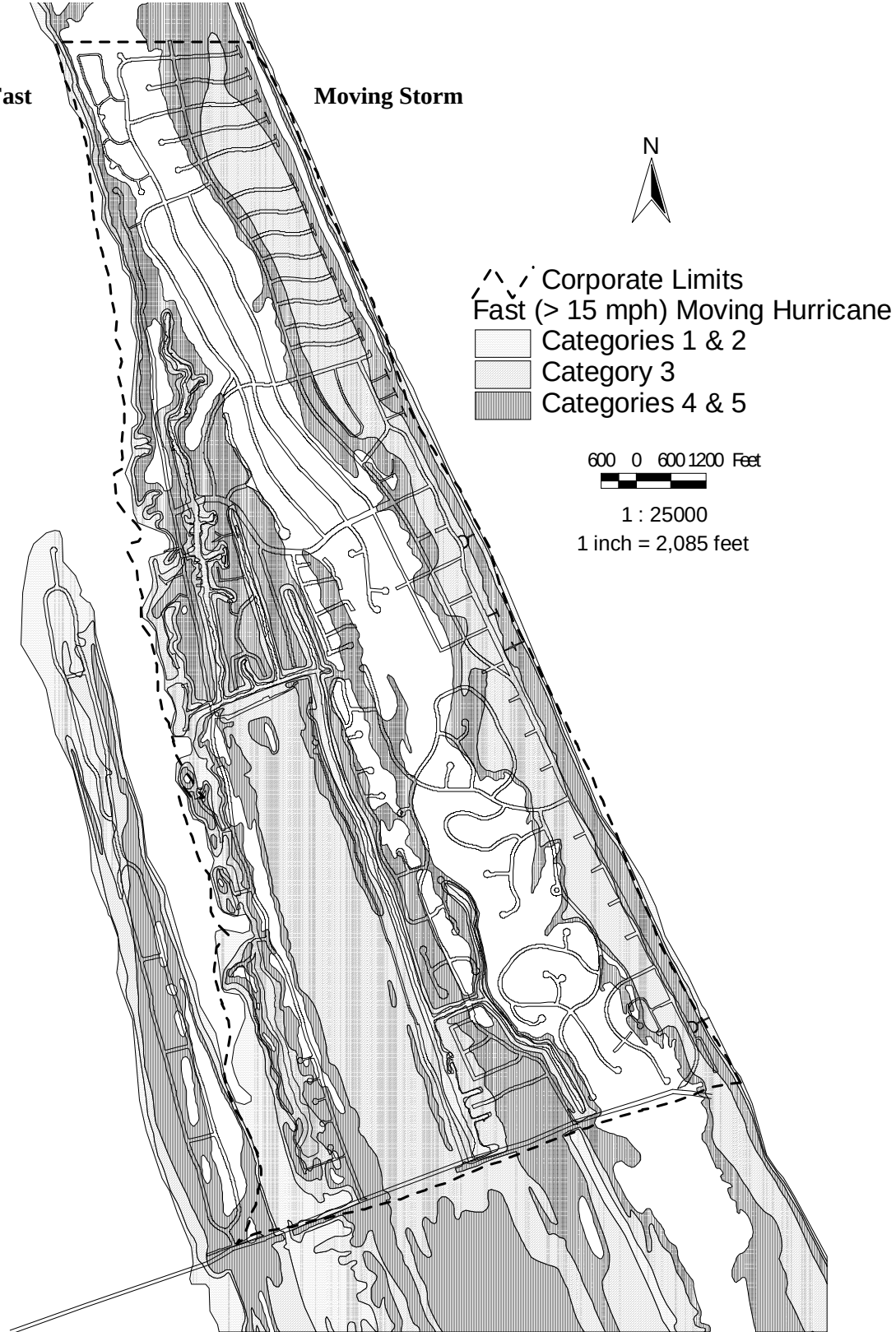


**Figure 18. SLOSH Model - Fast Moving Storm**



***Previous Occurrences / Historical Flood Damage***

The Ash Wednesday Storm of 1962 produced the most extensive damage recorded to date along this section of the Outer Banks. Water inundated Sea Crest Village and was impounded by the dune for 10 days. David Stick's account, *The Ash Wednesday Storm*, is filled with photographs of the storm damage.

The Halloween Storm in 1991 had a storm surge measurement of less than 3', but the wave period was 18-21 seconds versus the 8-12 seconds typical of northeasters. This is rare for the Atlantic. The unusually long wave periods allowed the run-up to reach much higher elevations and to deposit overwash sand higher and farther inland than has been seen in several decades. A result was the extensive flooding between the beach road and the bypass in Kitty Hawk and Kill Devil Hills. The higher run-up pumped water over the beach road into the low areas between the two roads. Unofficial reports of water marks indicate that in some areas the inland flooding may have reached three times higher than the ocean surge elevations (Spencer Rogers – Sea Grant).

The March 1993 "Storm of the Century" caused extensive flooding along soundfront properties on North Dogwood Trail in Southern Shores. This storm pummeled soundside residents with gale force winds for over 12 hours causing flooding and debris removal problems for over a month after the event. It generated water levels up to 7.5 feet above mean sea level.

Hurricane Emily, a Category 3 hurricane, grazed Hatteras Island on August 31, 1993. The eye of the hurricane came within 20 miles of Cape Hatteras, but did not pass over the Outer Banks. When the winds shifted from the northeast to the northwest, water was forced onto the island from Pamlico Sound, washing several homes from their foundations. Wind measuring equipment recorded wind gusts of up to 107 miles per hour.

Hurricane Isabel, a Category 2 storm, made landfall north of Cape Lookout on September 16, 2003. Southern Shores fared well as hurricane force winds moved through the area. There was no flood damage reported. However, wind damage and clean up after the storm was estimated at $1 million.

**Probability of Future Hazard Events**

It is not economically justifiable to attempt to provide protection against the largest flood that could occur. Such protection would be too costly for such a rare event. Therefore, governmental and private institutions have agreed that a one-percent flood (1/100) is the most infrequent event to be protected against. A one-percent flood, formerly called a 100-year flood, is a flood that would be exceeded in severity only once every hundred years on average. Statistically, the chance of getting hit by a 100-year storm during a 30-year mortgage period is about 25 percent or one chance in four. The average house lasts about 70 years. **During that average useful lifetime, there is a 50 percent chance of a 100-year storm.** That's like flipping coins – heads or tails. While low in any year, the cumulative risk for a building is quite high. The occurrence of a 100-year does not indicate that a similar storm will not occur for another 100 years. 100-year storms have been followed by equally severe storms the next year.

The Town received Flood Insurance Rate Maps (FIRM), effective September 20, 2006, resulting from a revised Flood Insurance Study. Implementations of those maps increased properties in our floodplain from 823 (previous study) to 1,482. This represents about 50% of all residential lots within the Town. The 1993 FIRM maps are overdue for their 5-year revision and the State of North Carolina is presently undertaking the update for FEMA as a Cooperating Technical State (CTS).

**Repetitive Loss Areas**

Based on an NFIP Repetitive Loss Correction Worksheet (AW-512) dated January 31, 2000, the Town of Southern Shores had one (1) repetitive loss property. That property has been recently demolished and a new 5 bedroom house was rebuilt on the site that is in compliance with current codes. A repetitive loss property is one for which two or more NFIP losses of at least $1,000 each have been paid since 1978. Because repetitive flooding accounts for approximately 40% of all flood insurance claims payments, a Category B community (1-9 repetitive loss properties) may voluntarily submit a repetitive loss plan under the CRS program for credit under this activity.

Because this plan is prepared in accordance with CRS guidelines, FEMA has agreed that it will qualify as the Town's Repetitive Loss Plan needed for the CRS.

**Figure 19. Photo of Kitty Hawk Pier, March 1962**

Photograph by Aycock Brown, courtesy of the Outer Banks History Center, Manteo, NC

**Figure 20. Photo of floodwaters, March 1962**

Photograph by Aycock Brown, courtesy of the Outer Banks History Center, Manteo, NC

**Figure 21. Photo of flood damage, March 1962**

Photograph by Aycock Brown, courtesy of the Outer Banks History Center, Manteo, NC

**Flood Hazard Inventory**

According to FEMA NFIP (5/02), the Town had 1,049 policies in force. The annual written premium is unknown for just Southern Shores because some properties from Duck and Martins Point continue to get included. In 1995 the Town had 496 policies in force within the town limits.

There are 2,900 properties within the corporate limits of Southern Shores. The total number of residences in Southern Shores is 2,186 (4/03) or 74% of available properties.

On the 1993 FIRM there are 210 properties located in Zone VE, of which 196 are developed (94%). In Zone AO, there are 461 properties, 396 are developed (86%). In Zone AE, there are 828 properties, 591 are developed (72%). Zone X (outside the mapped floodplain) contains 1,408 properties and 1,020 residences.

On the current FIRM there are 169 properties located in Zone VE, of which 151 are developed (89%). In all (9, 9.4 and 7) AE zones there are 1454 properties with 1169 developed (80%). Zone X (outside the mapped floodplain) contains 1259 properties and 1002 residences (80%).

Southern Shores:
Residential Properties By Flood Zone (FIRM revised April 2, 1993)

| Flood Zone | Total # Properties | Total Improved | # Flood Policies | Policy: Houses |
|---|---|---|---|---|
| VE | 210 | 196 | 106 | 54% |
| AO | 461 | 396 | 234 | 59% |
| AE | 828 | 591 | 328 | 56% |
| X | 1,408 | 1,020 | 174 | 17% |
| Total: | 2,900 | 2,203 | 842 | - |

Residential Properties By Flood Zone (FIRM revised September 20, 2006)

| Flood Zone | Total # Properties | Total Improved | # Flood Policies | Policy: Houses |
|---|---|---|---|---|
| VE 14 | 4 | 4 | No Data Available | ” |
| VE 12 | 232 | 214 | ” | ” |
| AE 9 | 537 | 455 | ” | ” |
| AE 7 | 916 | 422 | ” | ” |
| X | 1,259 | 1,003 | ” | ” |
| Total: | 2,900 | 2,203 | ” | ” |

**Table 12. Southern Shores Residential Properties By Flood Zone**

In addition to the flood insurance policy penetration, an assessment of the vulnerability of each flood zone was conducted. Table 13, Table 14, and Table 15 illustrate the vulnerability of each flood zone.

For residential properties, the number of existing residential properties was multiplied by the average number of persons per household (2.3266) according to the 2000 Census. Also, the tax assessment for each property was included to calculate the potential value of properties located within the flood zone to determine a rough estimate of the potential property damage that may occur. The number of vacant lots in each flood zone was included in the assessment and was multiplied by the average number of persons per household to project how many people would potentially be impacted by a coastal storm event. Additionally, the number of projected residential buildings was multiplied by the average property value for the existing properties within that particular flood zone.

The same methodology was used for commercial properties. The linear feet of roads in each flood zone was also calculated and multiplied by $12 per linear foot to determine the potential replacement cost if the roads in the flood zones were adversely impacted. A replacement value of $6,300,000 was assigned to the school.

Properties were assigned to the respective flood zone according to the centroid, or center point, of the property. For example, if a property is located partially in the flood zone and partially outside the flood zone, the determination is made according to where the centroid of the property is located.

Hazard Area Location: VE Flood Zone - 1999 Flood Map

| | Developed Land | | | Undeveloped Land | | |
|---|---|---|---|---|---|---|
| | Number of People | Number of Buildings (from tax records) | Approximate Value (from tax records) | Number of People (if developed under existing policies) | Number of Buildings (if developed under existing policies) | Approximate Value (average current value times the number of buildings from previous columns |
| Residential | 347 | 148 | $16,051,400 | 21 | 9 | $976,095 |
| Commercial | | 0 | $0 | | 0 | $0 |
| Industrial | | 0 | $0 | | 0 | $0 |
| Public Buildings and Critical Facilities | | | Replacement Value | | 0 | $0 |
| *Roads* | | 10,500 ft | $126,000 | | 0 | $0 |
| **Total** | **347** | **148** | **$16,177,400** | **21** | **9** | **$976,095** |

**Table 13. VE Flood Zone Area Vulnerability Assessment**

Hazard Area Location: AO Flood Zone - 1999 Flood Map

| | Developed Land | | | Undeveloped Land | | |
|---|---|---|---|---|---|---|
| | Number of People | Number of Buildings (from tax records) | Approximate Value (from tax records) | Number of People (if developed under existing policies) | Number of Buildings (if developed under existing policies) | Approximate Value (average current value times the number of buildings from previous columns |
| Residential | 1,016 | 433 | $88,304,000 | 202 | 86 | $17,538,410 |
| Commercial | | 0 | $0 | | 0 | $0 |
| Industrial | | 0 | $0 | | 0 | $0 |
| Public Buildings and Critical Facilities | | | Replacement Value | | 0 | $0 |
| *East Fire Station* | | 1 | $208,200 | | 0 | $0 |
| *Roads* | | 60,500 ft | $726,000 | | 0 | $0 |
| **Total** | **1,016** | **434** | **$934,200.00** | **202** | **86** | **$17,538,410** |

**Table 14. AO Flood Zone Area Vulnerability Assessment**

Hazard Area Location: AE Flood Zone - 1999 Flood Map

| | **Developed Land** | | | **Undeveloped Land** | | |
|---|---|---|---|---|---|---|
| | Number of People | Number of Buildings (from tax records) | Approximate Value (from tax records) | Number of People (if developed under existing policies) | Number of Buildings (if developed under existing policies) | Approximate Value (average current value times the number of buildings from previous columns) |
| Residential | 769 | 328 | $70,494,600 | 600 | 256 | $55,020,032 |
| Commercial | | 11 | $3,120,900 | | 0 | $0 |
| Industrial | | 0 | $0 | | 0 | $0 |
| Public Buildings and Critical Facilities | | | Replacement Value | | 0 | $0 |
| *Kitty Hawk Elementary School* | | 1 | $7,429,400 | | 0 | $0 |
| *Roads* | | 70,550 ft | $846,600 | | 0 | $0 |
| *Water Tower* | | 1 | $30,000 | | 0 | $0 |
| *South Fire Station* | | 1 | $298,200 | | 0 | $0 |
| Other 3 Bridges, 1 | | 4 | $3,400,000 | | 0 | $0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Culvert | | | | | | |
| Electric Transmission Lines | | | $3,932,979 | | | |
| Telephone Transmission Lines | | | $2,180,235 | | | |
| **Total** | **769** | **346** | **$18,117,414** | **600** | **256** | **$55,020,032** |

**Table 15. AE Flood Zone Area Vulnerability Assessment**

**Review of Possible Activities**

It is important that the Town consider all possible ways to reduce flood losses and protect the natural areas. To ensure that the full range of alternatives was reviewed, the Committee used the list of strategies and tools recommended by the National Flood Insurance Program Community Rating System CRS Coordinators Manual (FEMA Publication FIA-15, January 1999), and modified it to meet the requirements of the Disaster Mitigation Act of 2000.

The CRS Coordinators Manual lists six strategies and numerous tools to prevent or reduce flood losses and to preserve and restore the natural resources and functions of floodplains. The Committee discussed each of these strategies in detail.

Policies and programs, including ones included in the list above were reviewed and evaluated according to effectiveness and cost. Those policies and programs that scored high on effectiveness and low on cost were given priority and were used to develop the Action Plan.

| *Policies & Programs* | *Document Reference* | *Effectiveness (High, Medium, Low)* | *Cost (High, Medium, Low)* | *Rationale For Effectiveness* |
|---|---|---|---|---|
| **1. Preventive – keep flood problems from getting worse. They are usually administered by building, zoning, planning, and/or code enforcement offices**. | | | | |
| Zoning ordinance | Adopted May 4, 1979 | High | Low | High because the zoning regulations restrict development, thereby putting less property at risk |
| Waterway Ordinance | (84-0037) Adopted April 3, 1984 | High | Low | High because the maintaining canals clear of debris promotes drainage in the event of a flood |
| Flood Damage Prevention Ordinance | (2006-07-01) Adopted August 1, 2006 | High | Low | High because the regulations require new construction to be built at or above BFE + 2' and the >50% rule for rebuilding and/or remodeling. |
| Dune Protection Ordinance | Adopted April 8, 1980 | High | Low | High because dunes play a vital role in protecting property from storm surge damage |
| Coastal Area Management Act (CAMA) | (80-0017) Adopted April 8, 1980 | High | Low | High because CAMA regulations protect property from natural hazards |
| **2. Public Information Activities – advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards, and the natural and beneficial functions of local floodplains.** | | | | |
| Permitting | Town Code, Building Permits Adopted August 8, | High | Low | High because new development must adhere to Town |

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| | 1979 | | | codes to receive a permit |
| Education Activities (ISO Community Rating System program Outreach brochure mailing) | N/A | Medium | Low | Medium because education activities do not always effectively reach the target audience |
| Floodplain Mapping (Subdivision Ordinance adopted 12/1/92 Flood Hazard area with an effective date of flood insurance rate map (FIRM)) | Adopted December 1, 1992 | High | Low | High because mapped areas give property owners an idea of flooding associated with different storm events |
| Real Estate Disclosure | N/A | Low | Low | High because although there is no federal or state requirement, disclosures would better inform potential property owners |
| Library – Dare County Library, Strategy Plan | N/A | Low | Low | Low because people do not take advantage of the library |
| Technical Assistance (provided as part of Permitting and Inspections services) | N/A | High | Medium | High because there are a number of local, state, and federal agencies |
| Base Flood Elevation Sentinels | To Be Determined | High | Low | High because the program would help educate citizens and visitors about water |

| *Policies & Programs* | *Document Reference* | *Effectiveness (High, Medium, Low)* | *Cost (High, Medium, Low)* | *Rationale For Effectiveness* |
|---|---|---|---|---|
| | | | | levels associated with different storm events |
| **3. Property Protection – usually undertaken by property owners on a building-by-building or parcel basis.** | | | | |
| Building Elevation | Flood Damage Prevention Ordinance | High | Medium | High because the ordinance requires new construction to be built at or above BFE |
| Floodproofing | NC State Building Code Volume 1 | Medium | Low | Medium because dry flood proof is permitted for commercial structures only and needs to be physically installed prior to the flood event |
| Insurance | National Flood Insurance Program | High | Low | High because well-insured structures can be reconstructed |
| Relocation | N/A | Medium | Medium | Medium because older structures are economically obsolete in many cases. Many are demolished due to age and condition by owners to make way for a new structure that will comply with the current code. |
| Acquisition | N/A | Low | High | Low because while |

| *Policies & Programs* | *Document Reference* | *Effectiveness (High, Medium, Low)* | *Cost (High, Medium, Low)* | *Rationale For Effectiveness* |
|---|---|---|---|---|
| | | | | acquisition would remove vulnerable structures from harm; few repetitive loss properties in Town |
| Retrofit | N/A | High | Medium | High because retrofitted structures meet wind resistant construction standards |
| **4. Emergency Services – taken during a flood to minimize its impact. These measures are the responsibility of city or county emergency management staff and the owners of critical facilities.** | | | | |
| Flood warning | Dare County Emergency Operations Plan | High | Low | High because the warnings are typically posted on radio and television and reach much of the population |
| Flood response | Dare County Emergency Operations Plan | High | Low | High because the Town and the County effect rapid response |
| Emergency Operations Center | Dare County Emergency Operations Plan | High | Low | High because the Town has procedures for the operation of the center |
| Health and safety maintenance | Dare County Emergency Operations Plan | High | Low | High because health and safety are important to the Town, the evacuation routes are moderately protected from hazards |
| **5. Natural Resource Protection – preserve or restore natural areas or the natural functions of floodplain and watershed areas. They are usually implemented by parks or recreation.** | | | | |

| ***Policies & Programs*** | ***Document Reference*** | ***Effectiveness (High, Medium, Low)*** | ***Cost (High, Medium, Low)*** | ***Rationale For Effectiveness*** |
|---|---|---|---|---|
| Permitting | Town Code, Building Permits Adopted August 8, 1979 | High | Low | High because new development must adhere to Town codes to receive a permit |
| Coastal Barrier Protection – CAMA (residential) | (80-0017) Adopted April 8, 1980 | Medium | Low | Medium because although these measures can protect property against erosion, they are expensive |
| Erosion and Sedimentation Control (commercial, > 1 acre) | NCGS 113A-60 | Low | Medium | Low because sandy soils provide good drainage in most storm events during construction with little runoff. Sand fencing installed along dunes per CAMA requirements good for dune stabilization |
| Private Property Owners Association | Document reference, recorded covenants | High | Low | High because common areas owned by the property owners association is maintained as open space in perpetuity |
| Wetlands | Section 404 | Medium | Low | Medium because wetlands serve as a flood control measure and provide a natural function of the floodplain |

| *Policies & Programs* | *Document Reference* | *Effectiveness (High, Medium, Low)* | *Cost (High, Medium, Low)* | *Rationale For Effectiveness* |
|---|---|---|---|---|
| **6. Structural Projects – keep flood waters away from an area with a levee, reservoir, or other flood control measure. They are designed by engineers and managed or maintained by public works.** | | | | |
| Stormwater Management Regulations | Title 15A NCAC 2H. 1000 | High | Low | High because the regulations require new developments to provide for stormwater |
| Channel Modifications | To be determined | Low | High | Low because channelization can significantly increase runoff. Modification of existing waterway channels, i.e. interconnections, may require property condemnation and/or easements. |
| Beach Nourishment | N/A | Low | High | Low because of low erosion rate in Southern Shores |
| Right-of-way swales | N/A | High | Low | High because, without right-of-way swales, runoff goes unchecked into the waterways |

**Table 16. Evaluation of Policies and Programs**

**Flooding Policy**

When the Town of Southern Shores encounters a hurricane, thunderstorm, or tornado, it will also experience excessive water and/or flooding. To limit the damage in terms of property, personal injuries and loss of life, the Town has the following policies and programs in place:

***FEMA NFIP Flood Insurance Rate Map (FIRM)***

The Town of Southern Shores maintains the current paper FIRM in the Town Hall Code Enforcement offices. The Town also has generated both a paper and digital map that overlays the Flood Zone boundaries on the platted lots to educate and regulate landowners planning to improve residential and commercial property. The digital map showing various flood zones is available on the Town's web site at www.southernshores.org.

***Flood Damage Prevention Code***

The Town has in place a Flood Damage Prevention Code which sets forth standards as they relate to building and development near and within flood prone areas.

***ISO's Community Rating System (CRS) Program***

The Town voluntarily participates in ISO's Community Rating System (CRS) Program and has adopted some Flood Hazard Mitigation standards such as a 2' freeboard requirement that exceeds the Federal Minimum requirements.

***CAMA 30' Public Trust waters Buffer Rules***

Requires that no house, building or other non-water dependent structure be built within 30 feet of any Public Trust waterway.

***Maintenance of Waterways and Canals***

The Southern Shores Civic Assoc. Boat Club conducts semi-annual surveys of the canal system for debris and growth. This maintenance program involves controlling vegetative growth in order to keep these creeks, streams and waterways free of obstructions to reduce the likelihood that the banks of these channels will overflow causing flooding and its related damage.

**Gaps, Shortfalls or Conflicts with Flooding Policy**

Owners of unimproved property adjacent to canals have not always maintained shoreline vegetation per the Waterways ordinance requirement. Recent experience during high wind and flooding events suggests that significant trees are lost when the shoreline is undermined by erosion of the banks. The Southern Shores Civic Assoc. Boat Club encourages canal front owners to bulkhead property. The Town has not mandated bulkheading of shoreline. NFIP flood maps have been updated September 20, 2006.

***Technical & Fiscal Capabilities***

The Town has the in-house technical expertise in the Code Enforcement Department to enforce and carry out the policies, programs and ordinances which are under the authority of the Town as they deal with mitigating damage related to the high winds associated with hurricanes, thunderstorms, and tornadoes.

## ANNEX 7

# Town of Southern Shores

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Phone 252-261-2394 / Fax 252-255-0876
info@southernshores-nc.gov
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Resolution 2009-10-13

**Resolution of the Town of Southern Shores Council Requesting Action By the Dare Country Board of Commissioners to Merge The Hazard Mitigation Plan for the Town of Southern Shores with the Dare County Hazard Mitigation Plan**

WHEREAS, on October 30, 2000, the President of the United States signed into law the Disaster Mitigation Act of 2000 to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 to reinforce the importance of pre-disaster mitigation planning to help reduce disaster losses; and

WHEREAS, North Carolina Senate Bill 300 requires all local governments to have an approved Hazard Mitigation Plan in order to receive state public assistance funds (effective for state-declared disasters after November 1, 2004; and

WHEREAS, the Town of Southern Shores Hazard Mitigation Plan was approved on February 15, 2005 by the Southern Shores Town Council and subsequently approved by the Federal Emergency Management Agency (FEMA) and the North Carolina Division of Emergency Management (NCEM) and revised September 23, 2008; and

WHEREAS, the Town of Southern Shores has to update the Town of Southern Shores Hazard Mitigation Plan as required every five (5) years by FEMA and NCEM; and

WHEREAS, the Town of Southern Shores, in accordance with guidance provided by FEMA, NCEM, and the County of Dare, now desires to include said Plan with the County of Dare as part of their Hazard Mitigation Plan update which is currently in process.

NOW, THEREFORE, BE IT RESOLVED that the Town of Southern Shores Council hereby requests that the Dare County Board of Commissioners incorporate the Town of Southern Shores Hazard Mitigation Plan as part of a Multi-Jurisdictional Hazard Mitigation Plan Update for Dare County.

Adopted this 4th day of November 2009

TOWN OF SOUTHERN SHORES SEAL

Don Smith, Mayor

ATTEST:

Carrie Goodin, Town Clerk

## GLOSSARY

**Base Flood:** A term used in the National Flood Insurance Program to indicate the minimum size flood to be used by a community as a basis for its floodplain management regulations; presently required by regulation to be that flood which has a one-percent chance of being equaled or exceeded in any given year. Also known as a 100-year flood or one-percent chance flood.

**Base Flood Elevation (BFE):** The elevation for which there is a one-percent chance in any given year that flood levels will equal or exceed it. The BFE is generally based on statistical analysis of stream flow records for the watershed and rainfall and runoff characteristics in the general region of the watershed, and application of hydraulic backwater models.

**Base Floodplain:** The floodplain that would be inundated by a one-percent chance (100-year) flood.

**Building Code:** The regulations adopted by a local governing body setting forth standards for the construction, addition, modification, and repair of buildings and other structures for the purpose of protecting the health, safety, and general welfare of the public.

**Building:** A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes manufactured home on a permanent foundation on which the wheels and axles carry no weight.

**Community:** Any state or area or political subdivision thereof, or any Indian tribe or authorized tribal organization which has the authority to adopt and enforce regulations for the areas within its jurisdiction.

**Community Rating System (CRS):** Administered by FEMA, the Community Rating System provides flood insurance discounts for residents in NFIP communities that undertake floodplain mitigation activities above the minimum NFIP standards.

**Critical Facility:** Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, hospitals, and lifeline infrastructure such as water and sewer treatment facilities, power generation stations, communication and transportation networks. Essential facilities are elements that are important to ensure a full recovery of a community following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.

**Design Flood:** Commonly used to mean the magnitude of flood used for design and operation of flood control structures or other protective measures. It is sometimes used to denote the magnitude of flood used in floodplain regulation.

**Disaster/Emergency:** Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the "Stafford Act"), the Governor may request that the President declare a major disaster or emergency when state and local resources are insufficient to recover from the impact of the event. Following a Presidential declaration, the Federal Emergency Management Agency designated the types of assistance to be made available under the Stafford Act. This may include individual assistance, public assistance, and/or hazard mitigation assistance. Depending upon the situation, other Federal disaster relief programs may be activated as well.

A major disaster is defined as any natural catastrophe, or, regardless of cause, any fire, flood, or explosion that causes damage of sufficient severity and magnitude to warrant assistance supplementing state, local, and disaster relief organization efforts to alleviate damage, loss, hardship, or suffering.

An emergency is defined as any occasion or instance for which federal assistance is needed to supplement state and local efforts to save lives and protect property and public health and safety, or to lessen or avert the threat of a catastrophe.

**Enabling Statute:** A State law that transfers some of the police power residing in the State to localities within it for the purpose of zoning, subdivision, regulations, building codes, and the like.

**Erosion:** The wearing away of the land surface by running water, wind, ice, or other geological agents.

**Federal Emergency Management Agency (FEMA):** An independent agency of the federal government, reporting to the President. FEMA's mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.

**Flood Frequency:** A statistical expression of the average time period between floods equaling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equaled or exceeded on the average of once every hundred years; such a flood has a one-percent chance of being equaled or exceeded in any given year. Often used interchangeably with 'recurrence interval."

**Flash Flood:** A flood that reaches its peak glow in a short length of time (hours or minutes) after the storm or other event causing it. Often characterized by high velocity flows.

**Flood or Flooding:** Temporary inundation of normally dry land areas from the overflow of inland or tidal waters, or from the unusual and rapid accumulation or runoff of surface waters from any source. The rise in water may be caused by excessive rainfall, snowmelt, natural stream blockages, wind storms over a lake, or any combination of such conditions.

**Flood Control:** Keeping flood waters away from specific developments or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineering works.

**Flood Depth:** Height of the floodwater surface above the ground surface.

**Flood Insurance Rate Maps (FIRMs):** The official map of a community prepared by FEMA, showing base flood elevations along with the special hazard areas and the risk zones.

**Flood Insurance Study (FIS):** A study that provides an examination, evaluation, and determination of flood hazards, and if appropriate, corresponding water surface elevations in a community or communities. Also contains information on local flood history, local flood problems, and other flood studies.

**Floodplain:** Any normally dry land area that is susceptible to being inundated by water from any natural source. This area is usually low land adjacent to a river, stream, watercourse, ocean or lake.

**Floodplain Management:** The operation of a program of corrective and preventive measures for reducing flood damage, including by not limited to flood control projects, floodplain land use regulations, flood proofing buildings, and emergency preparedness plans.

**Flood proofing:** Any combination of structural and nonstructural additions, changes, or adjustments to properties and structures which reduce or eliminate flood damage to lands, water and sanitary facilities, structures, and contents of buildings.

**Floodway:** The channel of a watercourse and those portions of the adjoining floodplain required to provide for a passage of the selected flood (normally the 100-year flood) with an insignificant increase in the flood levels above that of natural conditions. As used in the National Flood Insurance Program, floodways must be large enough to pass the 100-year flood without causing an increase in elevation of more than a specified amount (one foot in most areas).

**Freeboard:** A factor of safety expressed in feet above a design flood level for flood protective or control works. Freeboard is intended to allow for all of the uncertainties in analysis, design and construction, which cannot be fully or readily considered in an analytical fashion.

**Geographic Information System (GIS):** A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

**Hazard:** A source of potential danger or adverse condition. Hazards include such naturally occurring events as floods, earthquakes, tornadoes, coastal storms, landslides, wildfires, and droughts that strike populated areas.

**Hazard Event:** A specific occurrence of a particular type of hazard.

**Infrastructure:** Refers to the public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams.

**Intensity:** A measure of the strength of a hazard event. The intensity (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.

**Mitigation:** Any action taken to permanently reduce or eliminate long-term risk to people and their property from the effects of hazards. Some examples include elevating houses above base flood levels, acquiring land in hazard areas, and zoning land in floodplains for parkland or low density use.

**Mitigation Plan:** A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the community and includes policy and implementation procedures designed to minimize present and future vulnerability to hazards.

**National Flood Insurance Program (NFIP):** Administered by the Federal Insurance Administration, the National Flood Insurance Program makes federally subsidized flood insurance available to property owners in communities that participate in the program. Participating communities must adopt and enforce floodplain management ordinances that meet the criteria established by FEMA.

**North Carolina Coastal Area Management Act (CAMA):** Enacted by the North Carolina General Assembly in 1974, the act created a new regulatory and planning framework for managing the resources and land use in the twenty counties included in the designated coastal zone. CAMA created the Coastal Resources Commission, establishing a permitting system for activities in areas of environmental concern, and mandated local coastal planning.

**Repetitive Loss Plan:** Under the Community Rating System (CRS), a Category C repetitive loss community has 10 or more repetitive loss properties. Because repetitive flooding accounts for approximately 33% of all flood insurance losses, Category C repetitive loss communities must prepare floodplain management plans for their repetitive loss areas. The CRS no longer provides separate credit for "repetitive loss plans." A Category C community can either prepare a floodplain management plan for all of its known flood problem areas, or it can prepare one that covers just its repetitive loss areas.

**Repetitive Loss Property:** Under the Community Rating System (CRS), a repetitive loss property is one for which two or more flood insurance claims of at least $1,000 each have been paid within any 10-year period since 1978.

**Replacement Value:** The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building or a particular size, type, and quality.

**Riparian Buffer:** An area contiguous to one or both sides of a watercourse that is maintained in a natural vegetative state.

**Riverine:** Of or produced by a river.

**Runoff:** That portion of precipitation, which is not intercepted by vegetation, absorbed by the land surface or evaporated, and thus flows overland into a depression, stream, lake or ocean (runoff call "immediate subsurface runoff also takes place in the upper layers of the soil).

**SLOSH (Sea, Lake, and Overland Surges form Hurricanes) Maps:** A computer simulation model developed for the National Weather Service used to predict the still-water super-elevation (i.e., the storm surge) of storm waters caused by the drop in barometric pressure, wind speed, forward speed of the storm, storm track, near shore bathymetry, shoreline configuration, and near shore topography. The SLOSH model is essential for developing hurricane evacuation plans in exposed coastal areas. Output from a SLOSH model has been used to create hurricane storm surge inundation areas for GIS and mapping.

**Special Flood Hazard Areas:** Areas in a community that have been identified as susceptible to a one-percent or greater chance of flooding in any given year. A one-percent-probability flood is also known as the 100-year flood or the base flood. Special Flood Hazard Areas are usually designated on the Flood Hazard Boundary Map (FHBM) as Zone A. After detailed evaluation of local flooding characteristics, the Flood Insurance Rate Map (FIRM) will refine this categorization in Zones A, AE, AH, AO, A1-30, VE and V 1-30,

**Structure:** Something constructed (See also Building)

**Subdivision Regulations:** Ordinances or regulations governing the subdivision of land with respect to such things as adequacy and suitability of building sites, utilities and pubic facilities.

**Vulnerability:** The extent to which people will experience harm and property will be damaged from a hazard.

**Wetlands:** Areas that are inundated or saturated at a frequency and for a duration sufficient to support a prevalence of vegetative or aquatic life requiring saturated or seasonally saturated soil conditions for growth and reproduction.

**Zoning Ordinance:** An ordinance under the local government's police power, which divides an area into districts and, within each district, regulates the use of land and buildings, height and bulk of buildings and other structures, and the density of population.