APPENDIX A

HAZARD DEFINITIONS[1]

A. Flooding

Flooding is a temporary overflow of water onto lands not normally covered by water producing measurable property damage or forcing evacuation of people and vital resources. Floods frequently cause loss of life; property damage and destruction; damage and disruption of communications, transportation, electric service, and community services; crop and livestock damage and loss and interruption of business. Hazards of fire, health and transportation accidents and contamination of water supplies are likely effects of flooding situations.

There are several types of hazards that are related to flooding:

1. 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. The eye of the storm is usually 20-30 miles wide and may extend over 400 miles. The dangers of the storm include torrential rains, high winds and storm surges. It produces measurable damage from heavy rainfalls, winds, and floods.

High winds are a primary cause of hurricane-inflicted loss of life and property damage. Another cause is the flooding resulting from the coastal storm surge of the ocean and the torrential rains, both of which accompany the storm. A hurricane watch is issued when there is a threat of hurricane conditions within 24-36 hours. A hurricane warning is issued when hurricane conditions (winds greater than 74 mph/119 kph or dangerously high water and rough seas) are expected in 24 hours or less.

All areas of Exeter are potentially at risk if a hurricane reaches Rockingham County. Hurricanes are known to create widespread inland small stream and river flooding because of torrential rains.

2. 100-year Floodplain events

Properties within the 100-year floodplain (the area inundated by a 100-year flood)[2] are at a great risk during a natural disaster or event related to flooding. Steep topography and restricted riparian basin areas preclude large floodplains.

The areas that are most susceptible to the 100-year flood in Exeter are depicted in Map 4. The structures that are located within this area are at a greater risk than structures located upland of these areas. However, even people who do not live near water are susceptible to flooding. There are several homes in the 100-year floodplain that report flooding on a regular basis.

3. Debris-Impacted Infrastructure

Debris carried by floodwaters can significantly compromise the effectiveness of otherwise adequately designed bridges, dams, culverts, diverting structures, etc. Storm debris, and structures such as poorly designed snowmobile bridges, carried by floodwaters, may exacerbate a given flooding hazard by becoming obstructions to normal storm water flow[3].

All bridges, culverts and related roadways are vulnerable to this kind of hazard in Exeter.

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[1] Except where otherwise noted, The Northeast States Emergency Consortium (http://www.nesec.org/hazards/) was referenced for all of the definitions of the hazards common in Exeter, Rockingham County and New Hampshire.
[2] "Water in Environmental Planning." Thomas Dunne and Luna B. Leopold, 1978. pg. 428.
[3] John J. Shaughnessy, *State of New Hampshire Natural Hazards Mitigation Plan*.

4. Landslides

A landslide is the downward or outward movement of slope forming materials reacting under the force of gravity including: mudflows, mudslides, debris flows, rockslides, debris avalanches, debris slides and earth flows. Landslides may be formed when a layer of soil atop a slope becomes saturated by significant precipitation and slides along a more cohesive layer of soil or rock Areas of particular landslide hazard are found where steep hillsides intersect thin, permeable layers of earth that overlay impermeable (dense, silty, or clayey) sediment. These areas are commonly adjacent to old riverbeds or lakebeds[4]. Streambank erosion may also eventually result in landslides.

Much of the development in New Hampshire is along rivers or in these particularly senstive areas, making landslide events more likely. A variety of residential and commercial development has occurred along the waterways in Exeter, which can lead to landslides and/or erosion of banks.

5. Rapid Snow Pack Melt

The climate, mountainous terrain and riverine watersheds are susceptible to flooding which may be accelerated by moderate temperatures and moderate to heavy rains leading to seasonal rapid melting of snow pack. The upland areas may be exposed to flash flood incidents with associated erosion and deposition issues in, or near streambeds. Lower lying areas may experience either flash flooding or inundation events accelerated by the rapid melting of the snow pack[5].

Structures and improvements located on, along, or at the base of steep slopes are most vulnerable, as are structures in the 100-year and 500-year floodplains.

6. River Ice Jams

Ice forming in riverbeds and against structures presents significant hazardous conditions. Storm waters encounter these ice formations which may create temporary dams. These dams may create flooding conditions where none previously existed (*i.e.*, as a consequence of elevation in relation to normal floodplains). Additionally, the impact of the ice itself on structures such as highway and railroad bridges may apply pressure laterally and/or may lift these structures which may not be designed for such impacts[5].

Bridges, culverts, and related roadways, such as identified in the Critical Facilities Database and Map 3 are most vulnerable. The potential for river ice jams is greatest along the Exeter River.

7. Dam Breach and Failure

Dams function to serve the needs of flood control, recreation, wildlife enhancement and water resources management[5]. During severe weather events, such as a flood, a dam's ability to serve as a flood control mechanism may be challenged and could breach or fail. In this event, anything downstream of a dam is in danger.

The Town of Exeter contains four Class A dams and few unclassified (man-made and beaver dams). These dams existing have not poses any major threat to life and/or property.

B. Wind

The following kinds of hazards are related to wind:

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[4] "Water in Environmental Planning." Thomas Dunne and Luna B. Leopold, 1978. pg. 19.
[5] John J. Shaughnessy, *State of New Hampshire Natural Hazards Mitigation Plan*

1. Hurricanes

The definition of a Hurricane was discussed above. As it relates to wind hazards, damage resulting from hurrican gusts can be substantial, especially considering the duration of the event which may last for many hours[5]. In New England, hurricane season begins on June 1 and continues through the end of November. August and September are peak months during hurricane season.

Rockingham County has experienced high winds associated with hurricane events, but is at a more significant risk to flooding resulting from the rainfalls from hurricanes[7]. All areas of Exeter are potentially at risk if a hurricane reaches Rockingham County.

2. Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel shaped cloud. These events are spawned by thunderstorms and, occasionally by hurricanes, and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction[7].

Risk from Tornadoes is considered to be high in Rockingham County. The county has experienced five tornadic events rated F2 or greater between 1951 and 1963.

3. "Nor'-easters"

A Nor'easter is a 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.

New Hampshire generally experiences at least one or two of these events each year with varying degrees of severity. These storms have the potential to inflict more damage than many hurricanes because high winds can last from 12 hours to 3 days, while the duration of hurricanes ranges from 6 to 12 hours. Infrastructure, including critical facilities, may be impacted by these events, and power outages and transportation disruptions (*i.e.* snow and/or debris impacted roads, as well as hazards to navigation and aviation) are often associated with the event.

Severe winter storms typically occur during January and February, however, winter storms do occur from late September through late April. All areas of Exeter are potentially at risk for property damage and loss of life due to Nor'-easters.

4. Downbursts

A downburst is a severe localized wind blasting down from a thunderstorm. These 'straight line' winds are distinguishable from tornadic activity by the pattern of destruction and debris. Depending on the size and location of these events, the destruction to property may be devastating. Downbursts fall into two categories. Microbursts cover an area less than 2.5 miles in diameter, and macrobursts cover an area at least 2.5 miles in diameter.

All locations in Exeter are at risk for property damage and loss of life due to downbursts, especially those areas with heavy tree cover.

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[6] New Hampshire Office of Emergency Management: http://www.nhoem.state.nh.us/mitigation/

[7] John J. Shaughnessy, *State of New Hampshire Natural Hazards Mitigation Plan*

5. Lightning

During the development of a thunderstorm, the rapidly rising air within the cloud, combined with the movement of the precipitation within the cloud, causes electrical charges to build up within the cloud. Generally, positive charges build up near the top of the cloud, while negative charges build up near the bottom. Normally, the Earth's surface has a slight negative charge. However, as the negative charges build up near the base of the cloud, the ground beneath the cloud and the area surrounding the cloud becomes positively charged. As the cloud moves, these induced positive charges on the ground follow the cloud like a shadow. Lightning is a giant spark of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as and insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, there is a discharge of electricity that we know as lightning.

All areas of Exeter are potentially at risk for property damage and loss of life due to lightning. Areas that are heavily wooded as well as areas with large open spaces, which are susceptible to damage to due lightning strikes, have been identified as areas of concern on Map 3.

C. Wildfire

The following kinds of hazards have been identified related to wildfire:

1. Forest Fires and Grass Fires

Historically, large NH wildland fires run in roughly 50 year cycles. The increased incidence of large wildland fire activity in the late 1940s and early 1950s is thought to be associated, in part, with debris from the Hurricane of 1938. Significant woody 'fuel' was deposited in the forests during that event. Present concerns of New Hampshire Department of Resources and Economic Development, Division of Forests & Lands are that the Ice Storm of 1998 has left a significant amount of woody debris in the forests of the region as may fuel future wildfires[8].

Wildfire season usually begins in March in coastal and southern sections, gradually extending to central, western and northern areas. The wildfire season usually ends in late November. The majority of wildfires usually occur in April and May, when the majority of vegetation is void of any appreciable moisture making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat..

Significant areas of Exeter and surrounding Towns are forested and are susceptible to wildfires. These areas are identified Map 3 of the Critical Facilities and Areas of Concern.

D. Ice & Snow Events

The following kinds of hazards are related to ice and snow:

1. Heavy Snow Storms

A winter storm can range from moderate snow to blizzard conditions. 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. According to the official definition given in 1958 by the U.S. Weather Bureau, the winds must exceed 35 miles per hour and the temperature must drop to 20° F (-7° C) or lower. All winter storms make walking and driving extremely dangerous.

All areas of Exeter are susceptible to heavy snow storms.

[8] John J. Shaughnessy, *State of New Hampshire Natural Hazards Mitigation Plan*

2. Blizzards

Intense Nor'-easters which occur in the winter months are often referred to as blizzards. A Blizzard is a snowstorm with sustained winds of 40 miles per hour (mph) or more or gusting up to at least 50 mph with heavy falling or blowing snow, persisting for one hour or more, temperatures of ten degrees fahrenheit or colder and potentially life-threatening traveling conditions. The definition includes the conditions under which dry snow, which has previously fallen, is whipped into the air and creates a diminution of visual range. Such conditions, when extreme enough, are called 'white outs'.

All areas of Exeter are potentially at risk for property damage and loss of life due to blizzards.

3. 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 and to produce widespread power outages. Ice storms also create treacherous conditions for highway travel and aviation. Debris impacted roads from fallen trees or overhead wires that snapped under the weight of the ice make emergency access, repair and cleanup extremely difficult.

All areas of Exeter are potentially at risk for property damage and loss of life due to ice storms.

4. Nor'-easters

In the winter months, Towns within the State may experience the additional coincidence of blizzard conditions with many of these events as well as the added impact of the masses of snow and/or ice upon infrastructure thus, impacting upon transportation and the delivery of goods and services for extended periods of time, as well as various related impacts upon the economy. The entire area of the State may be impacted by these events. Heavy snow and / or rainfall may be experienced in different areas of the State and the heavy rains may contribute to flood conditions. Nor'-easter events which occur toward the end of a winter season may exacerbate the spring flooding conditions by depositing significant snow pack at a time of the season when spring rains are poised to initiate rapid snow pack melting[9].

All areas of Exeter are potentially at risk for property damage and loss of life due to Nor'-easters.

E. Earthquake

An earthquake is a sudden 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, avalanches, and tsunamis. 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.

Generally, New Hampshire lies in a zone of Moderate seismic vulnerability. Rockingham County is in an area of particularly high seismicity which is evident in a cresent of historical events beginning in the Ossipee Range and following the general contour of the Merrimack River Valley[10]. Additionally, it is believed that the largest earthquake of record in New England was the 1755 "Cape Ann" event, just offshore of the NH coast.

[10] New Hampshire Office of Emergency Management: http://www.nhoem.state.nh.us/mitigation/