TOWN OF GREENLAND, NH

HAZARD MITIGATION PLAN 2006

Approved by the

GREENLAND BOARD OF SELECTMEN

And adopted as an official appendix to the Greenland Emergency Operations Plan

NOVEMBER 6TH, 2006

Rockingham
Planning
Commission

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NEW HAMPSHIRE BUREAU OF EMERGENCY MANAGEMENT

Greenland Hazard Mitigation Plan

This Plan serves a dual role as a stand alone document approved by the Greenland Board of Selectmen on Nov. 6th, 2006. This document also serves as an official appendix to the Greenland Emergency Operations Plan.

Approved by the Greenland Board of Selectmen:

____________________, Chair
DANIEL KERN

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Maurice Sodin

Date Nov. 6th, 2006

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EXECUTIVE SUMMARY

The Greenland Hazard Mitigation Plan (herein after, the *Plan*) was compiled to assist the Town of Greenland in reducing and mitigating future losses from natural hazard events. The *Plan* was developed by the Rockingham Planning Commission and participants from the Town of Greenland and contains the tools necessary to identify specific hazards and aspects of existing and future mitigation efforts.

The following hazards are addressed:

- Flooding (inland and coastal on the Bay)
- Hurricane – High Wind Event
- Severe Winter Weather
- Wildfire
- Earthquake
- Radon

The Critical Facilities include:

- Municipal facilities;
- Communication facilities;
- Fire stations and law enforcement facilities;
- Schools;
- Shelters;
- Evacuation routes; and
- Vulnerable Populations

The *Plan* is considered a work in progress and should be revisited frequently to assess whether the existing and suggested mitigation strategies are successful. Copies have been distributed to the Town of Greenland, and a copy will remain on file at the Rockingham Planning Commission. A copy of this Plan is also on file at the New Hampshire Bureau of Emergency Management (NH BEM) and the Federal Emergency Management Agency (FEMA). This *Plan* was approved by both agencies prior its adoption at the local level.

CHAPTER 1 – INTRODUCTION

BACKGROUND

The New Hampshire Bureau of Emergency Management (NH BEM) has a goal for all communities within the State to establish local hazard mitigation plans as a means to reduce and mitigate future losses from natural hazard events. The NH BEM outlined a process whereby communities throughout the State may be eligible for grants and other assistance upon completion of a local hazard mitigation plan. A handbook entitled Hazard Mitigation Planning for New Hampshire Communities was created by NH BEM to assist communities in developing local plans. The State's Regional Planning Commissions are charged with providing assistance to selected communities to develop local plans.

The Plan was prepared by Rockingham Planning Commission (RPC) with the assistance of participants from the Town of Greenland, under contract with the New Hampshire Bureau of Emergency Management (BEM) operating under the guidance of Section 206.405 of 44 CFR Chapter 1 (10-1-97 Edition). The Plan serves as a strategic planning tool for use by the Town of Greenland in its efforts to identify and mitigate the future impacts of natural and/or man-made hazard events. Upon adoption of this Plan by the Greenland Board of Selectmen, it will become an official appendix to the Greenland Emergency Operations Plan.

METHODOLOGY

In 2005, the Rockingham Planning Commission (RPC) organized the first meeting with emergency management officials from the Town of Greenland to begin the initial planning stages of the *Plan.* RPC and participants from the Town developed the content of the *Plan* using the ten-step process set forth in the *Hazard Mitigation Planning for New Hampshire Communities*. The following is a summary of the ten-step process conducted to compile the *Plan.*

Step 1 – Map the Hazards

Participants in the *Committee* identified areas where damage from historic natural disasters have occurred and areas where critical man-made facilities and other features may be at risk in the future for loss of life, property damage, environmental pollution and other risk factors. RPC generated a set of base maps with GIS (Geographic Information Systems) that were used in the process of identifying past and future hazards.

Step 2 – Identify Critical Facilities and Areas of Concern

Participants in the Committee then identified facilities and areas that were considered to be important to the Town for emergency management purposes, for provision of utilities and community services, evacuation routes, and for recreational and social value. Using a Global Positioning System, RPC plotted the exact location of these sites on a map.

Step 3 – Identify Existing Mitigation Strategies

After collecting detailed information on each critical facility in Greenland, the Committee and RPC staff identified existing Town mitigation strategies relative to flooding, wind, fire, ice and snow events and earthquakes. This process involved reviewing the Town's Masterplan, Capital Improvements Program (CIP), Zoning Ordinance, Subdivision Regulations, Site Plan Review Regulations, Greenland Central School Emergency/Crisis Response Plan and participation in the (National Flood Insurance Program) NFIP. This allowed the committee to identify portions of the Town's existing mitigation strategies. The Committee could see how natural hazards were dealt with in the context of the Master Plan which outlines the vision for the Town and how capital expenditures were planned to increase the Town's preparedness for Natural Disasters.

Step 4 – Identify Gaps in Existing Mitigation Actions or Strategies

The existing strategies were then reviewed by the RPC for coverage and effectiveness, as well as the need for improvement.

Step 5 – Identify Potential Mitigation Actions or Strategies

A list was developed of additional hazard mitigation actions and strategies for the Town of Greenland. Potential actions include updating the Emergency Operations Plan, becoming involved in Fire Prevention Week, and earthquake-proofing and purchasing cots for the Shelter.

Step 6 – Prioritize and Develop Action Plan

The proposed hazard mitigation actions and strategies were reviewed and each strategy was rated (good, average, or poor) for its effectiveness according to several factors (*e.g.*, technical and administrative applicability, political and social acceptability, legal authority, environmental impact, financial feasibility). Each factor was then scored and all scores were totaled for each strategy. Strategies were ranked by overall score for preliminary prioritization then reviewed again under Step 7.

Step 7 – Determine Priorities

The preliminary prioritization list was reviewed in order to make changes and determine a final prioritization for new hazard mitigation actions and existing protection strategy improvements identified in previous steps. RPC also presented recommendations to be reviewed and prioritized by emergency management officials.

Step 8 – Develop Implementation Strategy

An implementation strategy was developed for the Action Plan which included person(s) responsible for implementation (who), a timeline for completion (when), and a funding source and/or technical assistance source (how) for each identified hazard mitigation actions.

Step 9 – Adopt and Monitor the Plan

RPC staff compiled the results of Steps 1 to 8 in a draft document. This draft *Plan* was reviewed by members of the *Committee* and by staff members at the RPC. The draft *Plan* was also placed on the RPC website for review by the public, neighboring communities, agencies, businesses, and other interested parties to review and make comments via email. A letter was sent to the abutting New Hampshire communities of Stratham, North Hampton, Rye, Portsmouth and Newington to insure their opportunity to review the *Plan* prior to finalization (see Appendix F). A duly noticed public meeting was held by the Greenland Board of Selectmen (March 27th, 2006). This meeting allowed the community to provide comments and suggestions for the *Plan* in person, prior to the document being finalized. The draft was revised to incorporate comment from the Board of Selectmen and general public; then submitted to the NHBEM and FEMA Region I for their review and comments (March 28, 2006). Any changes required by NHBEM and FEMA were made and a revised draft document was then submitted to the Greenland Board of Selectmen for their final review. A second public meeting was then held by the Greenland Board of Selectmen on November 6th, 2006. At this public meeting the *Plan* was approved by the Board of Selectmen, and adopted as an appendix to the Greenland Emergency Operations Plan.

HAZARD MITIGATION GOALS AND OBJECTIVES OF THE STATE OF NEW HAMPSHIRE

The *State of New Hampshire Natural Hazards Mitigation Plan*, which was prepared and is maintained by the New Hampshire Bureau of Emergency Management (NH BEM), sets forth the following related to overall hazard mitigation goals and objectives for the State of New Hampshire:

1. To improve upon the protection of the general population, the citizens of the State and guests, from all natural and man-made hazards.
2. To reduce the potential impact of natural and man-made disasters on the State's Critical Support Services.
3. To reduce the potential impact of natural and man-made disasters on Critical Facilities in the State.
4. To reduce the potential impact of natural and man-made disasters on the State's infrastructure.
5. To improve Emergency Preparedness.
6. Improve the State's Disaster Response and Recovery Capability.
7. To reduce the potential impact of natural and man-made disasters on private property.
8. To reduce the potential impact of natural and man-made disasters on the State's economy.
9. To reduce the potential impact of natural and man-made disasters on the State's natural environment.
10. To reduce the State's liability with respect to natural and man-made hazards generally.
11. To reduce the potential impact of natural and man-made disasters on the State's specific historic treasures and interests as well as other tangible and intangible characteristics which add to the quality of life of the citizens and guests of the State.
12. To identify, introduce and implement cost effective Hazard Mitigation measures so as to accomplish the State's Goals and Objectives and to raise the awareness of, and acceptance of Hazard Mitigation generally.

Through the adoption of this Plan the Town of Greenland concurs and adopts these goals and objectives.

ACKNOWLEDGEMENTS

The Town of Greenland offers thanks to the **New Hampshire Bureau of Emergency Management** (www.nhBEM.state.nh.us), which provided the model and funding for this document.

Ken Fernald, Emergency Management Director
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Ralph Cresta, Fire Chief
Rich Carlin, School Board Member
Michael Maloney, Police Chief
Jamie Cormier, Police Officer
Bob Cushman, Building Inspector/Code Enforcement Officer

In addition, thanks are extended to the staff of the Rockingham Planning Commission for professional services, process facilitation and preparation of this document.

CHAPTER II – COMMUNITY PROFILE

NATURAL FEATURES

The Town of Greenland is located in the Seacoast of New Hampshire, on the southern side of Great Bay. Greenland is part of two regional watersheds, the Great Bay watershed (6,925 square acres) and the Coastal watershed (435 square acres)[1]. Waterways within the Town that lead to Great Bay include: the Winnicut River, Foss Brook, Shaw Brook, Pickering Brook, and Packer's Brook. Berry's Brook is the most significant waterway in Greenland that is part of the Coastal watershed. Another dominate feature of Greenland's Natural Features is Packer Bog, identified in Figure 1 below.

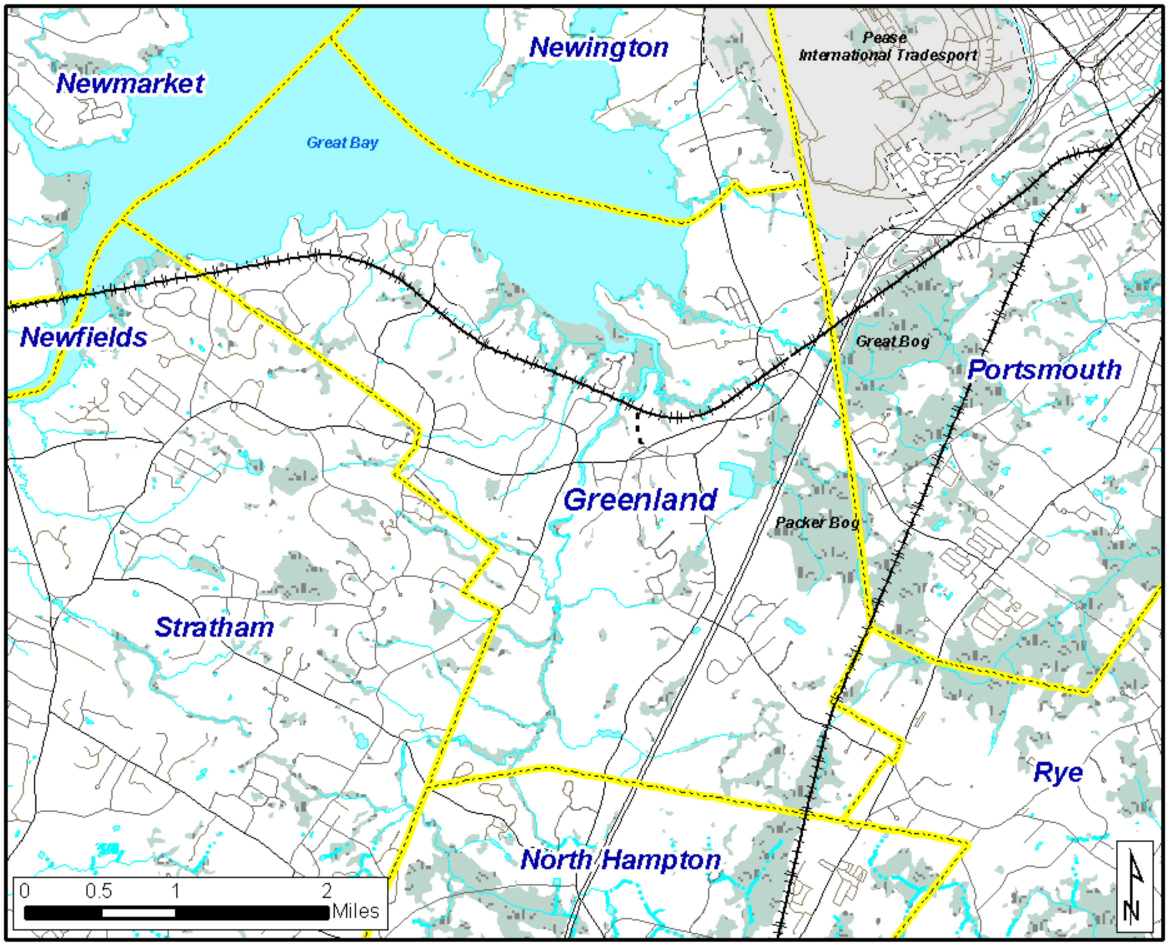

Figure 1: Location Map of Greenland, New Hampshire

[1] Town of Greenland, Water Resource Management and Protection Plan. 1991

LAND USE AND DEVELOPMENT

A land use map was prepared for this *Plan* using data from GRANIT (The New Hampshire Geographically Referenced Analysis and Information Transfer System). The land use data was created for Rockingham County in 1998. The data was developed through interpretation of 1:12,000 scale black and white digital orthophoto quadrangles from the United States Geologic Survey. For more information on this data layer please visit http://granit.sr.unh.edu. This data is presented in Map 1: Greenland Land Use.

Greenland is a predominately residential community. It has a small commercial zoning district that covers approximately 60% of Route 33, and also extends south along Bramber Valley Lane. Greenland also has a small industrial district in the northeast portion of Town, along both sides of Interstate 95. The majority of Greenland is zoned for residential. The potential for future development is Greenland is limited by several factors. Greenland has no municipal sewer and limited municipal water. Because of this Greenland's minimum lot size is 60,000 square feet, due to the need of on-site septic and wells. Greenland is also inundated with wetlands which decrease the land available for development. Due to these constraints, and the lack of available large parcels most of the future residential development will be small subdivisions.

CHAPTER III – NATURAL HAZARDS IN THE TOWN OF GREENLAND, NH

WHAT ARE THE HAZARDS?

The first step in planning for natural hazard mitigation is to identify hazards that may affect the Town. Some communities are more susceptible to certain hazards (i.e., flooding near rivers, hurricanes on the seacoast, etc.). The Town of Greenland is prone to several types of natural hazards. These hazards include: flooding, hurricanes or other high-wind events, severe winter weather, wildfires, radon and earthquakes. Other natural hazards can and do affect the Town of Greenland, but these were the hazards prioritized by the Committee for mitigation planning. These were the hazards that were considered to occur with regularity and/or were considered to have high damage potential, and are discussed below.

Natural hazards that are included in the State's Hazard Mitigation Plan, that are not included in the *Plan* are: drought, extreme heat, landslide, subsidence, avalanche and ice jams. Subsidence and avalanche are rated by the State as having Low and No risk in Rockingham County, respectively; due to this they were left out of the *Plan*. Greenland has no record of landslides; so landslides were not included in this *Plan*. The State of New Hampshire's Natural Hazard Mitigation Plan indicates that Rockingham County is at Moderate risk to drought, extreme heat, and radon; these hazards were not included in the *Plan*. When compared to natural hazards that could be potentially devastating to the Town (earthquakes or hurricanes) or natural hazards that occur with regularity (flooding or severe winter weather) it was not considered an effective use of the Committee time to include drought, and extreme heat in the *Plan* at this time. Ice jams were not included in the plan because of their infrequency and low potential for damage in Greenland, NH. Greenland is coastal and completely contained in the Coastal Watershed. Due to this streams and rivers in Greenland have small drainage basins and relatively short lengths; there is little chance of damaging ice building up on any of these small water bodies. When the *Plan* is revised and updated in the future, possible inclusion of these hazards will be reevaluated.

HAZARD DEFINITIONS

Flooding

Floods are defined as a temporary overflow of water onto lands that are not normally covered by water. Flooding results from the overflow of major rivers and tributaries, storm surges, and/ or inadequate local drainage. Floods can cause loss of life, property damage, crop/livestock damage, and water supply contamination. Floods can also disrupt travel routes on roads and bridges.

Inland floods are most likely to occur in the spring due to the increase in rainfall and melting of snow; however, floods can occur at any time of the year. A sudden thaw in the winter or a major downpour in the summer can cause flooding because there is suddenly a lot of water in one place with nowhere to go. Coastal flooding can be caused by storm surge associated with high wind events such as hurricanes or from tsunami.

100-year Floodplain Events

Floodplains are usually located in lowlands near rivers, and flood on a regular basis. The term 100 year flood does not mean that a flood will occur once every 100 years. It is a statement of probability that scientists and engineers use to describe how one flood compares to others that are likely to occur. It is more accurate to use the phrase "1% annual chance flood". What this means is that there is a 1% chance of a flood of that size happening in any year. The flood hazard areas that are identified in Greenland, A and AE are defined as follows[2]:

> *Zone A* is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
>
> *Zones AE and A1-A30* are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, Base Flood Elevations (BFEs) derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

Rapid Snow Pack Melt

Warm temperatures and heavy rains cause rapid snowmelt. Quickly melting snow coupled with moderate to heavy rains are prime conditions for flooding.

River Ice Jams

Rising waters in early spring often breaks ice into chunks, which float downstream and often pile up, causing flooding. Small rivers and streams pose special flooding risks because they are easily blocked by jams. Ice collecting in river bends and against structures presents significant flooding threats to bridges, roads, and the surrounding lands.

Tsunami

The National Tsunami Hazard mitigation Program (http://www.pmel.noaa.gov/tsunami-hazard/terms.html) defines a Tsunami as Japanese term derived from the characters "tsu" meaning harbor and "nami" meaning wave. It is generally accepted by the international scientific community to describe a series of traveling waves in water produced by the displacement of the sea floor associated with submarine earthquakes, volcanic eruptions, or landslides.

Hurricane - High Wind Event

Significantly high winds occur especially during hurricanes, tornadoes, winter storms and thunderstorms. Falling objects and downed power lines are dangerous risks associated with high winds. In addition, property damage and downed trees are common during high wind occurrences.

[2] http://www.fema.gov/fhm/fq_term.sht

Hurricanes
A hurricane is a tropical cyclone in which winds reach speeds of 74 miles per hour or more and blow in a large spiral around a relatively calm center (see Appendix C). The eye of the storm is usually 20-30 miles wide and may extend over 400 miles. High winds are a primary cause of hurricane-inflicted loss of life and property damage.

Tornadoes
A tornado is a violent windstorm characterized by a twisting, funnel shaped cloud. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. The atmospheric conditions required for the formation of a tornado include great thermal instability, high humidity and the convergence of warm, moist air at low levels with cooler, drier air aloft. Most tornadoes remain suspended in the atmosphere, but if they touch down they become a force of destruction.

Tornadoes produce the most violent winds on earth, at speeds of 280 mph or more. In addition, tornadoes can travel at a forward speed of up to 70 mph. Damage paths can be in excess of one mile wide and 50 miles long. Violent winds and debris slamming into buildings cause the most structural damage.

The Fujita Scale is the standard scale for rating the severity of a tornado as measured by the damage it causes (see Appendix D). A tornado is usually accompanied by thunder, lightning, heavy rain, and a loud "freight train" noise. In comparison with a hurricane, a tornado covers a much smaller area but can be more violent and destructive.

Severe Thunderstorms
All thunderstorms contain lightning. During a lightning discharge, the sudden heating of the air causes it to expand rapidly. After the discharge, the air contracts quickly as it cools back to ambient temperatures. This rapid expansion and contraction of the air causes a shock wave that we hear as thunder, which can damage building walls and break glass.

Lightning
Lightning is a giant spark of electricity that occurs within the atmosphere or between the atmosphere and the ground. As lightning passes through air, it heats the air to a temperature of about 50,000 degrees Fahrenheit, considerably hotter than the surface of the sun. Lightning strikes can cause death, injury and property damage.

Hail
Hailstones are balls of ice that grow as they're held up by winds, known as updrafts, which blow upwards in thunderstorms. The updrafts carry droplets of supercooled water – water at a below freezing temperature – but not yet ice. The supercooled water droplets hit the balls of ice and freeze instantly, making the hailstones grow. The faster the updraft, the bigger the stones can grow. Most hailstones are smaller in diameter than a dime, but stones weighing more than a pound have been recorded. Details of how hailstones grow are complicated, but the results are irregular balls of ice that can be as

large as baseballs, sometimes even bigger. While crops are the major victims, hail is also a hazard to vehicles and windows.

Severe Winter Weather
Ice and snow events typically occur during the winter months and can cause loss of life, property damage and tree damage.

Heavy Snow Storms
A winter storm can range from moderate snow to blizzard conditions. Blizzard conditions are considered blinding, wind-driven snow over 35 mph that lasts several days. A severe winter storm deposits four or more inches of snow during a 12-hour period or six inches of snow during a 24-hour period.

Ice Storms
An ice storm involves rain, which freezes upon impact. Ice coating at least one-fourth inch in thickness is heavy enough to damage trees, overhead wires and similar objects. Ice storms often produce widespread power outages.

Nor'easter
A Nor'easter is large weather system traveling from South to North passing along or near the seacoast. As the storm approaches New England and its intensity becomes increasingly apparent, the resulting counterclockwise cyclonic winds impact the coast and inland areas form a Northeasterly direction. The sustained winds may meet or exceed hurricane force, with larger bursts, and may exceed hurricane events by many hours (or days) in terms of duration[3].

Wildfire
Wildfire is defined as an uncontrolled and rapidly spreading fire.

Forest Fires and Grass Fires
A forest fire is an uncontrolled fire in a woody area. They often occur during drought and when woody debris on the forest floor is readily available to fuel the fire. Grass fires are uncontrolled fires in grassy areas.

Earthquakes
Geologic events are often associated with California, but New England is considered a moderate risk earthquake zone. An earthquake is a rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and phone lines, and often cause landslides, flash floods, fires, and avalanches. Larger earthquakes usually begin with slight tremors but rapidly take the form of one or more violent shocks, and end in vibrations of gradually diminishing force called aftershocks. The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. The magnitude and intensity of an earthquake is determined by the use of scales such as the Richter scale[4] and Mercalli scale.

[3] Definition of Nor'easter taken from NH State Natural Hazards Mitigation Plan October 2000 Edition.
[4] A copy of the Richter scale is displayed in Appendix E.

Radon

Radon is naturally occurring radioactive gas that can lead to lung cancer after prolonged exposure. In New Hampshire radon is associated with certain types of granite, depending on the geochemistry of the particular granite outcrop. The radon gas can build up in the lowest level of a dwelling and be a hazard to residents over a prolonged period of time.

PROFILE OF PAST AND POTENTIAL HAZARDS

As discussed above the natural hazards that were identified for mitigation in this Plan include: flooding, hurricanes-high wind events, severe winter weather, wildfire, earthquakes and radon. Some of the natural hazards could be included under more than one type of hazard. For example a hurricane could be considered a high wind event or a flooding event depending on the storm's consequences.

The hazard profiles below include: a description of the events included as part of the natural hazard, the geographic location of each natural hazard (if applicable), the extent of the natural hazard (e.g. magnitude or severity), probability, past occurrences, and community vulnerability. Past occurrences of natural hazards were mapped if possible (Map 2: Past and Future Hazards). Some of the natural hazards have not occurred within the Town of Greenland (within written memory), for these hazards the plan refers to a table of hazards that have occurred regionally and statewide (Table 3). Community vulnerability identifies the specific areas, general type of structures, specific structures, or general vulnerability of the Town of Greenland to each natural hazard.

Flooding

Description: Flooding events can include hurricanes, 100-year floods, 500-year floods, debris-impacted infrastructure, erosion, mudslides, rapid snow pack melt, river ice jams, dam breach and/or failure, coastal storm surge, and tsunami.

Location: Greenland is vulnerable to flooding in several locations. Generally, the Town is at risk within the Flood Zones identified by FEMA on Flood Insurance Rate Maps (FIRM). Greenland has two major flood zones: A and AE. There are also two areas of locally-identified potential flooding that are not within these flood zones, these areas are described below and displayed on Map 2: Past and Future Hazards. Greenland has one dam that is rated as a hazard class A dam: low hazard potential.

Extent: The extent of the Special Flood Hazard Zone and the 500-year flood zone can be seen in Map 2: Past and Future Hazards. Locally identified areas of potential flood problems include two areas. First a portion of Alden Ave. near Packer's Brook has been affected by local flooding. Also identified is the area that could be affected by dam breech. A breech of Winnicut River dam, located on Caswell Drive, could affect several homes along the river banks.

Probability: **HIGH**

Table 1: Probability of Flooding based on return interval

Flood Return Interval	Chance of Occurrence in Any Given Year
10-year	10%
50-year	2%
100-year	1%
500-year	0.2%

Past Occurrence: A History of larger flood events is listed in Table 3.

Community Vulnerability:

- Structures located in the flood zone
- Culverts
- Basements
- Erodable soils
- Locally-identified flood areas (Map 2: Past and Future Hazards)

Hurricane - High Wind Event

Description: High wind events can include hurricanes, tornadoes, "Nor'-Easters," downbursts and lightning/thunderstorm events.

Location: Hurricane events are more potentially damaging with increasing proximity to the coast. For this *Plan*, high-wind events were considered to have an equal chance of affecting any part of the Town of Greenland.

Extent: Greenland is located within a Zone II hurricane-susceptible region (indicating a design wind speed of 160 mph)[5]. Between 1900 and 1996 2 hurricanes have made landfall in New Hampshire, a category 1 and a category 2. In Maine, 5 hurricanes have made landfall (all category 1). In Massachusetts, 6 hurricanes have made landfall (2 category 1, 2 category 2 and 2 category 3). From this information it can be extrapolated that Greenland is a high risk to a hurricane event, with variable wind speeds between 74 – 130 mph (category 1-3).

From 1950 to 1995 Rockingham County was subject to 9 recorded tornado events, these included 2 type F0 (Gale Tornado, 40-72 mph), 2 type F1 (Moderate Tornado, 73-112 mph), 4 type F2 (Significant Tornado, 113-157 mph) and 1 type F3 (Severe Tornado, 158-206 mph)[6]. Type 3 tornados can cause severe damage including tearing the roofs and walls from well-constructed homes, trees can be uprooted, trains over-turned, and cars lifted off the ground and thrown[7].

Probability: **HIGH**. The State of New Hampshire's Natural Hazards Mitigation Plan rates Rockingham County with high likelihood of hurricane, tornado and "Nor'-Easters" events. Also, it rates the risk of downbursts, lightning and hail events as moderate.

[5] "Understanding Your Risks, Identifying Hazards and Estimating Losses", FEMA, page
[6] The tornado project .com
[7] "Understanding Your Risks, Identifying Hazards and Estimating Losses", FEMA, page

Past Occurrence: Between 1635 and 1991, 10 hurricanes have impacted the State of New Hampshire. The worst of these occurred on September 21, 1938, with wind speeds of up to 186 mph in MA and 138mph elsewhere. Thirteen of 494 people killed by this storm were residents of New Hampshire. The Storm caused $12,337,643 in damages (1938 dollars), timber not included.

Rockingham County tornado history is as follows: Category F0 tornados occurred on Oct. 03, 1970 and June 09, 1978. Category F1 tornados occurred on July 31, 1954 and July 26, 1966. Category F2 tornados occurred on Aug. 21, 1951, June 19, 1957, July 02, 1961 and June 09, 1963. The category F3 tornado occurred on June 09, 1953.

Community Vulnerability:

- Power lines,
- Communications lines,
- Shingled roofs,
- Chimneys, and
- Trees

Severe Winter Weather

Description: There are three types of winter events**:** blizzards, ice storms and extreme cold. All of these events are a threat to the community with subzero temperatures from extreme wind chill and storms causing low visibility for commuters. Snow storms have been known to collapse buildings. Ice storms disrupt power and communication services. Extreme cold affects the elderly.

Location: Severe winter weather events have an equal chance of affecting any part of the Town of Greenland.

Extent: Large snow events in Southeastern New Hampshire can produce 30 inches of snow, or more. Portions of central New Hampshire recorded snowfalls of 98" during one slow moving storm in February of 1969. Ice storms occur with regularity in New England. Seven severe ice storms have been recorded that affected New Hampshire since 1929. These events caused disruption of transportation, loss of power and millions of dollars in damage.

Probability: **HIGH**. The State of New Hampshire's Natural Hazards Mitigation Plan rates Rockingham County with high likelihood of heavy snows and ice storms.

Past Occurrence: A list of past winter storm events is displayed below, in Table 3.

Community Vulnerability:

- Power lines
- Communications lines,
- Trees
- Elderly Populations

Wildfire

Description: Wildfires include grass fires and forest fires.

Location: The Committee identified wooded of Town as at-risk to wildfires (see Map 2: Past and Future Hazards).

Extent: A wildfire in the Town of Greenland is unlikely, but if a crown fire were to occur it could be very damaging to structures abutting large wooded areas of Town.

Probability: **MODERATE**. The State of New Hampshire's Natural Hazards Mitigation Plan rates Rockingham County with moderate risk to wildfires.

Past Occurrence: Large wildfires have not occurred recently in Greenland. An area identified by the Committee was along the railroad tracks; where in the past passing trains have sparked small brush fires.

Community Vulnerability:

- Structures located near large open vegetated areas prone to lightning strike
- Vulnerability increases during drought events

Earthquake

Description: Seismic activity including landslides and other geologic hazards.

Location: An earthquake has an equal chance of affecting all areas in the Town of Greenland.

Extent: New England is particularly vulnerable to the injury of its inhabitants and structural damage because of our built environment. Few New England States currently include seismic design in their building codes. Massachusetts introduced earthquake design requirements into their building code in 1975 and Connecticut very recently did so. However, these specifications are for new buildings, or very significantly modified existing buildings only. Existing buildings, bridges, water supply lines, electrical power lines and facilities, etc. have rarely been designed for earthquake forces (New Hampshire has no such code specifications).

Probability: **MODERATE**. The State of New Hampshire's Natural Hazard Mitigation Plan ranks all of the Counties in the State with at moderate risk to earthquakes. The Town of Greenland's Peak Ground Acceleration (PGA) values range between 6.1 and 21.0[8]. These numbers are associated with how much an earthquake is felt and how much damage it may cause (Table 2).

Table 2: Peak Ground acceleration (PGA) values for Greenland (information from State and Local Mitigation Planning, FEMA).

PGA	Chance of being exceeded in the next 50 years	Perceived Shaking	Potential Damage
6.1	10%	Moderate	Very Light
10.6	5%	Strong	Light
21.0	2%	Very Strong	Moderate

[8] http://geohazards.cr.usgs.gov/eq/pubmaps/us.pga.050.map.gif

Past Occurrence: Large earthquakes have not affected the Town of Greenland within recent memory. A list of earthquakes that have affected the region is displayed in Table 3.

Community Vulnerability:

- Dams,
- Bridges,
- Brick Structures,
- Infrastructure,
- Water and Gas lines, and
- Secondary hazards such as fire, power outages, or hazardous material leak or spill.

Radon

Description: Radon is a naturally occurring radioactive gas. Exposure to radon has been found to be carcinogenic (cancer causing). Radon is released from some types of granite found in New Hampshire. The gas can build up in unventilated basements and have harmful effects on residents over time.

Location: Because some granite may emit radon and some won't, it is difficult to determine a location that radon is more or less likely to occur. Because of this all areas of Greenland are considered at equal risk.

Extent: Exposure to radon is estimated by the EPA (Environmental Protection Agency) to cause 13,600 deaths in the United States each year. The State of New Hampshire's Hazard Mitigation Plan states that 1 in 3 New Hampshire households have radon levels that exceed the EPA level of safety.

Probability: **MODERATE**. The State of New Hampshire's Natural Hazard Mitigation Plan ranks all of the Counties in the State with at moderate risk to Radon.

Past Occurrence: No individual homes were identified as at risk to radon. It is certain that radon does affect many of the homes in Greenland to some extent, but no known cases of cases of cancer have been linked to radon exposure in Greenland.

Community Vulnerability:

- Unventilated living spaces in basements or in the lowest level of a home.
- New subdivisions where granite ledge was excavated to create new house lots

Table 3: Past Hazard Events in Greenland and Rockingham County

Hazard	Date	Location	Critical Facility or Area Impacted	Remarks/Description
Flood	March 11-21, 1936	Statewide	$133,000,000 in damage throughout New England, 77,000 homeless.	Double Flood; snowmelt/heavy rain.
Flood	September 21, 1938	Statewide	Unknown	Hurricane; stream stage similar to March 1936
Flood	July 1986 – August 10, 1986	Statewide	Unknown	**FEMA DR-771-NH**: Severe storms; heavy rain, tornadoes , flash flood, severe wind

Hazard	Date	Location	Critical Facility or Area Impacted	Remarks/Description
Flood	August 7-11 1990	Statewide	Road Network	**FEMA DR-876-NH**: A series of storms with moderate to heavy rains; widespread flooding.
Flood	August 19, 1991	Statewide, Primarily Rockingham and Strafford Counties	Road Network	**FEMA DR-917-NH:** Hurricane Bob; effects felt statewide; counties to east hardest hit.
Flood	October 28, 1996	Rockingham County	Unknown - Typically structures and infrastructure in the floodplain	North and west regions; severe storms.
Flood	June – July 1998	Rockingham County	Heavy damage to secondary roads occurred	**FEMA DR-1231-NH:** A series of rainfall events
Hurricane	October 18,19 1778	Portions of State	Unknown	40-75 mph winds
Hurricane	1804	Portions of State	Unknown	
Hurricane	September 8, 1869	Portions of State	Unknown	> 50 mph winds
Great Hurricane Of 1938	September 21, 1938	All of Southern New England	2 billion board feet of timber destroyed; electric and telephone disrupted, structures damaged, flooding; statewide 1,363 families received assistance.	Max. wind speed of 186 mph in MA and 138mph max. elsewhere 13 of 494 dead in NH; $12,337,643 total storm losses (1938 dollars), timber not included.
Hurricane Carol	August 31, 1954	Southern New England	Extensive tree and crop damage in state.	SAFFIR/SIMPSON HURRICANE SCALE[9] - Category 3, winds 111-130 mph
Hurricane Donna	September 12, 1960	Southern and Central NH	Unknown	Category 3 Heavy Flooding
Hurricane Belle	August 10, 1976	Southern New England	Unknown	Category 1, winds 74-95 mph Rain and flooding in NH
Hurricane Gloria	September 27, 1985	Southern New England	Unknown	Category 2, winds 96-110 mph >70 mph winds; minor wind damage and
Tropical Storm Floyd	September 16-18 1999	Statewide	Unknown	
Ice Jam	Feb 29, 2000	Brentwood, NH Exeter River	Unknown	Discharge 570 cfs

[9] For a complete description of the Saffir/Simpson Hurricane Scale see Appendix C.

Hazard	Date	Location	Critical Facility or Area Impacted	Remarks/Description
Ice Jam	Mar 29, 1993	Epping, NH Lamprey River	Road flooding	
Tornado	May 21, 1814	Rockingham County	Unknown	F2[10]
Tornado	May 16, 1890	Rockingham County	Unknown	F2
Tornado	August 21, 1951	Rockingham County	Unknown	F2
Tornado	June 9, 1953	Rockingham County	Unknown	F3
Tornado	June 19, 1957	Rockingham County	Unknown	F2
Tornado	July 2, 1961	Rockingham County	Unknown	F2
Tornado	June 9, 1963	Rockingham County	Unknown	F2
Downburst	August, 1991	Stratham, NH	Five fatalities and eleven injuries. Major tree damage, power outages	Microburst $2,498,974 in damages
Ice Storm	December 17-20 1929	NH	Telephone, telegraph and power disrupted.	
Ice Storm	December 29-30 1942	NH	Unknown- Typically damage to overhead wires and trees.	Glaze storm; severe intensity
Ice Storm	December 22 1969	Parts of NH	Power disruption	Many communities affected
Ice Storm	January 17, 1970	Parts of NH	Power disruption	Many communities affected
Ice Storm	January 8-25 1979	NH	Major disruption of Power and transportation	
Ice Storm	March 3-6 1991	Southern NH	Numerous power outages in southern NH	Numerous in Southern NH
Ice Storm	January 7, 1998	Rockingham County	Power and phone disrupted, communication tower collapsed.	$17,000,000 in damages to PSNH equipment.
Snowstorm	February 4-7 1920	New England	Disrupt transportation for weeks	Boston 37-50cm of sleet , ice and snow
Snowstorm	February 15, 1940	New England	Paralyzed New England	30cm of snow with high wind.

[10] For a complete description of the Fujita Tornado Damage Scale see Appendix D

Hazard	Date	Location	Critical Facility or Area Impacted	Remarks/Description
Snowstorm	February 14-17 1958	Southern NH	Unknown	20-33" of snow
Snowstorm	March 18-21 1958	South central NH	Unknown	22-24"of snow
Snowstorm	March 2-5 1950	Southern NH	Unknown	25"of snow
Snowstorm	January 18-20 1961	Southern NH	Unknown	Blizzard Conditions; 50cm of snow
Snowstorm	February 8-10 1969	Southeastern NH	Paralyzing snow	27"of snow and high winds
Snowstorm	February 22-28 1969	Central NH	Unknown	34-98"of snow; very slow moving
Snowstorm "Blizzard of'78"	February 5-7 1978	Statewide	Trapped commuters on highways, businesses closed	Hurricane force winds; 25-33"of snow. People disregard warnings due to a series of missed forecasts
Snowstorm	April 5-7 1982	Southern NH	Unknown	Late season with thunderstorms and 18-22" of snow
Earthquake	November 18, 1929	Grand Banks Newfoundland	No damage	Richter Magnitude Scale: 7.2[11]
Earthquake	December 20, 1940	Ossipee	Ground Cracks and damage over a broad area	Richter Magnitude Scale: 5.5; Felt over 341 miles away.
Earthquake	December 24, 1940	Ossipee	Ground Cracks and damage over a broad area	Richter Magnitude Scale: 5.5; Felt over 550 KM away.
Earthquake	June 15, 1973	Quebec/NH border	Minor damage	Richter Magnitude Scale: 4.8
Earthquake	June 19, 1982	West of Laconia	Little damage	Richter Magnitude Scale: 4.5
Drought	1929-36	Statewide	Unknown	Regional
Drought	1939-44	Statewide	Unknown	Severe in southeast NH
Drought	1947-50	Statewide	Unknown	Moderate
Drought	1960-69	Statewide	Unknown	Longest recorded continuous period of below normal precipitation
Drought Warning	June 6, 1999	Most of State	Unknown	Governors office declaration; Palmer Drought Survey Index indicate "moderate drought" for most of state.

[11] For a complete description of the Richter Magnitude Scale see Appendix E.

CHAPTER IV – CRITICAL FACILITIES

The Critical Facilities List for the Town of Greenland has been identified by Greenland's Hazard Mitigation Committee. The Critical Facilities List has been broken up into four categories. The *first category* contains facilities needed for Emergency Response in the event of a disaster. The *second category* contains Non-Emergency Response Facilities that have been identified by the committee as non-essential. These are not required in an emergency response event, but are considered essential for the everyday operation of Greenland. The *third category* contains Facilities/Populations that the committee wishes to protect in the event of a disaster. The *fourth category* contains Potential Resources, which can provide services or supplies in the event of a disaster. Map 3: Critical Facilities at the end of this Chapter identifies the location of the facilities and the evacuation routes. A detailed list of critical facilities can be found in Table 4.

Table 4: Category 1 - Emergency Response Services and Facilities:
Facilities that may be utilized in to respond to a hazard event

Critical Facility	Comments
Town Office	
Police Station	
Fire Station	
Seabrook Siren (x4)	

Table 4: Category 2- Essential Facilities:
Facilities essential to the day-to-day functioning of Greenland

Critical Facility	Comments
Greenland Community Church	
Greenland Library	
Parish House	
Post Office	
Veteran's Hall	
Verizon Service box	
PSNH sub-station	
Bauer/ Nike	
Novell Iron	
New England Homes	
Seacoast VW	
Drehr. Halloway Mercedes	
Portsmouth Country Club	
Tran's Warehouse	
Portsmouth Well	
Bethany Church	
Ocean Rd. Overpass (I-95)	

Critical Facility	Comments
Breakfast Hill Overpass (I-95)	
Bramber Valley Golf	
Breakfast Hill Golf Club	
Dam	
Golf Club of New England	
United Church	
Train Trestle over Winnicut	
Discovery Center	
Cell Tower, Nextel	
Cell Tower, T-mobile	
Transfer Station	
McDonalds	
Autumn Pond Park	
Golf and Ski	
Piscataqua Trucking	

Table 4: Category 3 - Facilities/Populations to protect or account for during a hazard event:

Critical Facility	Comments
New Generation Day care	
Central School (K-8)	
Cumberland Farms (Gas)	
H & H Gas Station	
TA Truck Stop	
Amerigas	
Biospray	
Weeks House	
YMCA Day camp/day care	
LP Gas Line Valve (x2)	
Daycare, Coastal Ave.	
TA Culvert Under 95	
Day Care (Ports Ave)	

Table 4: Category 4 – Potential Resources in the event of a Natural Hazard:

Critical Facility	Comments
Cumberland Farms	
TA Truck Stop	
Suds and Soda	

CHAPTER V – POTENTIAL HAZARD AFFECTS

IDENTIFYING VULNERABLE FACILITIES

It is important to determine what the most vulnerable areas of the Town of Greenland are and to estimate their potential loss. The first step is to identify the areas most likely to be damaged in a hazard event. To do this, the locations of buildings and other structures were compared to the location of potential hazard areas identified by the Hazard Mitigation Committee using GIS (Geographic Information Systems). Vulnerable buildings were identified by comparing their location to possible hazard events. For example, all of the structures within the 100-year floodplain were identified and used in conducting the potential loss analysis for flooding.

CALCULATING THE POTENTIAL LOSS

The next step in completing the loss estimation involved assessing the level of damage from a hazard event as a percentage of the buildings' assessed value. The assessed value for every parcel in Greenland was provided for the purpose of calculating damage estimates. The damage estimates are divided into two categories based on hazard types: hazards that are location specific (e.g. flooding), and hazards that could affect all areas of Greenland equally. Damage estimates from hazards that could affect all of Greenland equally are much rougher estimates, based on percentages of the total assessed value of structures and utilities in Greenland. Damage estimates from hazard with a specific location are derived from the assessed values of each parcel that had its center in the hazard area in question. Greenland's Parcel database (with assessor's data) was queried using the GIS to determine the assessed value of all of the parcels within a hazard area.

After identifying the parcels and buildings that are at risk, the next step was to calculate a damage estimate for each potential hazard area. FEMA provides a model for estimating damage for various flooding events, so the flood damage estimates provide information including: damage estimates for structures, contents of buildings, functional downtime and replacement time. For wildfire and urban conflagration, damage estimates were determined for the buildings in the potential hazard areas as well as estimates of the building content value, based on the same estimates from the flood model. The following discussion summarizes the potential loss estimates due to natural hazard events.

Flooding

Flooding is often associated with hurricanes, rapid snow melt in the spring and heavy rains.

The average replacement value was calculated by adding up the assessed values of all structures in the 100 and 500 year floodplains. These structures were identified by overlaying digital versions of FEMA's FIRM maps on digital aerial photography of the Town of Greenland. Because of the scale and resolution of the FIRM maps and imagery this is only an approximation of the total structures located within the 100 and floodplain (A-zone and AE-zone). The Federal Emergency Management Agency (FEMA) has developed a process to calculate potential loss for structures during flood. The potential loss was calculated by multiplying the replacement value by the percent of damage expected from the hazard event. Residential and non-residential structures were combined. The costs for repairing or replacing bridges, railroads, power lines, telephone lines, and contents of structures are not included in this estimate. In addition, the figures used were based on buildings which are one or two stories high with basements. The percentage of structural damage and contents damage that could be expected for each flood depth is shown in Table 5, along with estimates of functional downtime (how long a business/residence would be down before relocating) and displacement time (how long a business/residence would be displaced from its flooded location).

The following calculation is based on **eight-foot flooding** and assumes that, on average, one or two story buildings with basements receive 49% damage (Understanding Your Risks, Identifying Hazards and Estimating Losses, FEMA page 4-13):

Potential Structure Damage: 49%
Approximately 49 structures in the AE Zone assessed at $13,672,000 = $6,699,280 potential damage
Approximately 25 structures in the A Zone assessed at $4,636,000 = $2,271,640 potential damage
Approximately 47 structures in the locally identified flood area assessed at $3,374,000 = $1,653,260 potential damage

The following calculation is based on **four-foot flooding** and assumes that, on average, one or two story buildings with basements receive 28% damage:

Potential Structure Damage: 28%
Approximately 49 structures in the AE Zone assessed at $13,672,000 = $3,828,160 potential damage
Approximately 25 structures in the A Zone assessed at $4,636,000 = $1,298,080 potential damage
Approximately 47 structures in the locally identified flood area assessed at $3,374,000 = $944,720 potential damage

The following calculation is based on **two-foot flooding** and assumes that, on average, one or two story buildings with basements receive 20% damage (Understanding Your Risks, Identifying Hazards and Estimating Losses, FEMA page 4-13):

Potential Structure Damage: 20%
Approximately 49 structures in the AE Zone assessed at $13,672,000 = $2,734,400 potential damage
Approximately 25 structures in the A Zone assessed at $4,636,000 = $927,200 potential damage
Approximately 47 structures in the locally identified flood area assessed at $3,374,000 = $647,000 potential damage

Table 5: Percentages of structural and content damage, based on the assessed value of a flooded parcel. Also shows the functional downtime and displacement time for each flood event.

Flood Depth	One-foot	Two-foot	Four-foot
% Structural Damage: Buildings	15%	20%	28%
% Structural Damage: Mobile Homes	44%	63%	78%
% Contents Damage: Buildings	22.5%	30%	42%
% Contents Damage: Mobile Homes	30%	90%	90%
Flood Functional Downtime: Buildings	15 days	20 days	28 days
Flood Functional Downtime: Mobile Homes	30 days	30 days	30 days
Flood Displacement Time: Buildings	70 days	110 days	174 days
Flood Displacement Time: Mobile Homes	302 days	365 days	365 days

~Dam Breach and Failure

Dam breach and failure could impact Greenland through flooding. Potential losses will depend on the extent of the breach and would mostly affect residential structures. There is one dam in Greenland, NH, that could cause damage to residents and/or infrastructure which is located on the Winnicut River, near where the River passes under Route 33. This Dam has a hazard class of A, which indicates low hazard risk.[12] Damage estimates for dam breech would be as follows:

> Approximately 12 structures in the locally identified dam breech flood area assessed at $4,086,600 = $817,320 potential damage for a two foot flood (20% structural damage)

~Storm Surge

Storm Surge could affect approximately 62 structures with a total value of $20,336,300. Using the same flood damage assumptions for this type of the flooding as were made above the damage estimates would be as follows:

> 8-foot flood (49% damage to structures) = $9,964,787 potential damage
> 4-foot flood (28% damage to structures) = $5,694,164 potential damage
> 2-foot flood (20% damage to structures) = $4,067,260 potential damage

[12] www.**dam**safety.org/documents/pdf/NH.pdf

Hurricane/ High Wind Events

~Hurricane

Hurricanes do affect the Northeast coast periodically. Since 1900, 2 hurricanes have made landfall in the State of New Hampshire. Due to the coastal location of the Town of Greenland, hurricanes and storm surges present a real hazard to the community. Even degraded hurricanes or tropical storms could still cause significant damage to the structures and infrastructure of the Town of Greenland. The assessed value of all residential and commercial structures in the Town of Greenland, including exempt structures such as schools and churches, and utilities is $257,594,142 (Assuming 1% to 5% damage, a hurricane could result in $2,575,941to $12,879,707 of structure damage.

~Tornado

Tornadoes are relatively uncommon natural hazards in New Hampshire. On average, about six touch down each year. Damage largely depends on where the tornado strikes. If is strikes an inhabited area, the impact could be severe. The assessed value of all residential and commercial structures in the Town of Greenland including exempt structures such as schools and churches, and utilities is $257,594,142 (Assuming 1% to 5% damage, a tornado could result in $2,575,941to $12,879,707 of structure damage.

~Severe Lightning

The amount of damage caused by lightning will vary according to the type of structure hit and the type of contents inside. There is now record of monetary damages inflicted in the Town of Greenland from lightning strikes.

Severe Winter Weather

~Heavy Snowstorms

Heavy snowstorms typically occur during January and February. New England usually experiences at least one or two heavy snow storms with varying degrees of severity each year. Power outages, extreme cold and impacts to infrastructure are all effects of winter storms that have been felt in Greenland in the past. All of these impacts are a risk to the community, including isolation, especially of the elderly, and increased traffic accidents. Damage caused as a result of this type of hazard varies according to wind velocity, snow accumulation and duration. Heavy snowstorms in Greenland could be expected to cause damage ranging from a few thousand dollars to several million, depending on the severity of the storm.

~Ice Storms

Ice storms often cause widespread power outages by downing power lines, making power lines at risk in Greenland. They can also cause severe damage to trees. In 1998, an ice storm inflicted $12,466,202 worth of damage to New Hampshire as a whole. Ice storms in Greenland could be expected to cause damage ranging from a few thousand dollars to several million, depending on the severity of the storm.

Wildfire

Wildfires have not damaged homes in Greenland in recent memory. Due to the ability and coordination of the emergency response services in Greenland and the surrounding Towns, a catastrophic wildfire is highly unlikely. In an extreme drought year the potential would increase for a severe fire that could damage homes. If a fire were to occur in a drought year it would still be rapidly contained but still has the potential to destroy a number of homes. Single family homes of wood-frame construction would be at the highest risk. Damage estimates would be the number of homes destroyed multiplied by the average assessed value, of the residential structures which is $207,794.

Earthquakes

Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and phone lines and are often associated with landslides and flash floods. Four earthquakes in New Hampshire between 1924-1989 had a magnitude of 4.2 or more. Two of these occurred in Ossipee, one west of Laconia, and one near the Quebec border. If an earthquake were to impact the Town of Greenland, underground lines would be susceptible. In addition, buildings that are not built to a high seismic design level would be susceptible to structural damage. The assessed value of all residential and commercial structures in Greenland, including exempt structures such as schools and churches, and utilities is $257,594,142 Based on Table 9 below, an earthquake could cause a range of damage depending on the construction and materials used to build the structures. Making the assumption that all of the structures in Greenland are single family homes built Pre-code, and wood frame construction, an earthquake could result in $1,030,376 of damage for a 0.07 PGA earthquake to $8,500,606 of damage for a 0.20 PGA earthquake.

Table 6: Earthquake Damage and Loss of Function Table. Building Damage and Functional Loss are based on the type of Structure and the PGA (g). Two PGA (Peak Ground Acceleration) were chosen for this Table, 0.07 and 0.20 which represent a low and high example of potential earthquake in Greenland, NH.

		Wood Frame Construction				**Reinforced Masonry**				**Unreinforced Masonry**	
PGA (g)		High	Mod.	Low	Precode	High	Mod.	Low	Precode	Low	Precode
0.07	**Single Family**	**0.1**	**0.2**	**0.3**	**0.4**	**0.1**	**0.2**	**0.4**	**0.5**	**0.6**	**1.0**
0.20		**1.3**	**1.7**	**2.8**	**3.3**	**1.3**	**2.5**	**6.1**	**9.0**	**6.5**	**9.4**
0.07		0	0	1	1	0	1	2	7	6	12
0.20		2	3	9	15	4	16	58	106	64	114
0.07	**Apartment**	**0.1**	**0.2**	**0.3**	**0.3**	**0.1**	**0.2**	**0.4**	**0.5**	**0.6**	**0.8**
0.20		**1.5**	**1.9**	**3.0**	**3.2**	**1.5**	**2.6**	**5.4**	**6.9**	**5.5**	**7.5**
0.07		0	0	1	1	0	1	2	8	7	13
0.20		2	3	10	16	4	19	72	129	76	147
		Steel Frame (Braced)				**Reinforced Masonry**				**Unreinforced Masonry**	
		High	Mod.	Low	Precode	High	Mod.	Low	Precode	Low	Precode
0.7	**Retail Trade**	**0.2**	**0.3**	**0.4**	**0.5**	**0.1**	**0.2**	**0.4**	**0.6**	**0.7**	**1.0**
0.20		**2.4**	**2.8**	**3.8**	**5.6**	**1.5**	**2.7**	**5.9**	**8.3**	**6.1**	**8.7**
0.07		0	0	0	0	0	0	0	1	1	2
0.20		2	3	6	12	1	3	12	22	14	24
		Pre-Cast Concrete Tilt-up				**Light Metal Building**					
		High	Mod.	Low	Precode	High	Mod.	Low	Precode		
0.07	**Wholesale Trade**	**0.2**	**0.4**	**0.5**	**0.6**	**0.4**	**0.7**	**1.0**	**1.6**		
0.20		**2.6**	**4.1**	**8.3**	**10.8**	**3.8**	**5.4**	**10.3**	**14.8**		

0.07		0	1	1	2	1	2	3	6		
0.20		4	8	22	36	6	13	28	43		
0.07	**Office Building**	**0.2**	**0.3**	**0.4**	**0.6**	**0.2**	**0.3**	**0.4**	**0.5**		
0.20		**2.0**	**2.9**	**5.6**	**8.1**	**2.5**	**2.9**	**3.7**	**5.2**		
0.07		0	0	0	1	0	0	0	1		
0.20		1	3	11	21	2	3	5	11		
		Pre-cast Concrete Tilt-up									
		High	Mod.	Low	Precode						
0.07	**Light Industrial**	**0.1**	**0.4**	**0.4**	**0.5**						
0.20		**2.6**	**3.9**	**6.0**	**7.4**						
0.07		0	1	1	2						
0.20		4	7	21	34						

2.0	Building Damage = % of damage based on value
2	Loss of Function (# of Days)
	No Information

High, Moderate, Low and Precode refer to general seismic design level

CHAPTER VI – EXISTING HAZARD MITIGATION ACTIONS

This section identifies those programs that are currently in place as hazard mitigation actions or strategies for the Town of Greenland, NH. The table below (Table 7), displays existing ordinance, regulations, plans and Town departments that plan for, or react to, natural hazards to mitigate possible damage.

Table 7: Existing Hazard Mitigation actions

Existing Protection	Protections Provided and Additional Comments
Building Codes	Protect against high winds and winter storms.
Zoning Ordinances	Wetland setbacks, Floodplain building requirements, and aquifer protection district
Subdivision and Site Plan Regulations	Storm drainage and erosion control plans are required
Seabrook Radiological Plan	Frequent training and drills occur in a coordinated effort with the State.
Tree Maintenance	Trees in the Town's right of way are maintained to prevent hazardous situations from falling limbs or trees
Back-up Power	Back-up power is in place for the Town Offices and Fire Station
School Emergency Plan	Disaster evacuation plans are in place for the local schools
Hazardous Materials Team	A team trained to deal with hazardous materials. Response equipment is located in Exeter and Hampton, New Hampshire
Mutual Aid Agreements	Police and fire departments have mutual aid agreements with surrounding Towns
Shoreland Protection Act	Various levels of Protection provided when development occurs near the Great Bay of other large waterways.
Wellhead Protection	Wellhead protection districts exist around municipal well in the Town of Greenland that are owned by the City of Portsmouth
Best Management Practices	Best Management practices are employed to reduce erosion and siltation during development
Hazardous Material Survey	Trucks carrying hazardous materials were identified and logged to determine what materials were generally traveling through the Town of Greenland, during a two month period.
Interstate Emergency Response	40+ town with mutual aid agreement to deal with disaster along Interstate 95

CHAPTER VII – POTENTIAL MITIGATION ACTIONS

POTENTIAL MITIGATION STRATEGIES

The Action Plan was developed by analyzing the existing Town programs, the proposed improvements and changes to these programs. Additional programs were also identified as potential mitigation strategies. These potential mitigation strategies were ranked in five categories according to how they accomplished each item:

- Prevention
- Property Protection
- Structural Protection
- Emergency Services
- Public Information and Involvement

The Committee brainstormed a list of strategies and actions that could be taken to mitigation future hazards are compiled in Table 8. Following the table is a summary of each proposed strategy or action.

Table 8: Potential Mitigation Actions

Mitigation Strategies or Action	Hazard(s) Mitigated
Generator for the school	All Hazards
Generator for the police station	All Hazards
Update the Emergency Action Plan	All Hazards requiring emergency response
Become involved in fire prevention week	Wildfire
Radon education (hand-outs and/or the website)	Radon
New Fire House	Wild Fire, All Hazards
Move EOC to the Police Station (2nd floor)	All Hazards requiring use of Emergency Operations Center
Radio tower update (currently not fully covered)	All Hazards
Cots for the Shelter	All Hazards requiring use of a shelter
Culvert on Packard Brook (by old train station)	Flooding
Review Building Codes to insure adequate compliance for wind speed.	High Wind Events
Review Zoning, Subdivision and Site Plan Regulations for vegetation setback and fire protection requirements and determine if more is required	Wildfire
Earthquake proof Primary Shelter	Earthquake
Establish a tree warden for the Town	High Wind events, Ice Storms, Wildfire
Inspect Railroad tracks near Discovery Center	Possible train accident
Training for Radio Dispatch personal to use Sirens	All Hazards
Public Education for supplies to have on hand for emergency preparedness	All Hazards
Survey Town residents to obtain voluntary special needs information	All Hazards that could affect vulnerable populations
Investigate extending mutual aid for Coastal Storms	High wind events, Flooding
Identify HAM radio operators in Town	Winter Storms, All Hazards

CHAPTER VIII – PRIORITIZATION OF MITIGATION ACTIONS

The goal of each strategy or action is reduction or prevention of damage from a hazard event. In order to determine their effectiveness in accomplishing this goal, a set of criteria was applied to each proposed strategy. A set of questions developed by the Committee that included the STAPLEE method was developed to rank the proposed mitigation actions. The STAPLEE method analyzes the Social, Technical, Administrative, Political, Legal, Economic and Environmental aspects of a project and is commonly used by public administration officials and planners for making planning decisions. The following questions were asked about the proposed mitigation strategies identified in Table 8:

STAPLEE criteria:

- **Social**: Is the proposed strategy socially acceptable to the community? Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- **Technical**: Will the proposed strategy work? Will it create more problems than it solves?
- **Administrative**: Can the community implement the strategy? Is there someone to coordinate and lead the effort?
- **Political**: Is the strategy politically acceptable? Is there public support both to implement and to maintain the project?
- **Legal**: Is the community authorized to implement the proposed strategy? Is there a clear legal basis or precedent for this activity?
- **Economic**: What are the costs and benefits of this strategy? Does the cost seem reasonable for the size of the problem and the likely benefits?
- **Environmental**: How will the strategy impact the environment? Will the strategy need environmental regulatory approvals?

Each proposed mitigation strategy was evaluated using the above criteria and assigned a score (Good = 3, Average = 2, Poor = 1) based on the above criteria. An evaluation chart with total scores for each strategy can be found in the collection of individual tables under Table 9.

Table 9.1: Generator for the school

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.5
Score	**20.5**

Table 9.2: Generator for the Police Station

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.5
Score	**20.5**

Table 9.3: Update the Emergency Action Plan

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	2.75
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.75
Score	**20.5**

Table 9.4: Become involved in fire prevention week

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.75
P: Is it Politically acceptable?	2.75
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	2.75
E: Are other Environmental approvals required?	2.5
Score	**19.5**

Table 9.5: Radon education (hand-outs and/or the website)

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	2.5
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2.5
E: Are other Environmental approvals required?	2.25
Score	**18.5**

Table 9.6: New Fire House

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.75
T: Is it Technically feasible and potentially successful?	2.5
A: Is it Administratively workable?	2.25
P: Is it Politically acceptable?	2.5
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	2.5
E: Are other Environmental approvals required?	2
Score	**17.5**

Table 9.7: Move EOC to the Police Station (2nd floor)

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	2.75
E: Are other Environmental approvals required?	2.75
Score	**20.5**

Table 9.8: Radio tower update (currently not fully covered)

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.75
Score	**20.75**

Table 9.9: Cots for the Shelter

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	2.5
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	2.5
E: Are other Environmental approvals required?	2.5
Score	**18.75**

Table 9.10: Culvert on Packard Brook (by old train station)

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.25
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	2
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2
E: Are other Environmental approvals required?	2
Score	**16.25**

Table 9.11: Review Building Codes to insure adequate compliance for wind speed.

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.75
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.75
P: Is it Politically acceptable?	2.25
L: Is there Legal authority to implement?	2.5
E: Is it Economically beneficial?	2.25
E: Are other Environmental approvals required?	2.5
Score	**17.75**

Table 9.12: Review Zoning, Subdivision and Site Plan Regulations for vegetation setback and fire protection requirements and determine if more is required

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.5
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.75
P: Is it Politically acceptable?	2.25
L: Is there Legal authority to implement?	2.5
E: Is it Economically beneficial?	2.5
E: Are other Environmental approvals required?	2.75
Score	**18**

Table 9.13: Earthquake proof Primary Shelter

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	2.25
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	2.25
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2
E: Are other Environmental approvals required?	2.75
Score	**17.5**

Table 9.14: Establish a tree warden for the Town

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.75
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.25
P: Is it Politically acceptable?	2.5
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2.25
E: Are other Environmental approvals required?	2.25
Score	**17.5**

Table 9.15: Inspect Railroad tracks near Discovery Center

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	2.5
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	2.75
L: Is there Legal authority to implement?	2
E: Is it Economically beneficial?	2
E: Are other Environmental approvals required?	2
Score	**16.75**

Table 9.16: Training for emergency response personal to use Sirens

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.75
T: Is it Technically feasible and potentially successful?	2.75
A: Is it Administratively workable?	2.5
P: Is it Politically acceptable?	2.5
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	2.75
E: Are other Environmental approvals required?	2.5
Score	**18.75**

Table 9.17: Public Education for supplies to have on hand for emergency preparedness

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.5
Score	**20.5**

Table 9.18: Survey Town residents to obtain voluntary special needs information

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	2.5
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	2.75
P: Is it Politically acceptable?	2.5
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2.25
E: Are other Environmental approvals required?	2.25
Score	**18.5**

Table 9.19: Investigate extending mutual aid for Coastal Storms

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	2.75
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	2.75
E: Is it Economically beneficial?	2.75
E: Are other Environmental approvals required?	2.5
Score	**19.75**

Table 9.20: Identify HAM radio operators in Town

Criteria	Evaluation Rating (1-3)
S: Is it Socially acceptable?	3
T: Is it Technically feasible and potentially successful?	3
A: Is it Administratively workable?	3
P: Is it Politically acceptable?	3
L: Is there Legal authority to implement?	3
E: Is it Economically beneficial?	3
E: Are other Environmental approvals required?	2.5
Score	**20.5**

Each strategy was evaluated and prioritized according to the final score. The highest scoring strategies were determined to be of more importance, economically, socially, environmentally, and politically feasible and, hence, prioritized over those that were lower scoring.

CHAPTER IX – ACTION PLAN

This step involves developing an action plan that outlines who is responsible for implementing each of the prioritized strategies determined in the previous step, as well as when and how the actions will be implemented. The following questions were asked to develop an implementation schedule for the identified priority mitigation strategies:

WHO? Who will lead the implementation efforts? Who will put together funding requests and applications?

HOW? How will the community fund these projects? How will the community implement these projects? What resources will be needed to implement these projects?

WHEN? When will these actions be implemented, and in what order?

Table 10 is the Action Plan. In addition to the prioritized mitigation projects, the Action Plan includes the responsible party (WHO), how the project will be supported (HOW), and what the timeframe is for implementation of the project (WHEN).

Table 10: Action Plan for proposed mitigation actions

Score	Project	Responsibility/ Oversight	Funding/ Support	Estimated Cost	Timeframe
20.75	Radio tower update (currently not fully covered)	EMD, Police Chief, Fire Chief	Grants	200K	1 year
20.5	Generator for the school	EMD, School Board, Fire Chief	Grants	80K	1.5 years
20.5	Generator for the police station	EMD, School Board, Fire Chief	Grants	30K	1.5 years
20.5	Move EOC to the Police Station (2nd floor)	EMD, Police Chief, Board of Selectmen	Grants	250K	2 years
20.5	Update the Emergency Action Plan	EMD, Police Chief, Fire Chief	Grants	$5,000	1 year
20.5	Public Education for supplies to have on hand for emergency preparedness	EMD, Webmaster	Local	-	1 month
20.5	Identify HAM radio operators in Town	EMD, Fire Chief	Local	-	ongoing
20.25	Generators for the school and the police station	EMD, School Board, Fire Chief	Grants	80K	1.5 years
19.75	Investigate extending mutual aid for Coastal Storms	EMD, Police Chief	Local	-	1 year
19.5	Become involved in fire prevention week	Fire Chief	Local	-	1 year
18.75	Cots for the Shelter	EMD, School Board	Grants	10K	1.5 years
18.75	Training for Dispatch personal to use Sirens	EMD, Fire Chief	Local	-	6 months
18.5	Radon education (hand-outs and/or the website)	Health Officer, Webmaster	Local	-	1 year
18.5	Survey Town residents to obtain voluntary special needs information	EMD, Fire Chief	Local / Grants	$1,000	2 months

Score	Project	Responsibility/ Oversight	Funding/ Support	Estimated Cost	Timeframe
18	Review Zoning, Subdivision and Site Plan Regulations for vegetation setback and fire protection requirements and determine if more is required	Planning Board	Local	-	1 year
17.75	Review Building Codes to insure adequate compliance for wind speed.	Building Inspector	Local	-	1 year
17.5	New Fire House	Fire Chief, Planning Board	Grants	2,000,000	2 years
17.5	Earthquake proof Primary Shelter	EMD, School Board	Grants	500K	5 years
17.5	Establish a tree warden for the Town	Board of Selectmen, Building Inspector	Local	-	6 months
16.75	Inspect Railroad tracks near Discovery Center	EMD, Police Chief, Building Inspector	Local	-	1 year
16.25	Culvert on Packard Brook (by old train station)	Board of Selectmen	Grants / DOT	500K	3 years
N/A	Safeguard Community Records	Town Administrator, School Board	Local	-	2 years

CHAPTER X – INCORPORATING, MONITORING, EVALUATING AND UPDATING THE PLAN

Incorporating the Plan into Existing Planning Mechanisms

Upon completion and approval by FEMA and the State of New Hampshire, the *Plan* will be adopted as a stand alone document of the Town and as an appendix of the Town's Emergency Operations Plan (EOP). Future updates the EOP will incorporate the *Plan* as a referenced appendix, but the two plans will always be printed as separated documents. The EOP is subject to annual review.

The *Plan* will also be consulted when the Town updates its Capitol Improvement Program (CIP). The Planning Board is responsible for updating the CIP annually, and will review the Action Plan during each update. The Planning Board in conjunction with Greenland Emergency Management will determine what items can and should be added to the CIP based on the Town's annual budget and possible sources of other funding.

The *Plan* will also be referenced in any future update of the Greenland Master Plan. Portions of the *Plan* could be incorporated into a Natural Hazards Chapter of the Master Plan. It will also be the responsibility of the Planning Board to incorporate current and future strategies identified in the *Plan* into proposed zoning ordinances and updates to Town Subdivision and Site Plan Review Regulations.

Monitoring, Evaluating and Updating the Plan

Recognizing that many mitigation projects are ongoing, and that while in the implementation stage communities may suffer budget cuts, experience staff turnover, or projects may fail altogether, a good plan needs to provide for periodic monitoring and evaluation of its successes and failures and allow for updates of the *Plan* where necessary.

In order to track progress and update the Mitigation Strategies identified in the Action Plan (Table 10), it is recommended that the Town revisit the *Plan* annually, or after a hazard event. If it is not realistic or appropriate to revise the *Plan* every year, then the *Plan* will be revisited no less then every five years. The Emergency Management Director is responsible for initiating this review with members of the Town that are appropriate including members of the public. In keeping with the process of adopting the 2006 *Plan*, a public hearing to receive public comment on *Plan* maintenance and updating will be held during any review of the *Plan*. This publicly noticed meeting will allow for members of the community not involved in developing the *Plan* to provide input and comments each time the *Plan* is revised. The final revised *Plan* will be adopted by the Board of Selectmen appropriately, at a second publicly noticed meeting.

Changes should be made to the *Plan* to accommodate for projects that have failed or are not considered feasible after a review for their consistency with STAPLEE, the timeframe, the community's priorities, and funding resources. Priorities that were not ranked high, but identified as potential mitigation strategies, should be reviewed as well during the monitoring and update of this *Plan* to determine feasibility of future implementation.