The Town of Ashby
Natural Hazard Pre-Disaster Mitigation Plan

Prepared by: Montachusett Regional Planning Commission (MRPC)
Funded by: *Federal Emergency Management Agency through the Massachusetts Emergency Management Agency* and *the Massachusetts Department of Conservation and Recreation.*
November 2008

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The Montachusett Regional Planning Commission (MRPC) has assisted in the development of a Natural Hazard Pre-Disaster Mitigation Plan for the Town of Ashby. It has been prepared for the Federal Emergency Management Agency (FEMA) to comply with the Disaster Management Act of 2000. It has been funded by the Federal Emergency Management Agency through the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation. This plan has been prepared to address natural hazards to which the Town of Ashby and the region is vulnerable.

The Plan is divided into the following five basic parts.

Part I (INTRODUCTION) is the introduction, explaining the purpose and benefits of natural hazard mitigation. It also includes a profile of the Town of Ashby and references the planning process used.

Part II (PRE-DISASTER MITIGATION PLANNING) describes PDM Planning and defines terms used in this Plan. It includes a discussion of the situation in the world, nation, region, and the Ashby area. This section will indicate existing programs related to Pre-Disaster Mitigation Planning efforts.

Part III (HAZARD IDENTIFICATION AND RISK ASSESSMENT) This section includes a summary of natural hazards and assesses the potential for occurrence based on historical records and information available from local, state and national sources. It also provides an overview of the recent disaster history affecting the Ashby region and a ranking and discussion of the types of hazards Ashby may face.

For this Natural Hazard Pre-Disaster Mitigation Plan, risk assessment and natural hazards have been grouped into the following **six categories of natural hazards**: #1 Flood-related hazards; #2 Wind-related hazards; #3 Winter-related hazards; #4 Fire-related hazards; #5 Geologic-related hazards; and #6 Other Natural Hazards.

It also presents the region's **vulnerability assessment and analysis of risk**. A profile highlights the existing development patterns and presents population data and distribution. The section identifies such things as the location of regional critical facilities and infrastructure (using Geographic Information System (GIS) mapping) and analyzes their locations as related to hazard zones. It includes a summary of the region's vulnerability. A complete listing of the Critical Facilities for the Town of Ashby can be found in Appendix 1.

Part IV (MITIGATION STRATEGY) presents the mitigation strategy for reducing the potential losses from future disasters. The strategy describes mitigation goals, identifies a comprehensive range of actions and projects, and presents an action plan that describes how the mitigation actions and projects will be implemented. If and when fully implemented, this strategy will achieve the goal: to reduce the loss of or damage to life, property, infrastructure, and natural and economic resources from natural disasters.

Part V (PLAN ADOPTION AND UDPATES) outlines how this plan was initially adopted and how it will be reviewed and updated in the future.

Part I Introduction

Purpose and Benefits

The purpose of the plan is to identify hazards and specific locations where the town is vulnerable to these hazards, and to establish a mitigation strategy to reduce the risks associated with these hazards.

Dealing with hazards before they occur is the best way to minimize the impacts when the hazard hits Ashby. This plan was created to achieve the following goal for Ashby:

To reduce the loss of or damage to life, property, infrastructure, and natural, and economic resources from natural disasters.

The preparation and implementation of this Natural Hazard Pre-Disaster Mitigation Plan will do the following for Ashby.

- **Make funding sources available** to implement the mitigation initiatives when eligible.
- **Support pre- and post-disaster decision making efforts.** Mitigation is directly related to disaster recovery. This plan emphasizes actions to be taken now to reduce or prevent future disaster damages. This plan helps the Town by developing policies and programs in the "calm before the storm." If the actions identified in this plan are implemented, the damage that is left in the aftermath of future events can be minimized, thereby easing recovery and reducing the cost of repairs and reconstruction.
- **Ease the receipt of post-disaster state and federal funding** because the list of mitigation initiatives is already identified.
- **Reduce vulnerability to disasters** by focusing limited financial resources to specifically identified needs.
- **Connect hazard mitigation planning to community planning** where possible.

Ashby's Profile

Ashby is located in the extreme northwestern part of Middlesex County, north of Worcester on the New Hampshire border, and it is part of the Montachusett Region. Ashby was once an outpost of Lunenburg, and was incorporated in 1767. The town is characterized by rugged, hilly terrain interspersed with gently rolling open fields, woodland, streams and wetlands. Most of the town is in the Nashua River Watershed with a small portion of the northwest corner in the Souhegan River Watershed. The town was originally agrarian, but in the mid-19th century began to harness its fast flowing streams for water powered manufacturing.

Ashby covers a total area of 24.17 square miles along the northern Massachusetts border with New Hampshire. It has a population of 2,926 (source: Mass. Department of Revenue, 2004), and a density of 121.1 persons per square mile. It has a normal temperature in January of 23.4 degrees Fahrenheit and a normal temperature in July of 71.3 degrees Fahrenheit. The annual rainfall is 47 inches. These figures are prior to the advent of global warming which may bring about changes to these figures.

To the east it is bordered by the towns of Townsend and Lunenburg, to the south is the City of Fitchburg, and to the west is Ashburnham. On the north it is bordered by the New Hampshire towns of Ipswich and Mason. Ashby is 8 miles north of the center of Fitchburg, 32 miles north of Worcester, 49 miles northwest of Boston, 87.1 miles from Springfield, 97.5 from Hartford, and 212 miles from New York City. Looking north Ashby is only 24.4 miles south of Nashua, New Hampshire, and 137 miles from Portland, ME.

Geology and Topography

The Ashby Region was formed over thousands of years of geologic activity and climatic change. Alternating periods of volcanic activity, shifting faults and erosion led to the formation, almost 5-600 million years ago, of the igneous and metamorphic rock that is characteristic of the terrain. This bedrock was often at or near the surface and was deeply worn by repeated glaciations. The last episode in the region, the Wisconsin Ice Age, ended approximately 15,000 years ago. The topography is rugged and hilly terrain with rock outcroppings on some of the steeper slopes, with gently rolling open fields, woodlands, stream corridors, and wetlands. The soils are primarily glacial tills. Geologic activity and the last Ice Age also left a deep imprint on Ashby's topography. Glacial sculpting wore deep groves in the land, creating the rolling, hilly terrain that dominates the landscape today.

Mount Watatic rises to a height of 1600 feet along the western border of town. Its summit is 1832 feet in Ashburnham. Most of the land in town is second growth forest of mixed deciduous and conifers.

Most of the areas soils are the direct result of glacial activity and are characteristic of Massachusetts as a whole. For the most part, the soils are deep, sandy and gravel soils formed from rubble left by the glacial retreats. A smaller percentage of soils are comprised of very deep, loamy and sandy soils from glacial outwash, and alluvial sediments on outwash plains and in the stream valleys.

The residents of Ashby rely totally on private wells for their drinking water. The town has a great deal of water and much of it is controlled by neighboring communities. Fitchburg controls two reservoirs on the south side of Ashby, and Townsend's municipal wells, in west Townsend, are supplied by the aquifer under eastern Ashby.

A Short History of the Area

Prior to the European colonial incursions, Ashby was the hunting and gathering area of Native Americans. Native Americans inhabited this area until they were pushed out in the late-eighteenth century. Ashby was once part of Lunenburg, and was incorporated in 1767. In 1768 forty-three families were listed on the town's roster. Ashby's first town moderator, John Fitch, occupied one of the three garrisons in town. He and his family were captured by the Indians during the war, and taken to Canada, and later ransomed by friends.

Ashby was originally agrarian as were most New England towns. By the mid -1700's the town began to harness its fast flowing streams for water-powered manufacturing. There were twenty-three water powered mill sites in Ashby. The first gristmill was built in 1750. Other manufacturing included saw mills, a wood turning mill, wool carding, and several food-processing mills. In 1831 the first wooden pails and tubs in Massachusetts were made by being turned on a lathe driven by a water wheel. In the early 20th century waterpower brought electricity to parts of town. Three noted clock-makers worked in Ashby and made large-standing, eight-day clocks of that time. Church organs were made in town using a roof mounted windmill for power. A unique cottage industry was the braided palm leaf hats made by women and sold to markets in the American South. Milk, butter and apples were cash produce sold in Fitchburg and Boston. By the turn of the 20th century most of the mills were gone. Ashby discouraged development by voting against having a railroad in town. Some farming persisted until recent years.

Ashby is changing. The high quality of life and relatively inexpensive land values in the region has spawned a movement of population from the eastern urban area. As housing prices increase, Ashby and the region has become an attractive community for people commuting to work in the east towards Boston, Devens, and Route 495, and south towards Worcester. Ashby has had a steady rebound in population since the 1980's (see Table 1 Population in the Town of Ashby from 1960 to 2004 below), and it is expected to increase at a slow but steady pace in the future.

This new residential development is important for hazard mitigation because Ashby, and most other communities in the region, are now beginning to build in hazard prone areas. Widespread ANR development (Approval Not Required) and residential subdivisions are the new trend.

Table 1
Population in the Town of Ashby from 1960 to 2004

Community	1960	1970	1980	1990	2000	2004*
Ashby	**1,183**	**2,274**	**2,311**	**2,717**	**2,845**	**2,926**

Source: US Decennial Census, * Mass Department of Revenue, 2006

Transportation Access and Egress

Highways

Ashby has a total of 51.93 miles of roads (source: 2006 MA Department of Revenue). Of the high importance to Ashby is Route 119 running from Groton in the east through the middle of Ashby to Ashburnham and on to Rindge, New Hampshire, and route 31 running from Brookline New Hampshire through the center of Fitchburg to Route 2. Route 2, runs east-west throughout the entire Montachusett Region. This is one of two limited access east-west highways in the state, and parallels the Massachusetts Turnpike in the north. This limited access highway provides the Ashby area with a direct link to I-495 and Boston in the east, and west to I-91, and the western half of the state and beyond. Consequently, this highway is a major thoroughfare for the state as well as for the region, and Ashby. In the time of an emergency this would function as a major evacuation route. While Ashby may be a destination for evacuees from more urbanized communities, Routes 31 and 119 may become evacuation routes to New Hampshire for Ashby residents.

The completion of I-190 in the early 1980's added a second major limited access highway to the region. This highway provides direct access to Worcester, I-290 and the Massachusetts Turnpike.

Bus Service

Ashby is a member of the Montachusett Regional Transit Authority (MART), which provides paratransit services for elderly and disabled residents of Ashby.

Rail Service

Commuter rail service is available to North Station, Boston, from Fitchburg (10 miles) via the MA Bay Transportation Authority.

Pan Am Railroad, formerly Guilford Transportation Industries, is the largest operator of freight rail lines in the Montachusett Region. It operates on a number of lines including those connecting the Moran Terminal in Charlestown, MA to Mechanicville, New York.

Other rail companies also provide freight service in the area, these include: the Providence and Worcester Railroad and CSX Transportation.

Airports

The largest nearby airport is Fitchburg Municipal Airport serving the North Central Massachusetts Aviation Community. Located between the cities of **Fitchburg** and **Leominster**, it maintains two runways suitable for corporate jet use. The airport has an Automated Surface Weather Observation System (ASOS) which reports weather by radio, telephone, and internet.

The Planning Process for Ashby

The natural hazard mitigation planning process for the Town of Ashby included the following tasks:

- Identifying the natural hazards that may impact the community.
- Conducting a Vulnerability/Risk Assessment to identify the infrastructure (*i.e.*, critical facilities, public buildings, roads, homes, businesses, etc.) at the highest risk for being damaged by the identified natural hazards.
- Identifying and assessing the policies, programs, and regulations Ashby is currently implementing to protect against future disaster damages. Examples of such strategies include:
  - Preventing or limiting development in natural hazard areas like floodplains;
  - Implementing recommendations in existing planning documents including: Open Space and Recreation Plan (OSRP), (although very few of these relate directly to mitigation measures) and Emergency / Evacuation Plans that address the impacts of natural hazards; and
  - Encouraging the use of specific structural requirements for new buildings such as buried utilities.

  Reviewing documents such as the Open Space and Recreation Plan and the E.O. 418 Community Development Plan, reveals that Ashby has directed little planning effort toward natural hazard mitigation. The major issues of housing development, the economy, capital planning, facilities development, and open space have occupied much of the planning efforts. Although the OSRP does target protecting water quality in its Action Steps, advocating the passing of a wetland bylaw, and pursuing conservation restrictions on sensitive upland buffer areas, this PDM Plan for natural disasters is a new direction.

- Identifying deficiencies in the current strategies and establishing goals for updating, revising or adopting new strategies.
- Adopting and implementing the final Local Natural Hazards Mitigation Plan.

In the planning process, the members of Ashby's Local Emergency Planning Committee identified Action Plan items and time frames for implementation. The actions were selected from a list of local strategies which were compiled during brainstorming sessions and others identified during the Plan review.

The action items selected were all considered to have a low to moderate cost to implement. In many cases grant funding would be sought for implementation given the limited resources available in the town.

The local action items represent a multi-faceted approach to addressing natural hazards in the Town and will be undertaken as resources become available, and will be integrated into ongoing planning activities. As part of the review and adoption process, the Town approved the action items that were in keeping with their goals and objectives.

Part II   Pre-Disaster Mitigation Planning

A **natural hazard** is defined as "an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss." (FEMA, Multi Hazard Identification and Risk Assessment, 1997). A natural hazard can also be exacerbated by societal behavior and practice, such as building in a floodplain, along a cliff or an earthquake fault, or increasing the amount of paving in a watershed. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

In the context of this PDM Plan, **Hazard Identification** details the geographic extent, the significance, and the probability of particular natural hazard affecting the region. Federal regulations for hazard mitigation plans include a requirement for a risk assessment, in order to provide communities with information needed to prioritize mitigation strategies. It is important to note that one particular category of hazard can be caused by several different types of natural events. For example, flooding can be the result of a hurricane, a nor'easter, a thunderstorm, a winter storm, or even the rupturing of a beaver dam.

Hazard mitigation is commonly defined as any sustained action that reduces or eliminates long-term risk to people, property and resources.

In order to fulfill the planning guidelines outlined in the **Federal Disaster Mitigation Act of 2000**, this Natural Hazard Pre-Disaster Mitigation Plan focuses on the risk assessment, analysis and recommendations for natural hazards mitigation only, and not man-made hazards (i.e. structural fires, release of hazardous materials.) Parts of this plan, such as critical infrastructure maps, may be utilized to develop other long-term mitigation strategies for man-made hazards.

Hazard mitigation planning is the process that analyzes a community's risk and vulnerability to natural hazards, develops a plan for coordinating available resources, and develops a strategy to implement in order to eliminate risks. This phrase and others used in the plan are generally accepted definitions by Massachusetts Emergency Management Agency (MEMA) and Federal Emergency Management Agency (FEMA).

The process of mitigation planning, when ultimately incorporated into a land use plan, has the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption in mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for emergency recovery, repair and reconstruction. There are **four types of benefits** that can be derived through implementation of a hazard mitigation plan:

1) Reduced public and private damage costs
2) Reduced social, emotional, and economic disruption

3) Better access to funding sources for flood mitigation projects
4) Improved ability to implement post-disaster recovery projects

When integrated into overall community planning goals, mitigation planning will also lead to benefits that go beyond solely reducing the costs associated with hazard vulnerability. Measures such as the acquisition or regulation of land in known hazard areas can help achieve multiple community goals, such as preserving open space, maintaining environmental health and natural features, and enhancing recreational opportunities.

The Montachusett Region is made up of varied areas with different population densities including urban, suburban, and rural. As the region grows and its population increases, the risk of a disaster caused by natural hazards becomes greater in every type of area. Hazard mitigation planning is a process directed at reducing the impact that natural disasters may have on the built environment and the lives of area residents. It is impossible to predict exactly when and where such a disaster might occur; however, careful planning can help minimize the losses that might result.

The World View

Each year, natural hazards worldwide result in loss of life and economic impacts totaling billions of dollars. Many times appropriate mitigation actions taken before a hazard event occurs can reduce the immediate impacts and prevent long recovery periods.

The National View

Since the early 1990s, FEMA and the United States Congress have witnessed large increases in disaster response and recovery costs. As a result, they have provided funds to communities, counties, and states to reduce impacts from natural hazards through hazard mitigation. Changes in federal laws have resulted in pre-disaster mitigation project funding and mitigation planning requirements. Each state, region, and community must have a mitigation plan that identifies steps to reduce the impact from hazards; if they do not have approved plans in place and a disaster occurs, they will not be entitled to apply for certain FEMA discretionary grant funding through the Hazard Mitigation Fund.

Between 1980 and 2002, the U.S. had 54 natural hazard disasters in which overall damages and costs reached or exceeded $1 billion per event. A natural hazard is defined as “an event or physical condition that has the potential to cause fatalities, injuries, property, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.”

Good Common Sense

Besides the federal requirements for funding and the promise of future mitigation dollars coming to the Town of Ashby, mitigation makes good common sense. As responsible people, hazard mitigation should become common language and practice among regional and local officials. For example, regularly scheduled clean-ups of waterways, catch basins, and streets prevent water pollution and debris, and runoff into brooks and rivers – these actions can also prevent flooding during heavy rainfall.

Hazard Mitigation Programs

The **Massachusetts State Hazard Mitigation Plan 2007** provides an in-depth overview of natural hazards in Massachusetts. According to the state plan flooding from northeast storms, hurricanes, heavy rainstorms and flash flooding are the most frequent, and most damaging natural hazard in Massachusetts. The plan also indicates that the state is affected by other natural hazards such as tornadoes, wildfires, drought, earthquakes, and winter-related hazards.

The State of Massachusetts has also prepared a **Climate Protection Plan (2004**). This underlines the effects of **Global Climate Change** on the state. Climate change refers to unstable weather patterns caused by increases in the average global temperature. Climate change is a worldwide concern because it would bring significant humanitarian, environmental, and economic impacts globally. If climate change trends continue, projected impacts in Massachusetts include changing weather patterns such as increasing temperatures and precipitation leading to more sever weather events and extremes, increased risks to public health, and snow events changing to rain with quicker runoffs that create flooding which the ground is unable to absorb, thus leading to summer drought.

A Presidential Major **Disaster Declaration** puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses and public entities. An emergency Declaration is more limited in scope and without the long-term federal recovery programs a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

Disaster response costs have greatly increased over the past 15 years. The federal government (FEMA) has provided funds in many disaster situations as well as in pre-disaster mitigation. Changes in federal law have resulted in per-disaster mitigation funding and mitigation planning requirements. Each state and county, and community must have a mitigation plan that identifies steps to reduce the impact from hazards; if they do not have approved plans in place and a disaster occurs, they will not be entitled to apply for certain FEMA discretionary funds.

Annually, natural hazards across the world take thousands of lives and wreak devastating economic impacts in the billions of dollars. Many times the right mitigation actions taken before an event occurs can reduce the immediate impacts and prevent the extended recovery period such as we have seen with Hurricane Katrina and Hurricane Rita. Mitigation can cost money, but the Federal Emergency Management Agency (FEMA) officials have estimated that for every dollar spent on pre-disaster mitigation, seven times that would be saved in a post disaster response. And of course the lives that would be saved are invaluable.

Local and Regional Planning and Mitigation Efforts

Planning efforts, like this one undertaken by the Town of Ashby and the Montachusett Regional Planning Commission, are making mitigation a proactive process. Pre-Disaster Planning emphasizes actions that can be taken before a natural disaster occurs. Future property damage and loss of life can be reduced or prevented by a mitigation program that addresses the unique geography, demography, economy, and land use of Ashby, and the region.

Preparing a Natural Hazards Mitigation Plan before a disaster occurs can save the community money and will facilitate post-disaster funding. Costly repairs or replacement of buildings and infrastructure, as well as the high cost of providing emergency services and rescue/recovery operations, may be avoided or significantly lessened if a community implements the mitigation measures detailed in the Plan.

Use of the Geographic Information System

One of the most useful tools in developing a risk and vulnerability assessment is a **geographic information system** (GIS) and maps produced from it. It is easier to point to areas on a map than refer to a list, and it is easier for people to see where their homes and businesses are located in relation to a particular hazard. Furthermore, maps improve communication about hazard risks between communities or organizations and disaster planners, engineers, and emergency response personnel. GIS was an essential component of the Montachusett PDM planning work done for the Town of Ashby.

Often, questions arise about the difference between disaster preparedness/hazard mitigation and emergency response. Both are important but do constitute different phases of the disaster cycle. Planning for a coordinated and effective response must occur during the preparedness phase of the disaster cycle, but the actual response activities occur after the impact of a natural hazard. Therefore, emergency response mitigation is one of the six categories of mitigation actions that this PDM Plan employs in its overall mitigation strategy, which includes prevention, property protection, natural resource protection, public education/information, structural projects, and emergency services/response.

Hazard mitigation and loss prevention is not the same thing as emergency response. Some flood loss reduction can be achieved by components of response plans and preparedness plans, such as a flood warning system or a plan to evacuate flood prone areas. However, warning and evacuation deal only with the immediate needs during and following a flood event. Hazard mitigation is much more effective when it is directed toward reducing the need to respond to emergencies, by lessening the impact of the hazard ahead of time.

Part III Hazard Identification and Risk Assessment

The following sections and tables and categories were derived from the State Hazard Mitigation Plans of 2004 and 2007. The groupings are based on data collected for the state plans. Included are those hazards that have or may impact the Town of Ashby. These tables are used to determine the total hazard index. Table 2 Natural Hazard Matrix (see below) shows the natural hazards as they have been grouped together into the six categories. This table is the Natural Hazard Matrix that was used at the Ashby Hazard & Vulnerability Session on April 3, 2007.

Table 2
Natural Hazard Matrix

Natural Hazard **Natural Hazard Separated by Flood, Wind, Fire, Geologic and Ice & Snow Related Hazards**	**Likelihood of Occurrence** **3 = Highly Likely** **2 = Possible** **1 = Unlikely**	**Location** **3 = Regional/State** **2 = Multi Community/ Regional** **1 = Local/Town**	**Impacts** **4 = Catastrophic** **3 = Critical** **2 = Limited** **1 = Negligible**	**Hazard Index** **Ranking Determined by Combining the Likelihood, Location and Impacts of a Natural Hazard**
Flood-Related Hazards				
• Beavers				
• Dam Failures				
• Drainage				
• Storm Water Run-off				
• Erosion				
• Land Slides				
• Flooding				
• Overland				
• Ponding				
• Riverine				
• Washouts				
• Sewer Back-up				
• Thunderstorms				
Wind-Related Hazards				
• Hurricanes				
• Tornadoes				
Fire-Related Hazards				
• Drought				
• Urban Fires				
• Wildfires				
Geologic Hazards				
• Earthquakes				
• Sink Holes				
Ice & Snow Hazards				
• Ice Jams				
• Snow Storms				
Other Natural Hazards				
•				
•				

<u>Local Natural Hazard and Vulnerability Matrix Data:</u>

Data Collection Process: At the Hazard and Vulnerability Session attendees were asked to identify the location(s) of, and describe, natural hazards for each hazard listed on the Natural Hazard Matrix. (The previous sentence sounded really odd the way it was- too many "hazard" mentions in one sentence) Maps of the community were projected using GIS data and participants indicated areas of concern. These areas were outlined and discussed. At the end of this part of the process participant were led through a filling out of the Natural Hazard Matrix presented below.

It is important to note that locations and descriptions for each hazard on the Natural Hazard Matrix were not always indicated as, "highly likely" or "possible". This doesn't mean that this type of hazard has not occurred in this community, or that they are immune to any particular hazard, just that nothing of significance was noted at that time. The natural hazards that were indicated as "unlikely", but which still have the potential to occur in Ashby were "Land Slides", "Sink Holes", and "Ice Jams". Being a somewhat rural community, "Urban Fires" were also ranked low, between "Possible" and "Unlikely".

Participants of this session (See Appendix 2) assigned values for each natural hazard based on three categories; (1) Likelihood of Occurrence, (2) Location (size), and (3) Impacts (potential). These values for each of these three categories were added to determine the Hazard Index, as shown in Table 3 Hazard and Vulnerability Session Matrix Review (see below).

Hazard & Vulnerability Session Matrix Review Town of Ashby				
<u>Natural Hazard</u> **Natural Hazard Separated by Flood, Wind, Fire, Geologic and Ice & Snow Related Hazards**	**<u>Likelihood of Occurrence</u>** **3 = Highly Likely** **2 = Possible** **1 = Unlikely**	**<u>Location</u>** **3 = Large/Multi-Community** **2 = Medium/Regional** **1 = Small/Local**	**<u>Impacts</u>** **4 = Catastrophic** **3 = Critical** **2 = Limited** **1 = Negligible**	**<u>Hazard Index</u>** **Ranking Determined by Combining the Likelihood, Location and Impacts of a Natural Hazard**
Wind-Related Hazards: Hurricanes	2.00	3.00	3.00	**8.00**
Ice & Snow Hazards: Snow Storms	3.00	2.00	3.00	**8.00**
Flood-Related Hazards: Beavers	3.00	1.50	3.00	**7.50**
Flood-Related Hazards: Dam Failures	2.00	2.00	3.00	**7.00**
Flood-Related Hazards: Drainage	3.00	1.00	3.00	**7.00**
Flood-Related Hazards: Storm Water Run-off	3.00	1.00	3.00	**7.00**
Fire-Related Hazards: Drought	2.00	2.00	3.00	**7.00**
Flood-Related Hazards: Thunderstorms	2.00	1.00	3.00	**6.00**
Fire-Related Hazards: Wildfires	2.00	2.00	2.00	**6.00**
Flood-Related Hazards: Erosion	2.00	1.00	2.00	**5.00**
Wind-Related Hazards: Tornadoes	2.00	1.00	2.00	**5.00**
Geologic Hazards: Earthquakes	2.00	2.00	1.00	**5.00**
Flood-Related Hazards: Flooding	2.00	1.00	1.00	**4.00**
Flood-Related Hazards: Sewer Back-up	2.00	1.00	1.00	**4.00**
Fire-Related Hazards: Urban Fires	1.50	1.00	1.00	**3.50**
Flood-Related Hazards: Land Slides	1.00	1.00	1.00	**3.00**
Geologic Hazards: Sink Holes	1.00	1.00	1.00	**3.00**
Ice & Snow Hazards: Ice Jams	1.00	1.00	1.00	**3.00**

Hazard Identification

Identifying potential hazards is the first step in any effort to reduce community vulnerability. The subsequent identification of the risk and vulnerability for a community is the primary factors in determining how best to allocate finite resources to address what mitigation might take place. The FEMA document titled Multi-Hazard Mitigation Planning Guide, dated March 2004 was used in developing this strategy plan as a basic template to identify the various natural hazard types. The hazard identification and analysis involves all of those hazards that potentially threaten Ashby and the Montachusett Region. For the purposes of the Natural-Hazard Mitigation Strategy Plan the following hazards are addressed.

Table 4

Floods	Wind-Related Hazards	Winter-Related Hazards	Fire-Related Hazards	Geologic Related Hazards	Other Natural Hazards
Flood Zones	Hurricanes	Heavy Snow	Droughts	Earthquakes	Climate Change
Stormwater Runoff	Tropical Storms	Ice Jams	Urban Fires		Extreme Temperatures
Erosion	Tornados	Ice Storms	Wildfires		Beavers
Nor'easters	Thunderstorms	Blizzards			
Dam Failure	Heavy Rains				

In assessing the hazards to a community, both the risk and the vulnerability must be taken into account. A **"hazard"** is the actual event that poses a danger to the community, (e.g. the hurricane, tornado, earthquake, etc. that threatens the Town of Ashby).

In the Hazard Mitigation Strategy, **"risk**" refers to the predicted impact that a hazard would have on people, services, specific facilities and structures in the community. The term "**vulnerability**" refers to the characteristics of the environment affected by the event. The vulnerability of an area refers to its susceptibility to a hazard. The areas of the town affected by extreme natural events are identified by hazard risk assessment. In determining the risk and vulnerability of the community, the likelihood, frequency and magnitude of damage from identified hazards are assessed.

In developing a mitigation strategy, Ashby defined the risks that could be faced and followed up with an assessment of the vulnerability of the at-risk areas, and the implications of experiencing natural disasters (e.g., loss of life, damage to the natural environment, property damage, and economic losses). **Risk assessment** is the determination of the likelihood of adverse impacts associated with specific natural hazards, and vulnerability assessment is concerned with the qualitative or quantitative exposure of some components such as the economy and the environment.

1. FLOOD RELATED HAZARDS

Ashby Flood Zones

Using GIS, it was determined that the Montachusett Region has approximately 649.04 square miles of land area. Of that area approximately 50.44 square miles (7.77%) are within the 100 Year Flood Zone and approximately 64.04 square miles (9.87%) are within the 500 Year Flood Zone, which includes the 100 Year Flood Zone. Map 1 (see appendix 3) shows the FEMA Q3 Flood Zones in the Montachusett Region.

The Town of Ashby itself has approximately 23.62 square miles of land area. Of that area approximately 0.89 square miles (3.79%) are within the 100 Year Flood Zone. Map 2 (see appendix 3) shows the FEMA Q3 Flood Zones in Ashby. Also see page 24 for Critical Infrastructure in Ashby.

Flooding

Flooding can be defined as a rising and overflowing of a body of water onto normally dry land. Floods can be slow or fast rising but generally develop over a period of days.

A high percentage of impervious surfaces and high groundwater levels do not allow heavy rain to be absorbed back into the ground. Basement, roadway, and infrastructure flooding can result in significant damages due to poor or insufficient storm water drainage. This not only causes flooding but also prevents groundwater recharge and can threaten water quality, which can affect public drinking water supplies.

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss – 75% of federal disaster declarations are related to flooding. Property damage from flooding totals over $5 billion in the United States each year. The following section includes brief descriptions of the various types of flood-related hazards most likely to affect Ashby.

Types of Flooding

A flood, which can be slow or fast rising but generally develops over a period of days, is defined by the National Flood Insurance Program as:

- A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from:
  - Overflow of inland waters;
  - Unusual and rapid accumulation or runoff of surface waters from any source; or
  - A mudflow

- Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

What is a Floodplain?

By their very nature, floodplains are the low, flat, periodically flooded lands adjacent to rivers and lakes, and subject to geomorphic (land-shaping) and hydrologic (water flow) processes. It is only during and after major flood events that the connections between a river and its floodplain become more apparent. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. In addition, the floodplain represents a natural filtering system, with water percolating back into the ground and replenishing groundwater. When a river is divorced from its floodplain with levees and other flood control facilities, then natural, built-in benefits are either lost, altered, or significantly reduced.

Farmers have, for generations, preserved and maintained as open space many acres in Ashby's floodplains. The active agricultural use of the floodplain is particularly compatible with flood hazard mitigation because the broad, open fields preserve the storage and conveyance functions of the floodplain, which in turn minimizes flooding and erosion downstream and to neighboring properties. The support of farming by Ashby and through State programs such as Agricultural Preservation Restrictions and Chapter 61A tax incentives are crucial to the long-term sustainability of Meadowlands.

One great misunderstanding is the belief that floods only happen in the floodplain. With sufficient rain, almost any area will experience at least pockets of surface flooding or overland flooding. Overland flooding in Ashby can result in erosion, washouts, road damage, loss of crops and septic system back-ups. Heavy rain in the more residential parts of Ashby with paved and impervious surfaces can easily overwhelm stormwater facilities resulting in localized flooding and basement damage. Stormwater flooding also contributes to water pollution by carrying silt, oil, fertilizers, pesticides and waste into streams, rivers and lakes. As the intensity of development continues to increase, the Ashby region will see a corresponding increase in serious stormwater problems.

The 100 Year Flood. The term "100-year flood" is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood that has a one percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance. A structure located within a Special Flood Hazard Area (SFHA) shown on a NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage.

Flooding is often the direct result of other frequent weather events in the Ashby such as "nor'easters," heavy rainstorms, tropical storms and hurricanes. As a result of these events Ashby is susceptible to:

- Riverine flooding, including overflow from the river, flash floods, ice-jams and dambreaks as well as a result of rainfall from tropical storms or hurricanes.

- Basement and roadway flooding, or stormwater flooding that is due to poor or insufficient storm water drainage, high groundwater levels and impervious surfaces which prevents groundwater recharge.

Flash Floods in the USA are responsible for more deaths than any other thunderstorm phenomena, according to the National Oceanographic and Atmospheric Agency (NOAA). Flash flooding is usually the product of very heavy rains in a short period of time over a small area. This causes small streams to increase in volume and violent power.

Some flooding can be predicted by weather reports, but many times smaller flash floods are the result of a microburst system, which simply overwhelms both natural and constructed drainage systems. These microbursts can cause damage to homes, industry, and farms in the floodplains and on hillsides. Transportation, emergency/safety services, power, water and wastewater, business and hazardous materials storage can be disrupted and greatly affect the residents in the flooded area.

Federal and local flood programs establish a 100-year floodplain, which is divided into two zones: a "floodway" and a "flood fringe." The "**floodway**" is defined as the channel of a river or other water course and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water elevation more than one foot. Floodways that are depicted on National Flood Insurance Program maps are more highly hazardous areas. They are areas where, if construction occurs, it places structures at significant risk in terms of depths and velocities of floodwaters. Ashby zoning prohibits structures in these areas.

The "**flood fringe**" is the area of the floodplain lying outside of the floodway, but subject to periodic inundation from flooding. Development may be permitted in such areas if it satisfies conditions and requirements regarding the height of the structure's first floor above the projected 100-year flood elevation, "flood proof" construction, displacement of flood waters, and related concerns. The State Building Code requires that all new living space be constructed at or above the projected 100-year flood level within the 100-year "flood fringe" area, and that there be equal space for water to come into and go out of a foundation.

Floodplain boundaries are delineated on FEMA's Flood Insurance Rate Maps (FIRMs). The 500-year floodplain is not subject to Ashby regulations. Major floods, such as those caused by heavy rains from hurricanes, and localized spot flooding can exceed the 100- and 500-year flood levels. In addition, many small streams are not mapped for their flood hazard.

As local watersheds continue to be developed, Ashby may face seasonal and periodic flooding and the associated problems. Riverine flooding is the most common and can be the most powerful of flood events. Every river, stream and tributary can potentially flood. With sufficient rain almost any area in Ashby can experience at least pockets of surface flooding, even in areas outside the mapped floodplain.

In addition to property loss, floods along the rivers and streams can also greatly impact **agricultural interests** by damaging or destroying crops, outbuildings, and equipment. The past three hundred years of increasingly intensive human occupation, however, have impacted the hydrology of the watersheds, and today flooding can result in the erosion of productive soils and the deposition of debris in agricultural and recreational areas. Farms throughout the flood area can suffer from direct damages and lost revenues, resulting in increased economic impacts.

Ashby's Critical Infrastructure in FEMA Q3 Zones

GIS Analysis was performed relative to the location of Critical Infrastructure and other buildings that have the potential to be affected by these flood zones. At the recommendation of the Federal Insurance Administration a 250ft buffer was applied to the FEMA Q3 Flood Zones in determining whether structures are located within the Special Flood Hazard Area boundaries. If any part of a parcel, building or structure intersected this buffer then it was considered to have the potential to be inside the flood zone.

Through this analysis it was determined that approximately 28 pieces of critical infrastructure have the potential to be affected by these flood hazards (see Table 5 Critical Infrastructure in FEMA Q3 Flood Zones below). It should be noted that other infrastructure such as roadways and rail lines may be affected by flood hazards but are not included in the critical infrastructure. In addition potential monetary damages due to loss of all buildings in these flood zones is approximately $56,287,900 for the 100 Year Flood Zone (source: Ashby Assessor's Office). These figures do not take into account monetary damages to property and personal property as well as Critical Infrastructure that are not buildings such as bridges and dams.

Table 5

Critical Infrastructure in FEMA Q3 Flood Zones

NAME	TYPE	ZONE
Bridge 25C	Bridge	100 Year
Bridge 25E	Bridge	100 Year
Bridge 25F	Bridge	100 Year
Bridge 284	Bridge	100 Year
Bridge 285	Bridge	100 Year
Bridge 70F	Bridge	100 Year
Bridge 798	Bridge	100 Year
Bridge 799	Bridge	100 Year
Bridge 7NJ	Bridge	100 Year
Bridge 7NK	Bridge	100 Year
Bridge 7NL	Bridge	100 Year
Bridge 7NN	Bridge	100 Year
Bridge 7NP	Bridge	100 Year
Bridge 7NQ	Bridge	100 Year
Bridge 7NR	Bridge	100 Year
Bridge 7QR	Bridge	100 Year
Bridge 7QT	Bridge	100 Year
Bridge 7QU	Bridge	100 Year
Bridge AA9	Bridge	100 Year
Bridge AEP	Bridge	100 Year
Ashby Reservoir Dam	Dam	100 Year

Damon Pond Dam	Dam	100 Year
Fitchburg Reservoir North Dam	Dam	100 Year
Fitchburg Reservoir S.E. Dam	Dam	100 Year
Fitchburg Reservoir South Dike	Dam	100 Year
4-H Camp Middlesex	Other Critical Facility	100 Year
Crossroads For Kids/camp Lapham	Public Water Supply	100 Year
Fitchburg Reservoir	Public Water Supply	100 Year
Pines Campground	Public Water Supply	100 Year

*Critical Infrastructure data were derived from various sources including MassGIS, EOT/MHD, MEMA, MA DCR, MA Dept of Early Education & Care, MART, MRPC and the Town of Ashby.
**Flood Zone data was downloaded from MassGIS.

Stormwater Runoff

Flooding from stormwater runoff is a problem that will increase in Ashby. It is caused by increased amounts of impervious surfaces, and by undersized stormwater drainage infrastructure, including culverts and detention basins. Development which is increasing at a slow but steady rate in Ashby not only creates more impervious surfaces, but it also changes natural drainage patterns by altering existing contours by grading and filling, sometimes creating unexpected stormwater flooding during heavy rains. When the present financial and credit crises turns around, development in Ashby will most likely continue to increase as it had in the first part of this decade.

Flooding at times is due to undersized pipes and catch basins and lack of upstream detention that cause streams to jump their banks and flood roadways and properties. Stormwater contributes to water pollution by carrying silt, oil, fertilizers, pesticides and waste into streams, rivers and lakes. Stormwater flooding has the potential to cause considerable property damage because it occurs in areas of concentrated development, Ashby is fortunate in this regard because it has few areas of concentrated development. One of the most significant impacts of stormwater on Ashby is septic system failures. This can cause an immediate and acute public health hazard.

Areas of stormwater runoff/drainage related hazards were noted at the Ashby Hazard & Vulnerability Session. Locke Road east of Mason Road: Locke Brook overflows in times of heavy rain and is underwater, making it difficult to pass through this section of roadway. The town also noted that the dirt roads in town have very little drainage. In times of significant rain the roads flood over and erode or wash-out. Map 3 (see appendix 3) shows the stormwater runoff/drainage related hazards that were indicated at the Ashby Hazard & Vulnerability Session.

In addition, potential monetary damages due to loss of all buildings in these stormwater runoff/drainage related hazards are approximately $610,700 (source: Ashby Assessor's Office). These figures do not take into account monetary damages to property and personal property as well as Critical Infrastructure that are not buildings such as bridges and dams.

Erosion Related Hazards

At the Ashby Hazard and Vulnerability Sessions, the town noted two areas of significance regarding erosion related hazards. North of Townsend Rd, in the Willard Brook State Forest: Fieldstone blocks along the state park occasionally shift and come out of place. This occurrence is infrequent but the potential exists for these blocks to land in the roadway. Bernhardt Road_Bridge: Erosion of the land surrounding the bridge (due to flooding) has caused it to collapse. The bridge is closed and the town needs funding to replace it. It is hanging, unsupported at one end and the abutment wall is susceptible to erosion. Several homes in this area are affected due to access, which could be a problem in an emergency response situation. Potential monetary damages to buildings from erosion can total $298,000 (source: Ashby Assessors Office).

Heavy Rain

Torrential rains are associated with slow moving or stationary tropical weather systems. In addition to flooding residences and businesses, heavy rain in Ashby have been known to overcome storm drain systems and cause severe flooding or structural failure of roads and culverts (see locations in previous section on Stormwater Runoff). Heavy rain can have a disastrous effect on agricultural interests by drowning crops and increasing the probability of disease and pest infestations in surviving crops. It doesn't take a major event for flooding to result in many small areas of Ashby. Many of their storm drain systems are overcome during small rain events that flood roads and personal property.

Nor'easter

A nor'easter gets its name from its continuously strong northeasterly winds blowing in from the ocean ahead of the storm. A northeast coastal storm, known as a nor'easter, is typically a large counter-clockwise wind circulation around a low pressure center. The storm radius, which can affect Ashby, is often as much as 1000 miles, and the horizontal storm speed is about 25 miles per hour. Sustained wind speeds in Ashby of 10-40 mph are common during a nor'easter with short term wind speeds gusting higher. Nor'easters are a common winter occurrence in New England and Ashby, and can result in minor flooding. Detailed studies of satellite images and other readings suggest that some low pressure systems associated with nor'easters may develop tropical storm characteristics such as an eye in the center of the low.

The Massachusetts Hazard Mitigation Plan reports that while hurricanes strike the Ashby area with much more force than Nor'easters, the region suffers more damage from Nor'easters because they are a more frequent occurrence and they bring high winds and sustained rains. They are more problematic in part because they have a longer duration – 12 hours to 3 days, versus 6 to12 hours for hurricanes.

Ashby will have flooding associated with the heavy precipitation of Nor'easter storms. Problems can be exacerbated when the rains fall and melting snows and ice are added to the flow. The chunks of ice can clog drainage passages and increase localized flooding. This flooding can affect private residences, businesses, and public infrastructure such as roadways and storm drains.

Dam Failure in Ashby

Dam Failure is an uncontrolled release of water impounded by a dam. The Massachusetts Office of Dam Safety reports that the region's dams, like the other parts of New England infrastructure, are an aging infrastructure that is expensive to repair. Routine maintenance is necessary to control the growth of trees and keep the area clear so defects can be detected. In addition to aging, the region's dams are often doing work beyond their original design. The increase in impervious surfaces leads to increased flows in some streams and rivers and thus greater demands are placed on the dams. See below Ashby Hazard Potential, and Ashby's Critical Infrastructure.

The Riverways Program within the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement (DFWELE) has been studying the larger environmental costs of both operational dams and dam failures. Dam failures may cause loss of life and property downstream, but they may also degrade the environment. Many dams act as a holding area for contaminated sediments. With a dam failure, these sediments are released and can damage wildlife and the ecology of the river system. An associated cost of dam failures is the potential for such destruction to affect fish ladders or culverts for directing water.

Dam failures are potentially the worst of flood events. Typically, a dam failure is the result of neglect, poor design, or structural damage caused by a major event such as an earthquake. When a dam fails, huge volumes of water are often released, causing widespread destruction and potential loss of life. Floods due to dam failures have occurred in New England in the past.

Dam failure is a highly infrequent occurrence, but a severe incident can be deadly. Since 1984, three dams have failed in or very near to Massachusetts, and two have come very close to failing. One of the dam failures resulted in a death. Many of the dams in the state were built in the 19th century during the industrial revolution; some are even older and date back into the late 18th century. These structures are hazards that need to be considered when preparing a Natural Hazard Pre-Disaster Mitigation Plan. Even dams that are considered safe could fail if they were affected by events such as an earthquake.

The Office of Dam Safety maintains records of dams located throughout the Commonwealth, ensures compliance with acceptable practices pertaining to dam inspection, maintenance, operation and repair of dams. In accordance with recent changes in the dam safety regulations, dam owners are now responsible for registering, inspecting, reporting inspection results to the Office of Dam Safety and maintaining their dams in good operating condition.

In 2002 the Massachusetts legislature enacted revisions of the Dam Safety Statute, MGL Chapter 253 44-50, which significantly changed the responsibilities of dam owners to register, inspect and maintain dams in good operating condition. Amendments to Dam Safety Regulations 302 Code of Massachusetts Regulations (CMR) .00-10.16 became effective November 4, 2005 and are reflective of the statutory changes.

Dam Registration: In accordance with Massachusetts General Laws (MGL) Chapter 253 Section 10.05, dam owners must add their dam(s) to the public record by completing a Registration Form provided by the Office of Dam Safety. The office is in the process of updating the dam owner information database and preparing dam registration Certificates. The Certificates are issued to dam owners for recording at registries of deeds. The dam owner must record the certificate at the applicable registry of deeds as an attachment to the record deed that describes the parcel where the dam is located.

<u>Hazard Potential Classification</u>

High Hazard Potential dam refers to dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

Significant Hazard Potential Dam refers to dams located where failure may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.

Low Hazard Potential Dam refers to dams located where failure may cause minimal property damage to others. Loss of life is not expected.

Emergency Action Plans: MGL Chapter 253 and 302 CMR 10.00 requires that dam owners prepare, maintain and update Emergency Action Plans for all High Hazard Potential dams and certain Significant Hazard Potential dams.

Ashby Dam Hazard Potential and Structural Condition

Map 7 (see appendix 3) shows the Dam Hazard Potential for the Montachusett Region. According to the Massachusetts Department of Conservation and Recreation, Office of Dam Safety, there are 6 dams in the Town of Ashby. Table 6 Ashby Dam Hazard Potential and Structural Condition (see below) shows the hazard potential and structural condition of those dams at the date of last inspection. Of those 6 total dams, two are considered to be high hazards, 3 are considered low hazards and the Mount Watatic Dams hazard status is unknown.

Table 6

Ashby Dam Hazard Potential & Structural Condition

NAME	HAZARD POTENTIAL	STRUCTURAL CONDITION	LAST INSPECTION
Ashby Reservoir Dam	High	Poor	4/2/1998
Damon Pond Dam	High	Poor	1/1/2005
Fitchburg Reservoir North Dam	Low	None/Unknown	10/28/1981
Fitchburg Reservoir S.E. Dam	Low	None/Unknown	10/28/1981
Fitchburg Reservoir South Dike	Low	None/Unknown	1/18/1982
Mount Watatic Dam (NJ)	Unknown	None/Unknown	4/11/2002

*Source- Department of Conservation and Recreation, Office of Dam Safety, and the Town of Ashby.

One dam of significant concern to the town was noted at the Ashby Hazard & Vulnerability Session. Ashby Reservoir Dam: This dam is in the jurisdiction of Fitchburg. Sheldon Hill Rd has been closed, at the request of the state, due to the classification of this dam as High Hazard. A potential breach of this dam this dam would affect a significant area. Several roads would be flooded, most notable the intersection of Route 119 & Route 31. Also, the flooding would likely wash out the old wooden bridge that is the only access to the 4-H Club, and affect the 4-H Club itself. There are also a couple of homes that could be in the direct flow of water. A potential breach of the Ashby Reservoir Dam could have a domino affect on Damon Pond Dam, another High Hazard dam, potentially creating additional problems downstream. The potential exists to wash out several more roads, most notably Route 119, heading into Townsend, with the possibility to affect several more homes.

Map 3 (see appendix 3) shows the dam hazards that were indicated at the Ashby Hazard & Vulnerability Session.

Ashby Critical Infrastructure in Dam Hazard Areas

GIS Analysis was performed relative to the location of Critical Infrastructure and other buildings that have the potential to be affected by dam hazards. If any part of a parcel, building or structure intersected this hazard area then the building was considered to have the potential to be inside the dam hazard. It should be noted that the hazard data is very approximate in nature; therefore it is not intended to depict exact locations of hazards, rather general areas where hazards may occur.

Through this analysis it was determined that approximately 12 pieces of critical infrastructure have the potential to be affected by these dam hazards (see Table 7 Critical Infrastructure in Dam Hazard Areas below). It should be noted that other infrastructure such as roadways and rail lines may be affected by dam hazards but are not included in the critical infrastructure. In addition, potential monetary damages due to loss of all buildings in these dam hazards are approximately $6,132,500 (source: Ashby Assessor's Office). These figures do not take into account monetary damages to property and personal property as well as Critical Infrastructure that are not buildings such as bridges and other dams.

Table 7

Critical Infrastructure in Dam Hazard Areas

NAME	TYPE
Bridge 25C	Bridge
Bridge 25D	Bridge
Bridge 25F	Bridge
Bridge 285	Bridge
Bridge 798	Bridge
Bridge 7NK	Bridge
Bridge 7NN	Bridge
Bridge 7NQ	Bridge
Bridge AA9	Bridge
Ashby Reservoir Dam	Dam
Damon Pond Dam	Dam
4-H Camp Middlesex	Other Critical Facility

Emergency Action Plan for Dams

- **REGULATORY REQUIREMENTS**

  MGL Chapter 253 and 302 CMR 10.00 requires Emergency Action Plans be prepared, maintained and updated, by dam owners, for High Hazard Potential dams and certain Significant

Hazard Potential dams:
302 CMR 10.11: Emergency Action Plans

(1) All dams classified or reclassified as high hazard potential shall have an Emergency Action Plan (EAP). If the Commissioner requires it, the owner of a non-high hazard potential dam shall also be required to provide an EAP. Approval to construct a new significant hazard potential dam or high hazard potential dam shall be contingent upon the submission of an EAP to the Commissioner. All EAP's are subject to approval by the Commissioner. The EAP shall, at a minimum, contain the following:

(a) the identification of equipment, manpower and material available for implementation of the plan; (b) a notification procedure for informing the local emergency agencies; (c) a dam failure inundation map for high hazard potential dams and a topographic map for significant hazard potential dams showing the stream which will be flooded; and (d) a procedure for warning nearby local residents if failure of the dam is imminent and a listing of addresses and telephone numbers of downstream residents who may be affected by the failure of the dam

(2) Prior to submission of an EAP to the Commissioner, the owner shall submit a copy of the proposed EAP to the local and state emergency agencies, and all local emergency coordinators involved in the plan, for review. The owner shall submit with the EAP, recommendations received from said agencies and coordinators, if any.

(3) Annually, the owner shall review the EAP, update it and provide the updated EAP to all involved agencies for review.

(4) EAP'S shall be provided by the owner in both hard copy and electronic format to the Commissioner and the Massachusetts Emergency Management Agency.

Flood Insurance Claims in the Montachusett Region

As reported in the Profiles, as of 2007, all twenty-two MRPC communities now participate in the National Flood Insurance Program.

According to FEMA, for the period between 1978 and 2002, there had been 61 Closed Loss Claims from the region with $ 328,560.34 in total payments. During this time period the Town of Ashby did not experience any closed loss claims. The town of Ashby does not have any repetitive loss structures.

In summary, flooding due to a variety of causes (hurricanes, Nor'easters, thunderstorms, winter storms, and dam failure) is highly likely in the Ashby Region.

Overview of the National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a federal program, administered by FEMA, which makes federal flood insurance available in communities that agree to adopt and enforce corrective and preventative floodplain management regulations that are intended to reduce future flood damages. Congress created the NFIP in 1968 with the passing of the National Flood Insurance Act. The Act was passed to address the fact that homeowners insurance does not cover flood damage, which left much of the burden of flood recovery to the general taxpayer through federal disaster relief programs. In general, flood insurance from private companies is either not available or extremely expensive. The goal of the NFIP is to shift the cost of flood damages from general taxpayers to those who live in floodplains. This is done by paying flood damage claims with premiums collected from flood insurance policy holders. NFIP flood insurance is available anywhere in a participating community, regardless of the **flood zone**. Federal law requires that flood insurance be purchased as a condition of federally insured financing used to secure buildings in the **Special Flood Hazard Area (SFHA)**.

The program has 3 main components: Floodplain Regulations, Flood Hazard Mapping, and Flood Insurance. The regulation component includes the minimum floodplain management requirements that communities must adopt and enforce in order to participate in the program. These minimum requirements focus on land use and construction standards which are designed to reduce flood damages. In Massachusetts, many of the NFIP regulatory requirements are included in State regulations, such as the State Building Code and the Wetlands Protection Act. The remaining requirements are included in the participating community's floodplain zoning bylaw or ordinance. The NFIP floodplain management requirements are located in Volume 44 of the Code of Federal Regulations (CFR), Section 60.3. 44 CFR 60.3 is posted online at:
http://a257.g.akamaitech.net/7/257/2422/13nov20061500/edocket.access.gpo.gov/cfr_2006/octqtr/pdf/44cfr60.3.pdf.

The mapping component is responsible for producing flood hazard mapping products to support the regulatory and insurance functions of the program. Flood Insurance Studies (FIS) and Flood Insurance Rate Maps (FIRM) are produced by FEMA for participating communities. The participating community must adopt the FIRM and FIS as the documents that define the areas where the NFIP regulatory requirements will be enforced. The FIRMs also support the insurance side of the NFIP, as they establish flood zones and flood elevations that are used for rating flood insurance policies, and to determine where flood insurance is required as a condition of a federally insured mortgage. Flood Hazard Mapping regulations can be found at 44 CFR Part 65, at:
http://www.access.gpo.gov/nara/cfr/waisidx_06/44cfr65_06.html.

The insurance component makes flood insurance available for all residential and non-residential structures in a participating community, regardless of flood zone. Insurance rates are subsidized for buildings that were constructed prior to the issuance of a FIRM for the subject community. Buildings that are built after the initial FIRM was issued are rated based on their compliance with NFIP regulatory requirements. Both the mapping and regulatory components of the program directly impact the insurance component, as they are involved in the rating of buildings and the determination of the premium. An additional component of a standard flood insurance policy is ICC or Increased Cost of Compliance coverage. ICC coverage is available for residential and non-residential buildings and provides for the payment of a claim for the cost to comply with state or community floodplain management laws or ordinances after a direct physical loss by flood. When the community determines that the building has been substantially damaged, ICC will pay up to $30,000.00 for the cost to elevate, flood proof, demolish or relocate the building. In some instances, ICC may be used toward the local share (25% match) of a hazard mitigation grant. For specific information please go to:
http://www.fema.gov/business/nfip/icc.shtm, or order "FEMA 301: Increased Cost of Compliance Coverage – Guidance for State and Local Officials" from FEMA by calling 1-800-480-2520.

Some useful NFIP links are listed below.

FEMA NFIP Page: **http://www.fema.gov/about/programs/nfip/index.shtm**

Floodsmart (Flood Insurance Website): **www.floodsmart.gov**

FEMA Flood Insurance Manual:
http://www.fema.gov/pdf/nfip/manual200705/floodmancvrwebmay2007.pdf

Answers to Questions about the NFIP: **http://www.fema.gov/business/nfip/qanda.shtm**

NFIP Program Description: **http://www.fema.gov/doc/plan/prevent/floodplain/nfipdescrip.doc**

FEMA NFIP Publications: **http://www.fema.gov/business/nfip/libfacts.shtm**

Mandatory Purchase of Flood Insurance Guidelines: **http://www.fema.gov/business/nfip/mpurfi.shtm**

Flood Insurance Policy and Claims Statistics:
http://www.fema.gov/business/nfip/statistics/pcstat.shtm

NFIP Summary of Coverage Document **http://www.fema.gov/pdf/nfip/summary_cov.pdf**

FEMA Technical Bulletins **http://www.fema.gov/fima/techbul.shtm**

FEMA Map Service Center **www.msc.fema.gov** No registration required to view maps.

FEMA Flood Hazard Mapping Page **http://www.fema.gov/plan/prevent/fhm/index.shtm**

LOMA/LOMR Forms: **http://www.fema.gov/plan/prevent/fhm/frm_form.shtm**

FEMA Flood Hazard Mapping Tutorials: **http://www.fema.gov/plan/prevent/fhm/ot_main.shtm**

2. WIND RELATED HAZARDS

As wind speed increases, pressure against an object increases at a disproportionate rate. For example, a 25- mile per hour wind causes about 1.6 pounds of pressure per square inch. When the wind speed increases to 75 miles per hour, the force on that object increases to 450 pounds per square inch. At a wind speed of 125 miles per hour, the force increases to 1,250 pounds per square inch.

The major wind-related hazards that can occur in the Ashby region include hurricanes (tropical storms), and tornadoes. Although they are not frequent events on an annual or seasonal basis, the chance of occurrence, and the extent of damage associated with each, is of concern to disaster mitigation planners. Unlike flooding, where historical river flow records allow the potential extent of flooding to be delineated with some accuracy within each community, delineating the exact area where a hurricane or tornado will strike is not possible. A brief description of hurricanes and tornadoes, along with the general risks associated with each for the Ashby region follows.

Hurricanes and Tropical Storms in the Ashby Region

Both hurricanes and tropical storms can produce substantial damage from storm surge, waves, erosion and intense winds in coastal areas. While this type of coastal storm surge has been the number one cause of hurricane related deaths in the past, more people have died from **inland flooding** associated with tropical systems in the last 30 years.

Since the 1970s, inland flooding has been responsible for more than half of all deaths associated with tropical storms in the United States. Inland flooding from hurricanes can occur hundreds of miles from the coast, placing communities such as Ashby, which would not normally be affected by the strongest hurricane winds in danger.

Hurricanes

A hurricane is a type of tropical cyclone; an organized rotating weather system that develops in the tropics and can move up the coast to affect Ashby.

Tropical cyclones are classified as follows:

Tropical depression: An organized system of persistent clouds and thunderstorms with a low level circulation and maximum sustained winds of 39 mph or less.

Tropical storm: An organized system of strong thunderstorms with a well-defined circulation and maximum sustained winds of 39-73 mph.

Hurricane: An intense tropical weather system with a well-defined circulation and maximum sustained winds of 74 mph or higher. The typical hurricane moves at an average speed of approximately 12 miles per hour. While in the lower latitudes, hurricanes tend to move from east to west. However, when a storm drifts further north, the westerly flow at the mid-latitudes tends to cause the storm to curve toward the north and east. When this occurs, the storm may accelerate its forward speed. This explains why some of the strongest hurricanes have reached New England and the Ashby region.

Tropical depressions and tropical storms, while generally less dangerous than hurricanes, can be deadly. The winds of tropical depressions and tropical storms are usually not the greatest threat. Heavy rains, flooding and severe weather, such as tornadoes, create the greatest problems associated with tropical storms and depressions. Serious power outages can be associated with hurricanes and other tropical storms. After Hurricane Gloria in 1985, some residents were without power for several days.

Hurricanes can occur along the East Coast of the United States anytime in the period between June and November. Hurricane intensity and the potential property damage posed by a hurricane are rated from 1 to 5 according the Saffir-Simpson Hurricane Scale (see Table 8 Saffir-Simpson Hurricane Scale below). Hurricanes reaching Category 3 and higher are considered major hurricanes given the potential for loss of life and property damage. The potential damage of each category is summarized in the following. (References to coastal surges are not included because coastal flooding and tidal surge is not an issue in the Montachusett Region.)

Table 8

Saffir-Simpson Hurricane Scale	
Category	**Wind Speed**
Tropical Storm	39–73 mph (63–117 km/h)
1	74–95 mph (119–153 km/h)
2	96–110 mph (154–177 km/h)
3	111–130 mph (178–209 km/h)
4	131–155 mph (210–249 km/h)
5	≥156 mph (≥250 km/h)

*Source- National Weather Service, National Hurricane Center

Category 1 –Damage potential to unanchored mobile homes, trees, shrubbery, and poorly constructed signs.

Category 2 –Damage to roofing material, doors, and windows. There can be considerable damage to mobile homes and poorly constructed signs. There can be significant damage to trees and shrubs, with some trees blown down.

Category 3 –Small residences and buildings may experience some structural damage. There can be destruction of mobile homes and poorly constructed signs. Foliage will be blown off trees and trees may be blown down.

Category 4 –Winds 131 to 155 mph. Small residences may experience complete roof structure failures. Mobile homes completely destroyed. All signs, trees, and shrubs blown down. Doors and windows extensively damaged.

Category 5 –Winds greater than 155 mph. Many residences and industrial buildings experience complete roof failure. Complete building failures possible. Small utility buildings can be blown over or away. All signs, trees, and shrubs blown down. Mobile homes completely destroyed. Windows and doors severely and extensively damaged. Hurricane force winds can destroy buildings and mobile homes. Debris, such as signs, roofing materials, siding and lawn furniture can become missiles.

Hurricanes can also spawn tornadoes. Tornadoes generally occur in thunderstorms embedded in rain bands well away from the center of the hurricane. Usually tornadoes produced by tropical cyclones are relatively weak and short-lived.

A **hurricane watch** is issued when a hurricane or hurricane conditions pose a threat to an area in the next 36 hours. A **hurricane warning** is issued when hurricane winds of 74 mph or higher are expected in the next 24 hours. If a hurricane's path is erratic or unusual, the warning may be issued only a few hours before the beginning of hurricane conditions.

<u>Hurricanes and New England</u>

While there have been relatively few direct hits from hurricanes in New England, peripheral effects from offshore hurricanes and tropical storms that track inland are not uncommon. In the period of time that records have been kept for hurricanes, Massachusetts has experienced 45 wind-related occurrences associated with hurricanes. Of those, six have had a direct impact and 39 have had an indirect impact. The most recent hurricane to affect the region was Hurricane Bob, which passed through in 1991.

Some of the greatest rainfall amounts associated with tropical systems occurs from weaker tropical storms that have a slow forward speed (1 to 10 mph) or stall over an area. Due to the amount of rainfall a Tropical Storm can produce, they are capable of causing as much damage as a category 2 hurricane.

While the coastal communities of southeastern Massachusetts generally take the brunt of hurricanes, flooding and winds also affect the inland areas such as Ashby and the Montachusett Region. The sustained rains of the storm contribute to river flooding, and high winds in Ashby have caused widespread power outages and property damage. An assessment of the hurricane risk in Ashby can be categorized as “medium”.

Of all the natural threats that might affect the Ashby, hurricanes such as the one in 1938, have the potential to cause the most property damage and loss of life if adequate planning and preparation is not undertaken. Although hurricanes can produce tremendous damage, they can, unlike other threats, be tracked for several days before impacting a community—giving residents time to prepare and evacuate if necessary. We cannot, however, plan to move or remove infrastructure when a hurricane is predicted.

Along with the new residents who have moved into Ashby and the region, has of course, come increased residential construction. Additionally, Ashby has a fair amount of old housing that was not built to today’s standards. Also worth noting is that this period of time has been a fairly prosperous one with larger and more expensive homes being constructed. Thus, in terms of dollar amount of damage, it is likely that a major storm may result in a higher amount of property damage than prior events

For those in Ashby it might be difficult to visualize the total devastation that a hurricane like Katrina can cause. Few people except those over 70 have experienced the massive damage from the Hurricane of 1938. Hurricane Bob, while destructive in its own right, was only a relatively weak Category 2 storm. It can get much worse especially now that we’re faced with a changing climate.

The Atlantic hurricane season runs from June 1st through November 30th. Based on the number and intensity of storms, mid-August through mid-October is defined as the peak period. However, hurricanes or other severe storms can occur in the Ashby region at any time. During the months of June and July, hurricanes tend to form in the Caribbean and the Gulf of Mexico. By mid-August, as the waters of the tropical Atlantic warm, the focus turns to the Eastern Atlantic in the vicinity of the Cape Verde Islands off the African coast. The tropical waves intensify as they move westward; become tropical depressions, then tropical storms and finally hurricanes. Most of these storms turn northward around the peripheries of the semi-permanent Bermuda and Azores high-pressure areas, but in some cases can affect the Atlantic and Gulf Coast states. By early October, the waters over the Atlantic begin to cool and the focus for storm development shifts back to the Caribbean and the Gulf of Mexico.

The timing of the storm relative to other weather events also has a bearing on the overall impact of the hurricane. If a hurricane follows another hurricane or a major rain event, the effects can be magnified as flooding is greater and weakened or loosened trees are more susceptible to toppling. The severity of an event considers the potential for loss of life, property damage, and critical facility or business interruption. Experts anticipate that the next major New England hurricane that will affect Ashby may have severe impacts because present residents are unaware of the serious danger, and major property investment has increased the value of structures that could get damaged in Ashby.

Given that the last major storm event was nearly twelve years ago, there is concern that those who have re-located to the area during this period or come of age during this period, are unaware of the real danger posed by a powerful hurricane. NOAA (National Oceanic and Atmospheric Administration) estimates that 80-90% of the population now living in United States coastal areas have never experienced a major hurricane. This is most likely true for Ashby and the Montachusett Region. This lack of firsthand knowledge can cause an ill prepared response to warnings and poor or little preparedness. When residents are slow to respond to warnings the severity of impacts can be expected to be greater.

The **1938 Hurricane** struck on September 21. Winds of over 120 miles per hour blew across the region. Extensive damage occurred to roofs, trees, and crops in Ashby. Widespread power outages occurred in the region, which in some areas lasted several weeks. In Connecticut, downed power lines resulted in catastrophic fires to sections of New London and Mystic. Parts of interior Massachusetts not only bore the brunt of high winds, but also experienced severe river flooding as rain from the hurricane combined with heavy rains earlier that week and produced rainfall totals of up to 17 inches. This resulted in some of the worst flooding ever experienced in Massachusetts. In New England this powerful storm caused 564 deaths and over 1,700 injuries. Nearly 9,000 homes and businesses were destroyed with over 15,000 damaged.

One of the hazards that may occur during a hurricane event is strong surface winds that can cause a barrage of flying debris. Hurricanes are categorized by sustained winds of 74 mph to 200 mph, which can cause tremendous debris problems. Southern New England has been affected by 41 tropical cyclones between 1900 and 2002. Twelve of these storms have caused significant damage. Each of these storms brought high winds resulting in heavy precipitation.

There are detailed accounts of both the 1938 and 1954 hurricanes, and the devastation that they caused in Ashby and the Region. Not only is the risk of hurricanes high, the vulnerability to hurricanes is also considerable. The purpose of hazard mitigation is to reduce the vulnerability of an area to a potential risk, by using pre-disaster strategies to safeguard communities such as Ashby.

A hurricane is defined as a large circulating windstorm covering hundreds of miles that forms over warm ocean water. As stated earlier, to be officially classified as a hurricane, the wind speeds must exceed seventy four (74) miles per hour. During a hurricane, high winds, and small scale wind bursts may damage or destroy homes, businesses, public buildings and infrastructure.

The wind bursts, termed "**microbursts**", are localized winds and may reach speeds in excess of 200 miles per hour. In the northern hemisphere winds circulate in a counter clockwise direction. These winds that accompany hurricanes have the potential to cause serious damage. Locally, downed power lines leave residents without electricity and can create dangers of electrocution, and can impede normal life and business for days. In Ashby, fallen trees have damaged buildings and blocked roadways. Unsecured building components including gutters, screened enclosures, roof coverings, shingles, car ports, porch coverings, overhangs, siding, decking, windows, walls, and gables can be blown off structures and carried by the wind to cause damage in other places. Wind driven rain often causes water damage in roof and wall envelopes.

Debris generated by high winds can include wood, brick, concrete, metal, and may also contain hazardous materials such as gas, oil, and cleaning solvents from damaged households and businesses. Though dealing with debris appears to be solely a post disaster problem, it also can be mitigated through pre-disaster actions including the designation of local debris disposal sites as has been done in Ashby The occurrence of these storm events in the Ashby region can be expected to be "highly likely", that is the frequency of 1-2 times each year means that Ashby needs to be prepared for high wind events.

While New England, and Ashby in particular, are not the area of the United States most burdened by hurricanes, the Atlantic coast of the United States can expect to see an average of 2 major hurricanes (Category 3, 4, or 5) every 3 years, and New England can expect one major landfall in each decade. This is in part due to the geography of Massachusetts—its projection easterly into the Atlantic places it in the typical path of storms that originate in Cape Verde or the Bahamas. The National Weather Service reports, "Southern New England has been affected by forty-one such storms since 1900, 12 of which made landfall with significant impact." It should be noted, however, that these historical paths are neither indicators of future behavior nor the full representation of hurricane impacts in the region. The heaviest areas of hurricane damage are on the eastern side of landfall, as the storm moves in a large counter-clockwise spinning spiral. The most damaging storms have actually made landfall and tracked to Ashby and this region- including the major 1938 unnamed hurricane that made landfall in Milford, Connecticut and the 1954 Hurricane Carol that made landfall in Old Saybrook, Connecticut.

Tropical Storm and Hurricane Tracks in the Montachusett Region and Ashby

The Montachusett Region and Ashby have experienced several Tropical Storms and Hurricanes between 1851 and 2003. Map 4 (see appendix 3) shows the tropical storm and hurricane tracks for the Montachusett Region during this time period. According to the National Oceanic and Atmospheric Administration, between 1851 and 2003 there have been 9 such events (see Table 9 Tropical Storm and Hurricane Tracks in the Montachusett Region and Ashby below). Of those 9 events, one had its storm track pass directly through the town of Ashby. In addition, it was noted in the Ashby Hazard & Vulnerability Session that strong winds knock down trees and have a potential to affect the telephone and electrical cables. The potential exists to also block roads and cause problems in an emergency response event. This type of event has occurred in the past, but most of the impacts in Ashby have been relatively minor to this point.

Table 9

Tropical Storm & Hurricane Tracks in the Montachusett Region (1851-2003)		
DATE	**CATEGORY**	**NAME**
9/28/1861	Tropical Storm	Not Named
9/30/1874	Tropical Storm	Not Named
10/10/1894	Tropical Storm	Not Named
8/31/1954	Category 2 Hurricane	Carol
7/30/1960	Tropical Storm	Brenda
9/12/1960	Category 2 Hurricane	Donna
9/15/1961	Tropical Storm	Not Named
9/27/1985	Category 1 Hurricane	Gloria
9/17/1999	Tropical Storm	Floyd

*Source- The National Oceanic and Atmospheric Administration

Tornadoes

Tornado Touchdown Locations in the Montachusett Region

The Montachusett Region has experienced several Tornado occurrences between 1951 and 2002. Map 6 (see appendix 3) shows the tornado occurrences and density in the Montachusett Region during this time period. According to the National Climatic Data Center, between 1951 and 2002 there have been 14 such events (see Table 10 Tornado Touchdown Locations in the Montachusett Region below). In the Ashby Hazard and Vulnerability Session the town indicated the same hazards exist related to Tornados as for Hurricanes. Strong winds knock down trees and have a potential to affect the telephone and electrical cable. The potential exists to also block roads and cause problems in an emergency response event. This type of event has occurred in the past, but most of the impacts have been relatively minor to this point.

Table 10

Tornado Touchdown Locations in the Montachusett Region (1951-2002)		
DATE	**F-SCALE**	**COMMUNITY**
6/9/1953	F4- Devastating	Petersham
6/1/1956	F1- Moderate	Fitchburg
11/21/1956	F2- Significant	Clinton
6/19/1957	F1- Moderate	Lancaster
7/5/1957	F2- Significant	Leominster
5/20/1963	F2- Significant	Clinton
7/11/1970	F1- Moderate	Townsend
7/1/1971	F1- Moderate	Ayer

11/7/1971	F1- Moderate	Hubbardston
8/9/1972	F2- Significant	Phillipston
6/22/1981	F3- Severe	Hubbardston
7/10/1989	F1- Moderate	Hubbardston
7/10/1989	F1- Moderate	Sterling
8/10/1990	F0- Gale	Gardner

*Source- National Climatic Data Center
(For an explanation of the F-Scale see Table TOR 2 below)

The National Weather Service reports that despite technological advances in equipment, the warning window for a tornado is still only about 2 minutes. In addition, this warning is very general, typically covering an area as large as a county. Massachusetts ranks nationally as 35th in occurrences of tornadoes for the period 1950 – 1995, but 16th in fatalities and 12th in property damages based on these same events.

Massachusetts can expect on average, three tornadoes per year throughout the state. Thus all populations are vulnerable, but given that 38% of tornado fatalities are in mobile homes, mobile home park residents are a more vulnerable group than the general population. The higher fatalities does not reflect the fact that mobile home parks are more likely to be hit by a tornado, but rather that if hit mobile homes are more vulnerable to damage.

The most devastating tornado ever to occur in New England was the Worcester Tornado of July 9, 1953. With little warning the tornado hit Worcester at 5:08 p.m. It first touched down in Petersham, and then traveled on a 46-mile southeast path through Barre, Rutland and Holden, across Worcester into Shrewsbury, Westboro and Southboro. Within a matter of minutes, more than 90 people were dead, and over 1,300 injured. Fifteen thousand were left homeless by this category 4 Tornado. Wind speeds of 207 to 260 miles per hour destroyed hundreds of homes. Damage estimates were placed in excess of $52 million in 1953 dollars.

Another damaging tornado occurred in Windsor Locks, Connecticut, on the Massachusetts border, at about 3:00 p.m. on October 3, 1979. The Tornado lasted only about one minute, but killed three people, injured over 300, destroyed 40 homes and caused $300 million in property damage, including the destruction of an airplane museum.

The most recent killer tornado to hit New England occurred on May 29, 1995, in Great Barrington, Massachusetts. This tornado had winds in excess of 200 miles per hour, three people were killed, 23 injured, and it caused an estimated $25 million in damage.

Makeup of Tornadoes

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud with whirling winds of up to 300 miles per hour. These events are spawned by thunderstorms and occasionally by hurricanes, and may occur singularly or in groups. Tornadoes can occur at anytime of the year, although they are rare outside of the warm season. The peak months of tornado, "Tornado Season" occurs in the Northeast from May through September, with August being the month of greatest tornado frequency. Most tornadoes are likely to occur during the mid-afternoon and evening hours (3-6PM). However, they can occur at any time, often with little or no warning.

Tornadoes move at an average speed of 30 miles per hour and generally move from the southwest to northeast. Their direction of travel can be erratic. These short-lived storms are the most violent of all atmospheric phenomena and the most destructive over a small area. Tornadoes are commonly found in the right front quadrant of an approaching storm.

On average the United States experiences 100,000 thunderstorms each year. Approximately 1,000 tornadoes develop from these storms. Damage from tornadoes is caused as a result of high wind velocity and wind blown debris. Normally, a tornado will stay on the ground for no more than 20 minutes.

Injuries and deaths most often occur when buildings collapse. The tornadoes experienced in recent history in New England have been generated by severe summer storms. Although these tornadoes are not as intense as those that form in the Midwest tornado belt they can still inflict tremendous damage with little or no warning.

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Because wind is invisible, you can't always see a tornado. A visible sign of the tornado is the dust and debris which can get caught in the rotating column made up of water droplets. Tornadoes are the most violent of all atmospheric storms.

There are two types of tornadoes: those that come from a supercell thunderstorm and those that do not. Tornadoes that form from a supercell thunderstorm are the most common and often the most dangerous. A supercell is a long-lived (greater than 1 hour) and highly organized storm feeding off an updraft (a rising current of air) that is tilted and rotating. This rotating updraft - as large as 10 miles in diameter and up to 50,000 feet tall - can be present as much as 20 to 60 minutes before a tornado forms. Scientists call this rotation a mesocyclone when it is detected by Doppler radar. The tornado is a very small extension of this larger rotation.

Non-supercell tornadoes are circulations that form without a rotating updraft. One non-supercell tornado is the gustnado, a whirl of dust or debris at or near the ground with no condensation funnel, which forms along the gust front of a storm. Another non-supercell tornado is a landspout. A landspout is a tornado with a narrow, rope-like condensation funnel that forms when the thunderstorm cloud is still growing and there is no rotating updraft - the spinning motion originates near the ground. Waterspouts are similar to landspouts, except they occur over water. Damage from these types of tornadoes tends to be minor to moderate. (**www.nssl.noaa.gov**.)

Tornados are classified by the Fujita Tornado Damage Scale or F-Scale (see Table 11 below). This scale for rating tornado intensity is based on the damage tornadoes inflict on human-built structures and vegetation. The official Fujita Tornado Damage Scale category is determined by meteorologists (and engineers) after a ground and/or aerial damage survey; and depending on the circumstances, ground-swirl patterns (cycloidal marks), radar tracking, eyewitness testimonies, media reports and damage imagery, as well as photogrammetry/videogrammetry if video is available.

Table 11

The Fujita Tornado Damage Scale

F-SCALE NUMBER	INTENSITY PHRASE	WIND SPEED	TYPE OF DAMAGE DONE
F0	Gale tornado	< 73 mph	Light Damage- Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	Moderate tornado	73-112 mph	Moderate Damage- Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	Significant tornado	113-157 mph	Considerable Damage- Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	Severe tornado	158-206 mph	Severe Damage- Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	Devastating tornado	207-260 mph	Devastating Damage- Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Incredible Damage- Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

* Source- The National Oceanic & Atmospheric Administration

Hail and Thunderstorms

According to the National Climatic Data Center the Montachusett Region has experienced 74 Hail and/or Thunderstorm Wind events between 1955 and 2002 (see Table 12 Hail and Thunderstorm Wind Occurrences in the Montachusett Region below). Map 5 (see appendix 3) shows the locations of hail and thunderstorm wind events in the Montachusett Region during this time period. Of these 74 events, 2 events had their center in the Town of Ashby. At the Ashby Hazard & Vulnerability Session it was mentioned that during thunderstorms the Communication Station at the fire station gets hit fairly often and service is interrupted. As a result of this occurrence, the town now has a spare antenna for use during these events. Potential Monetary damages to buildings from thunderstorms can total $78,700 (source: Ashby Assessors Office)

Table 12

Hail & Thunderstorm Wind Occurrences

in the Montachusett Region (1955 -2002)

DATE	OCCURRENCE	COMMUNITY
6/1/1956	Hail Occurrence	Hubbardston
6/13/1956	Hail Occurrence	Fitchburg
6/19/1957	Hail Occurrence	Lancaster
7/5/1957	Hail Occurrence	Westminster
7/5/1957	Hail Occurrence	Fitchburg
8/12/1957	Hail Occurrence	Hubbardston
6/30/1961	Hail Occurrence	Townsend
5/31/1962	Hail Occurrence	Athol
5/31/1962	Hail Occurrence	Gardner
4/20/1963	Thunderstorm Wind Occurrence	Westminster
7/25/1967	Hail Occurrence	Winchendon
8/31/1973	Thunderstorm Wind Occurrence	Fitchburg
7/19/1974	Thunderstorm Wind Occurrence	Harvard
6/22/1988	Hail & Thunderstorm Wind Occurrence	Gardner
6/22/1988	Hail & Thunderstorm Wind Occurrence	Sterling
6/22/1988	Thunderstorm Wind Occurrence	Templeton
7/11/1988	Hail & Thunderstorm Wind Occurrence	Groton
7/14/1988	Thunderstorm Wind Occurrence	Winchendon
8/12/1988	Thunderstorm Wind Occurrence	Leominster
6/2/1989	Hail & Thunderstorm Wind Occurrence	Lunenburg
6/2/1989	Hail & Thunderstorm Wind Occurrence	Groton
6/2/1989	Hail & Thunderstorm Wind Occurrence	Groton
6/2/1989	Thunderstorm Wind Occurrence	Winchendon
6/2/1989	Thunderstorm Wind Occurrence	Winchendon
6/2/1989	Thunderstorm Wind Occurrence	Fitchburg
7/7/1989	Hail & Thunderstorm Wind Occurrence	Groton
7/28/1989	Thunderstorm Wind Occurrence	Hubbardston
8/6/1989	Thunderstorm Wind Occurrence	Hubbardston
6/11/1991	Hail & Thunderstorm Wind Occurrence	Royalston
8/18/1991	Thunderstorm Wind Occurrence	Ashby
7/8/1996	Hail & Thunderstorm Wind Occurrence	Athol
7/8/1996	Hail & Thunderstorm Wind Occurrence	Athol
7/8/1996	Hail Occurrence	Harvard
7/8/1996	Thunderstorm Wind Occurrence	Ayer
2/22/1997	Thunderstorm Wind Occurrence	Fitchburg
2/22/1997	Thunderstorm Wind Occurrence	Shirley
7/9/1997	Hail & Thunderstorm Wind Occurrence	Lunenburg

7/9/1997	Hail & Thunderstorm Wind Occurrence	Groton
7/9/1997	Thunderstorm Wind Occurrence	Templeton
7/17/1997	Hail & Thunderstorm Wind Occurrence	Athol
8/16/1997	Hail & Thunderstorm Wind Occurrence	Athol
5/20/1998	Hail & Thunderstorm Wind Occurrence	Royalston
5/29/1998	Hail & Thunderstorm Wind Occurrence	Athol
5/29/1998	Thunderstorm Wind Occurrence	Fitchburg
5/31/1998	Hail & Thunderstorm Wind Occurrence	Phillipston
5/31/1998	Hail & Thunderstorm Wind Occurrence	Gardner
5/31/1998	Thunderstorm Wind Occurrence	Winchendon
5/31/1998	Thunderstorm Wind Occurrence	Leominster
7/6/1999	Hail & Thunderstorm Wind Occurrence	Athol
7/6/1999	Thunderstorm Wind Occurrence	Templeton
7/24/1999	Thunderstorm Wind Occurrence	Shirley
7/25/1999	Hail Occurrence	Harvard
8/5/1999	Hail & Thunderstorm Wind Occurrence	Gardner
6/2/2000	Thunderstorm Wind Occurrence	Ashburnham
6/2/2000	Thunderstorm Wind Occurrence	Leominster
7/18/2000	Hail & Thunderstorm Wind Occurrence	Townsend
7/18/2000	Hail & Thunderstorm Wind Occurrence	Townsend
8/3/2000	Hail & Thunderstorm Wind Occurrence	Gardner
6/17/2001	Thunderstorm Wind Occurrence	Shirley
6/30/2001	Hail & Thunderstorm Wind Occurrence	Sterling
7/1/2001	Hail & Thunderstorm Wind Occurrence	Athol
7/1/2001	Hail & Thunderstorm Wind Occurrence	Groton
7/1/2001	Thunderstorm Wind Occurrence	Templeton
7/1/2001	Thunderstorm Wind Occurrence	Ashby
7/1/2001	Thunderstorm Wind Occurrence	Fitchburg
8/3/2001	Hail Occurrence	Petersham
5/31/2002	Hail & Thunderstorm Wind Occurrence	Gardner
5/31/2002	Hail & Thunderstorm Wind Occurrence	Townsend
5/31/2002	Thunderstorm Wind Occurrence	Winchendon
6/2/2002	Hail & Thunderstorm Wind Occurrence	Gardner
7/15/2002	Hail & Thunderstorm Wind Occurrence	Sterling
8/2/2002	Thunderstorm Wind Occurrence	Fitchburg
8/16/2002	Hail & Thunderstorm Wind Occurrence	Phillipston
8/16/2002	Hail & Thunderstorm Wind Occurrence	Gardner

*Source- The National Climatic Data Center

Massachusetts is regularly susceptible to flooding from severe rainstorms and thunderstorms throughout the warmer months.

A **thunderstorm** is a rain shower during which you hear thunder. Since thunder comes from lightning, all thunderstorms have lightning. According to the NOAA, a thunderstorm is classified as "severe" when it contains one or more of the following: hail three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), and/or tornadoes.

An average thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. At any given moment, there are roughly 2,000 thunderstorms in progress around the world. It is estimated that there are 100,000 thunderstorms each year. About 10% of these reach severe levels.

Three basic ingredients are required for a thunderstorm to form: moisture, rising unstable air (air that keeps rising when given a nudge), and a lifting mechanism to provide the "nudge." The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise upward -- hills or mountains, or areas where warm/cold or wet/dry air bump together can cause rising motion -- it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the surface of the earth to the upper levels of the atmosphere (the process of convection). The water vapor it contains begins to cool, releasing the heat; and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice, and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound waves we hear as thunder.

In summary, wind damage due to a variety of causes (hurricanes, Nor'easters, winter storms, tornadoes) is highly likely in Ashby and the Montachusett region, and could have a dramatic potential. The severity of the impacts on persons, property, and public infrastructure can be expected to be significant but limited in scope in Ashby.

3. WINTER RELATED HAZARDS

Winter weather in Massachusetts and southern New England can be described as unpredictable. Days of frigid, arctic air and below freezing temperatures may be followed by days of mild temperatures in the 40s or 50s. Nor'easters, as described in the previous section, are also common and given the precise temperature can result in heavy rain and strong winds and/or blizzard conditions.

Ashby Snow Storms

Map 8 (see appendix 3) shows the 2-Day Record Snowfall totals and averages for the Montachusett Region from 1948 to 2002. According to the National Climatic Data Center, the 2-day record snowfall total for the as recorded by the Ashburnham Weather Station is 24 inches for Ashby.

Information obtained at the Ashby Hazard & Vulnerability Session is that the town has applied for and received Blizzard Reimbursement Funds four times in the last 30 years; 1978, 1992, 1996 and 2005.

Heavy Snow

Snow is frozen precipitation in the form of a six-sided ice crystal. Snow formation requires temperatures to be below freezing in all or most of the atmosphere from the surface up to cloud level. Snow can fall when surface temperatures are above freezing in a relatively shallow layer. In situations like this, the snow will not have enough time to melt before reaching the ground - though it will be quite wet with large flakes, the result of wet snowflakes sticking to one another.

Generally, ten inches of snow will melt into one inch of water. Sometimes the snow-liquid ratio may be much higher - on the order of 20:1 or 30:1. This commonly happens when snow falls into a very cold airmass, with temperatures of 20 degrees or less at ground-level.

While melting snow adds to flooding, snowfall also presents a nonflooding hazard as access to critical facilities may be compromised by large amounts of snowfall. Variations on this hazard are a snowstorm in combination with rain that produces a very heavy wet snow or ice storms both of which weigh down trees and power lines. In February of 2004, the American Meteorological Society initiated a rating scale for winter storms. The Category 1-5 scale is intended to be used to assess damage rather than predict impacts. Snowstorms are difficult to predict and small temperature fluctuations determine the difference between snow and rain. The scale presents categories of increasing intensity- notable, significant, major, crippling and extreme storms- based on the amount of snow, area affected, and population impacted.

Ice Jams

Ice Jam Occurrences in the Montachusett Region

The Montachusett Region has experienced several Ice Jam Occurrences between 1914 and 2005. Map 9 (see appendix 3) shows the Ice Jam Occurrences during this time period. According to the United States Army Corps of Engineers, there have been 34 Ice Jam Occurrences between 1914 and 2005 (see Table 13 Ice Jam Occurrences in the Montachusett Region below).

Table 13

Ice Jam Occurrences in the Montachusett Region (1913-1999)

DATE	COMMUNITY	RIVER
3/12/1936	Athol	Millers River
12/26/1937	Winchendon	Priest Brook
1/25/1938	Winchendon	Millers River
4/2/1940	Winchendon	Priest Brook
2/11/1941	Royalston	Millers River
1/9/1943	Royalston	Millers River
1/6/1949	Leominster	North Nashua River
2/7/1951	Sterling	Rocky Brook
2/9/1951	Winchendon	Priest Brook
12/21/1951	Royalston	Millers River
2/2/1953	Sterling	Rocky Brook
1/24/1957	Royalston	Millers River
2/20/1958	Royalston	Millers River

1/24/1959	Royalston	Millers River
4/3/1959	Winchendon	Priest Brook
3/31/1960	Sterling	Rocky Brook
12/12/1960	Leominster	North Nashua River
2/26/1961	Royalston	Millers River
1/21/1964	Sterling	Rocky Brook
1/23/1964	Royalston	Millers River
2/11/1965	Gardner/Templeton	Otter River
2/25/1965	Sterling	Rocky Brook
3/19/1968	Winchendon	Priest Brook
1/3/1969	Royalston	Millers River
1/15/1970	Royalston	Millers River
2/4/1970	Gardner/Templeton	Otter River
2/4/1970	Winchendon	Millers River
1/24/1971	Royalston	Millers River
1/10/1973	Royalston	Millers River
1/?/1996	Athol	Millers River
1/24/1999	Westminster	Nashua River
1/17/2004	Athol	Millers River
1/24/2005	Athol	Millers River
12/15/2005	Athol	Millers River

*Source- United States Army Corps of Engineers

Ice jams occur in the winter or early spring when normally flowing water begins to freeze. There are two types of ice jams; a freeze up and a breakup jam. A freeze up jam forms in the early winter as ice formation begins. This type of jam can act as a dam and begins to back up the flowing water behind it. The second type, a break up jam forms as a result of the breakup of ice cover, causing large pieces of ice to move downstream potentially acting as a dam, impacting culverts and bridge abutments. The Great Flood of 1936 in the Connecticut River Valley is an example of how much damage could be done to bridges and communities. A recent film on WGBY Television (The Great Flood of 1936: The Connecticut River Story) documented the results with actual footage and interviews with people who were there. The following is from the film jacket;

> "In March of 1936, the greatest flood in over 300 years roared down the Connecticut River. A hard winter followed by exceptionally early, warm spring weather unleashed an armada of icebergs that destroyed everything in its path. A huge ice jam, the likes of which had not been seen in the Connecticut River Valley since the Ice Age, dammed the river. When the dam finally burst, the roar was heard for miles." The Connecticut River overflowed "…its banks, inundating towns, destroying homes and bridges, and leaving thousands of people homeless."

This is a good example of why Pre-Disaster Mitigation can be so important.

Ice Storms

Ice storms are a much more common occurrence in Ashby than some of the other weather events such as ice jams. Every winter the community is faced with one or more ice storms.

There are several weather phenomena that can create ice storm conditions. Rain droplets that fall into a shallow layer of cold air near the earth's surface can freeze upon contact with the ground, leaving a coating of ice known as freezing rain. Freezing rain most often occurs when mild, moist air is layered over a cold polar or artic air mass near the earth's surface. Lower elevations are often vulnerable to ice storms - significant and damaging accumulations of ice - since cold, dense air will naturally settle into lower elevations.

For example, it is quite typical for the Ashby Region to receive an ice storm when cold air in the valleys is "overridden" by milder, moist air from the Atlantic. Freezing rain causes dangerous traveling conditions. Rain can freeze on anything it contacts, including roads, rail tracks, and sidewalks. It is extremely difficult to drive on a road glazed over with ice. Bridges and overpasses, which typically freeze quicker than other surfaces, are particularly hazardous to drivers. Aviation can be brought to a standstill due to dangerous icing conditions.

Power outages are also common in an ice storm. The weight of the ice formed by **freezing rain** often causes downed power lines and tree limbs, leaving thousands in the affected area without electricity.

Another form of freezing precipitation is **ice pellets**, which occur when snowflakes melt into raindrops as they pass through a thin layer of warmer air. The raindrops then refreeze into particles of ice when they fall into a layer of sub-freezing air near the surface of the earth.

Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. Sleet is different from hail. Sleet is a wintertime phenomena; hail falls from convective clouds (usually thunderstorms) under completely different atmospheric conditions - and often during the warm spring and summer months. Examples have occurred in the Ashby region where heavy accumulations of hail have threatened flat roofed buildings and interfered with summertime traffic and events.

Blizzards

Blizzards are also relatively common in Ashby. They are characterized by low temperatures (usually below 20°F) and accompanied by winds that are at least 35 mph or greater. There must also be sufficient falling and/or blowing snow in the air that will frequently reduce visibility to 1/4 mile or less for the duration of at least 3 hours. A “severe” blizzard is categorized as having temperatures near or below 10 °F, winds exceeding 45 mph, and visibility reduced by snow to near zero.

Storm systems powerful enough to cause blizzards usually form when the jet stream dips far to the south, allowing cold air from the north to clash with warm air from the south. Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, resulting in strong winds and extreme conditions due to the blowing snow

4. FIRE RELATED HAZARDS

Droughts

Drought is a temporary irregularity and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought occurs in virtually all-climatic zones yet its characteristics vary significantly from one region to another, since it is relative to the normal precipitation in that region.

The American Meteorology Society defines drought as a period of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. The National Climatic Data Center uses the Palmer Drought Severity Index (PDSI) to compute drought conditions.

Beyond its role as a factor leading to wildfire, drought also has impacts on public safety for all firefighting activity, agricultural production, and economic vitality of large users such as golf courses or industrial processes. According to the 2002 Massachusetts Drought Management Plan, Massachusetts generally has enough precipitation to support the demands residents and businesses place on water.

Ashby and Droughts

Periods of drought are not unheard of though, with the 1960s and more recently 1999 – 2000, and 2002 being notable times of water stress. At the present time in the Ashby region water levels are lower than usual due to the lack of rainfall over the summer and early fall as well as the limited amount of snow in the past winter. Local suppliers are encouraged to develop Drought Plans that include drought indicators and drought triggers. Following the plan may lead to the institution of voluntary or mandatory water use restriction policies. According to the state plan, “Municipal governments are critically important to managing drought situations and assessing the impact of drought situations.”

The Commonwealth of Massachusetts is often considered a “water-rich” state. Under normal conditions, regions across the state annually receive between 40 and 50 inches of precipitation. However, Massachusetts can experience extended periods of dry weather, from single season events to multi-year events such as experienced in the mid 1960s. Historically, most droughts in Massachusetts have started with dry winters, rather than a dry summer.

According to the Massachusetts Department of Conservation and Recreation, the Central Drought Region, of which Ashby is a part of, experiences 50 months of drought emergency per 100 years.

At the Ashby Hazard and Vulnerability Session, the town indicated they believe drought events could affect the ability to fight fires, depending on the extent of the drought. The town has a lack of pressurized hydrant systems. Some of the water sources could dry up or diminish affecting that ability to fight fires. The town has a lot of woods, which would increase the likelihood of forest fires in the event of a drought occurrence. Another concern of the town was that many people in the town depend on well water. Depending on the extent of the drought the water levels would be significantly reduced, making it difficult to draw enough water. Most of the elderly citizens in the town have old, hand dug wells which may be particularly difficult to draw water from.

The Massachusetts Drought Management Plan was developed as part of the response to the period of precipitation deficiency beginning in the spring and summer of 1999. In some areas of the state, cumulative deficits in precipitation reached 8-12 inches below normal over a 12-month period. Streamflows across much of the state routinely fell below the 25th percentile of their historical flows for the month (within the lowest 25 percent on record for the month) and many with long periods of record, set record low streamflow levels. Groundwater levels were also below normal throughout the summer over almost the entire state. While the Metropolitan District Commission's (MDC) Quabbin and Wachusett Reservoirs were at near normal capacity during the summer, Worcester's reservoir dropped to only 60-70 percent of capacity. Worcester is a member of the Massachusetts Watershed Resource Authority MWRA so the Town was not in trouble. But it was necessary for Worcester to supplement its supply with MDC water for the first time in almost 20 years. Precipitation remained below normal for the period from April, 1999 to March, 2000. While the summer of 2000 provided relief from these dry conditions, it is worth noting that the conditions in the first few months of the year were slightly worse than the early years of the drought of record experienced during the 1960's.

The following table provides the drought indications that are used to determine the drought level or severity.

Drought Indices

Drought Level	PDI	CMI*	Fire*	Precipitation	Groundwater	Streamflow	Reservoir
Normal	-1.0 to -1.99	0.0 to –1.0 slightly dry	Low	1 month below normal	2 consecutive months below normal **	1 month below normal**	Reservoir levels at or near normal for the time of year
Advisory	-2.0 to -2.99	-1.0 to -1.9 abnormally dry	Moderate	2 month cumulative below 65% of normal	3 consecutive months below normal**	At least 2 out of 3 consecutive months below normal**	Small index Reservoirs below normal
Watch	-3.0 to 3.99	-2.0 to -2.9 excessively dry	High	1 of the following criteria met: 3 month cum.<65%or 6 month cum. <70% or 12 month cum.<70%	4-5 consecutive months below normal**	At least 4 out of 5 consecutive months below normal**	Medium index Reservoirs below normal
Warning	-4.0 and below	<-2.9 severely dry	Very High	1 of the following criteria met: 3 month cum.<65% and 6 month cum.<65% or 6 month cum. <65% and 12 month cum. <65% or 3 month cum. <65% and 12 month cum. <65%	6-7 consecutive months below normal**	At least 6 out of 7 consecutive months below normal**	Large index reservoirs Below normal
Emergency	-4.0% and below	<2.9 severely dry	Extreme	Same criteria as Warning And Previous month was Warning or Emergency	>8 months below normal**	>7 months below normal**	Continuation of previous months condition's

*The Crop Moisture Index and the Fire Danger levels are subject to frequent change. The drought level for these two indicators is determined based on the repeated or extended occurrence of each index at a given level. Below normal for groundwater and streamflow are defined as being within the lowest 25% of the period of record.

Major Fires

A major fire or conflagration is a large destructive, often uncontrollable fire that spreads substantial destruction. The regional *Forest Vegetation Map* includes major power lines and railroads since both of these corridors are often the starting point for fires. Like state forests, power lines and railroad tracks attract humans who may carelessly start fires, and more often than not, trains themselves, and work on the rails spark many fires.

Wildfires

A wildfire can be defined as a naturally occurring, highly destructive, uncontrollable fire. Risk of wildfires has the potential to be significant in the Ashby area because of the many heavily wooded areas. Wildfire risk to developed areas is less, given the existing fire protection service and facilities. Although new construction in heavily wooded areas could pose a threat if vegetation is not managed properly

Map 12 (see appendix 3) shows the outdoor fire risk by community in the Montachusett Region based on past occurrences between 1995 and 2001. According to the Massachusetts Department of Conservation and Recreation the town of Ashby is considered to have a low fire risk. 24 outdoor fires were reported by the town during this time period, averaging 3.43 outdoor fires per year.

Wildfires are a natural part of the Montachusett Region's ecosystem. Fires keep the forest floor clean of debris, encourage the growth of grasses that serve as wildlife feed, and ensure that trees have plenty of room to grow. Natural fires, recurring in a cyclical manner, can recycle nutrients and create a diversity of natural habitats. In these ways, wildfires that occur in isolated areas can be a positive force.

Increasingly, however, development is encroaching into isolated areas of Ashby and wildfires present a danger to human life and manmade facilities. Forest fires that were in remote areas are now forest fires in people's backyards. The dual issues of human suppression of forest fires and human encroachment into forest areas, has increased the risks associated with wildfire. The Wildlands/Residential Interface is getting more attention because as development (particularly low-density residential development) pushes into flammable vegetative areas the threats of wildfires increase.

Wildfires are influenced by three major factors: weather, topography, and fuel. These three factors can combine in different ways to produce different levels of wildfire threats. Weather, in particular long periods of drought but also lightning strikes and winds influence the behavior of wildfires. Fire hazard is generally higher in the spring and fall when there are dry and windy conditions. Topography is a factor as steep slopes and gulleys can act as a chimney for fires and the presence or lack of fuel – low shrubs and branches, wood, roofs, wood piles, etc – can shape the resulting fire.

The types of injuries that wildfire can cause include: loss of life, loss of property, and environmental damage. Fighting fires relies on having adequate access to the area and sufficient water. Ashby is somewhat more at risk because it does not have a town-wide public water system. In Ashby, fire fighters rely on water tankers, dry hydrants, and fire ponds and there is a potential for homes to be lost.

After a wildfire there is the potential for increased erosion, hydrophobic soils (soil that is hydrophobic- causes water to collect on the soil surface rather than infiltrate into the ground. Wild fires generally cause soils to be hydrophobic temporarily, which increases surface runoff and erosion in post-burn sites), and major shifts in habitat, depending on the severity and speed of the burn.

Similar to hurricanes, one of the largest risk factors for wildfires is the complacency of a population that is unfamiliar with the danger. Many years have gone by since there was a major wildfire in Ashby. New development in recent years is located in forested areas that have not been cleared of flammable brush, etc. and homeowners who come from urban areas are not aware of the wildfire risk.

Drought is the main factor that determines the intensity of a wildfire season - the less moisture present in trees and vegetation, the more likely they are to ignite and the hotter they will burn. The probability of wildfires in the region is almost certain every year. And whether caused by nature, careless campers, or the sparks that fly from railroads, most fires in Ashby are of a limited nature. They take a great deal of physical effort to extinguish especially on hot dry days or during a drought, but Ashby's fire department is experienced and prepared to deal with these events.

It was stated at the Ashby Hazard & Vulnerability Session that in the past the town has been very lucky in terms of forest fires, they have not been too much of a problem. However, if a forest fire were to occur, the town has a lot of state property that may be difficult to access in order to fight a forest fire.

Map 3 (see appendix 3) shows the fire hazards that were indicated at the Ashby Hazard & Vulnerability Session.

<u>Government's Role in Dealing with Drought Related Hazards</u>

Massachusetts Local Government: Local governments or waters suppliers, either independently or in conjunction with the Department of Environmental Protection (DEP), are responsible for the management of their systems to ensure that they can provide water sufficient to meet public health and safety needs.

When dry conditions occur, actions by local government and water suppliers can range from requesting voluntary compliance with water use restrictions to declarations of local water emergencies (either under local bylaw or through petition to the DEP) based on the status of their local water supplies.

Massachusetts Department of Environmental Protection: DEP has the authority to declare water emergencies for communities facing public health or safety threats as a result of the status of their water supply system, whether caused by drought conditions or for other reasons. Such local-based response is perhaps the most important element in managing public water supplies during drought situations as almost all water supplies are locally or regionally controlled.

Massachusetts Department of Food and Agriculture: Crop losses can pose severe financial impacts on farmers, aquaculturists, and other agricultural businesses. The Department of Food and Agriculture is responsible for recommending to the Governor, through the Secretary of Environmental Affairs, an emergency declaration or other needed steps based on either actual or predicted impacts to agricultural products. This declaration is often made in anticipation of crop failures so that the Commonwealth will be eligible to receive federal disaster assistance from the U.S. Department of Agriculture (USDA). If the assistance is available to individual farms, the Department works to ensure that these farmers are aware of that aid.

Massachusetts Department of Environmental Management: Risk of fires in wild land, rural areas, state forests and parks in the Ashby Region are linked to dry conditions. In addition, a drought can impact the availability of water for fire suppression. Assessment of fire risk and management of fire control resources is an on-going activity of the Bureau of Forest fire Control under the Department of Environmental Management. It is the responsibility of DEM Director of Forestry to manage state fire suppression resources and to coordinate with other local, state, and federal agencies, as well as other states to coordinate the appropriate resources given the situation.

Massachusetts Department of Fisheries and Wildlife: Dry conditions can lead to a range of impacts to fisheries and wildlife, from reducing food sources to fish kills or displacement of certain populations of animals. Department responses include responding to incidents of wildlife entering residential or urban areas. They also include identifying developing impacts to specific fisheries and wildlife populations so that other agencies, such as local governments, DEP or others, can implement measures to reduce the impacts to these resources. For example, if low streamflows threaten fish populations, DFW can work with DEP and local municipalities to ensure that water restrictions are in place to minimize the impact from water use in these areas.

Massachusetts Emergency Management Agency: Dry conditions can have severe impacts on public water supply providers, farmers and other water users. MEMA is responsible for coordination of Federal, State, local, voluntary and private resources during a large-scale emergency. MEMA's network includes public health and safety officers, emergency workers, fire, police, public works and transportation officials, non-profit & volunteer agencies, private businesses & industry and all Federal agencies. MEMA's coordination effort includes rapid deployment of appropriate resources, such as drinking water, to sustain public health and safety.

Massachusetts Department of Public Health: Dry conditions can impact the availability of water and the quality of water. Low water pressures can result in bacteria problems in water distribution systems. Low water levels in surface water supplies can also result in water quality problems. The local Departments of Public Health in conjunction with the state monitor drinking water quality in communities. The state Department of Public Health provides notification to communities on necessary steps to purify drinking water.

5.

GEOLOGICAL RELATED HAZARDS

Earthquakes

Earthquake Events in the Montachusett Region

The Montachusett Region has been affected by several earthquake events between 1978 and 2007. Map 10 (see appendix 3) shows the locations of fault lines and earthquake events during this time period. According to the Weston Observatory of Boston College there have been five earthquake events that have had their center in the Montachusett Region between 1978 and 2007 (see Table 14 Earthquake Events in the Montachusett Region below).

Table 14

Earthquake Events in the Montachusett Region (1978-2007)

DATE	MAGNITUDE	COMMUNITY
11/9/1982	2.3	Petersham
2/9/1983	2.0	Athol
7/13/1993	1.6	Harvard
10/2/1994	2.4	Petersham
9/20/1996	2.2	Petersham

*Source- Weston Observatory of Boston College

There has not been an earthquake that is centered in Ashby. Due to the fact that earthquakes have the potential to impact a large area, it is important to note that there have been an additional 24 earthquake events during this time period in the communities that abut the Montachusett Region (see Table 15 Earthquake Events in the Communities Abutting the Montachusett Region below).

Table 15

Earthquake Events in the Communities Abutting

the Montachusett Region (1978-2007)

DATE	MAGNITUDE	COMMUNITY
9/1/1978	2.0	Boxborough
1/16/1983	2.1	Pepperell
2/10/1984	2.1	Boxborough
10/4/1985	1.8	Littleton
10/15/1985	3.1	Littleton
1/5/1986	1.7	New Ipswich, NH
1/5/1986	2.3	Littleton
4/3/1987	2.1	Dunstable
6/2/1988	1.6	Rindge, NH
11/29/1988	1.9	Boxborough
1/23/1990	3.6	Littleton
8/24/1990	2.0	Berlin
12/2/1992	1.5	Westford
7/28/1993	1.9	Tyngsborough
10/2/1994	3.1	Hardwick
10/2/1994	3.4	Hardwick
10/9/1995	2.6	Mason, NH
5/2/1996	1.9	Littleton
10/13/1999	2.6	Littleton
6/8/2000	1.4	Littleton
10/8/2004	0.2	Littleton
10/8/2004	1.2	Littleton
10/8/2004	1.8	Littleton
6/29/2007	0.9	Princeton

*Source- Weston Observatory of Boston College

When considering the potential of an earthquake in Ashby these nearby communities where earthquakes have been centered become relevant. Earthquakes have been centered in Rindge, New Hampshire, Adjacent New Ipswich, New Hampshire Pepperell to the east, and numerous quakes (10) have been recorded in Littleton since 1985.

An earthquake is the sudden release of strain vibration, sometimes violent, of the earth's surface that follows a release of energy in the earth's crust. The exact earthquake mechanism is still unknown; however, New England’s earthquakes appear to be the result of the cracking of the surface due to the compression and buckling of the North Atlantic Plate.

A fault is a fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other. Faults are divided into three main groups, depending on how they move. Normal faults occur in response to pulling or tension: the overlying block moves down the dip of the fault plane. Thrust (reverse) faults occur in response to squeezing or compression: the overlying block moves up the dip of the fault plane. Strike-slip (lateral) faults occur in response to either type of stress; the blocks move horizontally past one another. Most faulting along spreading zones is normal, along subduction zones is thrust, and along transform faults is strike-slip. Geologists have found that earthquakes tend to reoccur along faults, which reflect zones of weakness in the earth's crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

The focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus). Earthquakes with focal depths from the surface to about 43.5 miles are classified as shallow. Earthquakes with focal depths from 43.5 to 186 miles are classified as intermediate. The focus of deep earthquakes may reach depths of more than 435 miles. The focuses of most earthquakes are concentrated in the crust and upper mantle. The depth to the center of the Earth's core is about 3,960 miles, so even the deepest earthquakes originate in relatively shallow parts of the Earth's interior.

The epicenter of an earthquake is the point on the Earth's surface directly above the focus and the focus is the area of the fault where the sudden rupture takes place. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. Earthquakes beneath the ocean floor sometimes generate immense sea waves or tsunamis. It is expected that Ashby will not experience a tsunami unless there are extreme circumstances in the North Atlantic.

The severity of earthquake effects is dependent upon: magnitude of energy released; proximity to the epicenter; depth to the epicenter; duration; geologic characteristics; and, type of ground motion. When earthquakes occur, much of the damage is a result of structures falling under the stress created by the ground movement. Another significant effect is damage to the public and private infrastructure (i.e. water service, communication lines, drainage system). Because earthquakes are highly localized it is difficult to assign regional boundaries that share the same relative degree of risk. Major damage often occurs due to liquefaction. Liquefaction is the conversion of soil into a fluid-like mass. This can occur when loosely packed, waterlogged sediments lose their strength in response to strong shaking.

To better understand how an earthquake event may affect a given area the United States Geological Survey (USGS) has published a magnitude to intensity comparison guideline based on the Modified Mercalli Intensity Scale (see Table 16 Magnitude/Intensity Comparison below). While the magnitude of an earthquake measures the energy released at the source of an earthquake, the intensity measures the strength of shaking produced by an earthquake at a particular location. It is important to note that this table should be taken with extreme caution, since ground motion effects and thus intensity depend not only on the magnitude, but also on the distance to the epicenter, the depth of the earthquake's focus beneath the epicenter, and geological conditions (certain terrains can amplify seismic signals).

Table 16

Magnitude / Intensity Comparison

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

*Source- United States Geological Survey

6. *OTHER NATURAL HAZARDS*

Climate Change

Climate Change refers to unstable weather patterns caused by increases in the average global temperature. There is a consensus among climate scientists that these changes result from atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and other heat-trapping gases. These greenhouse gases form a blanket of pollution that stays in the atmosphere and may be the fundamental cause of climate instability characterized by severe weather events such as storms, droughts, floods, heat waves, and sea level rise. Many of these weather events, aside from sea level rise can have an impact on Ashby. Even in the case of the rise in sea level, if this becomes dramatic that could also have an impact in the future by forcing coastal residents to move farther inland toward Ashby.

Is Climate Change Real?

Atmospheric concentrations of carbon dioxide are the highest they have been in 140,000 years, with concentrations going from 290 parts per million (ppm) in 1870 to 373 ppm today. A consensus of climate change scientists agrees that the increasing concentrations of Greenhouse Gases (GHGs) are causing a rise in average global temperatures. Whether or not this rise in temperature is fully human-induced, temperature records are being broken frequently. For example, 2003 was the third warmest year on record, following 2002, while 1998 remains the warmest year ever recorded. The International Panel for Climate Change (IPCC), a group sponsored by the United Nations and the World Meteorological Organization, representing more than 2,000 leading climate scientists, predicts an average temperature increase of 5-9°F by 2100, although a wider range of outcomes is possible. To put this number in perspective, only about 9°F separates the world at the beginning of the twenty-first century from the world at the end of the last Ice Age, more than 10,000 years ago.

What Could Be the Impacts of Climate Change on Massachusetts?

We should be concerned about climate change worldwide because, if it continues, it will bring significant humanitarian, environmental and economic impacts globally. While there is some scientific uncertainty as to the magnitude of these potential changes, there is broad agreement that such change would affect many aspects of our daily lives.

These impacts could result in changes for Ashby. For example, the New England Regional Assessment (NERA) predicts that if climate trends continue as projected, the weather patterns in the Ashby region at the end of this century would look more like those now found in Richmond, Virginia or Atlanta, and Georgia. Climate change on this scale would have wide-ranging consequences for Ashby.

Potential Impacts of Climate Change

***Weather Events*:** Weather extremes, already a characteristic of the Ashby region, are likely to become more frequent and cause more damage under a changing climate. While no one storm is directly attributable to climate change, an increasing number of such events could become more commonplace, severely interrupting life and economic activity in the Ashby Region. For example, downed power lines, overburdened septic systems, and travel delays are all costs that would have to be borne by residents.

Economic Impacts: Climate change would have impacts on important industries from tourism to agriculture, which rely on the strength and vitality of our natural resources.

Water Resources: While Ashby would be less affected than communities to the south, higher temperatures would accelerate evaporation and cause drier conditions and droughts, placing pressure on water resources, which are already stressed by regional growth. Water shortages in Ashby could, in turn, alter the natural fish populations in rivers, streams, lakes, and ponds including ground water supplies.

Fish and Ocean Impacts: A warmer, saltier ocean and changing coastal currents would alter coastal and marine ecosystems, affecting the distribution, growth rate, and survival of our commercial fish, shellfish, and lobster stocks as well as our farmed fish and shellfish. This could have an effect on what seafood we eat, and how much it will cost us, even in the non-coastal area of Ashby.

Human Health and Comfort: While CO_2 itself is non-toxic, its warming effects cause hotter weather with more frequent and severe heat waves, posing multiple health risks that include a rise in heat-related illness, more frequent periods of harmful outdoor air quality, and the spread of certain diseases by increasing numbers of ticks and other carriers in the Ashby area.

Natural Resources: Climate change could have serious impacts on Ashby's diverse ecosystems, native species, and may encourage the spread of non-native species. It would also likely alter the natural range of many different plants and animals.

Weather Extremes a Taste of Things to Come

The following is excerpted from a Washington Post article printed in the Daily Hampshire Gazette on August 9, 2007.

“A monsoon dropped 14 inches of rain in one day across many parts of South Asia this month. Germany had the wettest May on record, and April was the driest there in a century. Temperatures in Bulgaria reached 113 degrees last month and 90 Degrees in Moscow in late May, shattering longtime records.”

“The year still has almost five months to go, but it has already experienced a range of weather extremes that the United Nations’ World Meteorological Organization said … is well outside the historical norm and is a precursor of greater weather variability as global warming transforms the planet."

"The warming trend confirmed in February by the Intergovernmental Panel on Climate Change—based on the findings that 11 of the past 12 years had higher average ground temperatures than any others since formal temperature recording began—appears to have continued with a vengeance…. The WMO reported that January and April were the warmest worldwide ever recorded."

"Climate change projections indicate it to be very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent…." "The average Northern Hemisphere temperatures during the second half of the 20th century were very likely the highest during any other 50-year period in the last 500 years, and likely the highest in the past 1300 years….." "the warming of the globe is expected to result in more extreme weather because of changes in atmospheric wind patterns and the ability of warmer air to hold more moisture…." "Projected is an increase in extreme events as the global temperatures rise…" including "floods, droughts and heat waves" Also predicted was that "temperate zones such as Europe and the United States are likely to become more prone to flooding and areas closer to the equator will experience more drought."

"What is frightening …is that it's all happening more quickly that the earlier models predicted…."

Extreme Temperatures

There is no universal definition for extreme temperatures. The term is relative to the usual weather in the region based on climatic averages. Extreme heat is usually defined as a period of 3 or more consecutive days above 90 °F. But more generally a prolonged period of excessively hot weather, which may be accompanied by high humidity. Extreme cold again is relative to the normal climatic lows in a region. Temperatures that drop decidedly below normal and wind speeds that increase can cause harmful wind-chill factors. The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Ashby has four seasons. The seasons have several defining factors, but temperature is the most important. The average temperatures for Ashby are:

20°F average in January
67.2°F average in July

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. The lowest temperatures in the Ashby area can be below -20 degrees.

Extreme heat

In 2006, the average temperature in November was 52 degrees. This was 2.2 degrees warmer than the 20th century average, the 12th warmest November in 112 years. This is important when we consider temperatures in *Ashby* can go over 100 degrees.

From 1979 –2002, excessive heat exposure caused 8,966 deaths in the United States. During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

Because most heat-related deaths occur during the summer and because weather projections for this coming years indicate hotter-than-average summers, residents should be aware of who is at the greatest risk and what actions can be taken to prevent a heat-related illness or death. At greater risk are the elderly, children, and people with certain medical conditions, such as heart disease. However, even young and healthy individuals can succumb to heat if they participate in strenuous physical activities during hot weather. Some behaviors also put people at greater risk: drinking alcohol; taking part in strenuous outdoor physical activities in hot weather; and taking medications that impair the body's ability to regulate its temperature or that inhibit perspiration.

Beavers

This section deals with the different aspects of hazards caused by beavers. In all of the communities of the Montachusett Region beavers have been a concern. It takes a great deal of time and expense to control their activities. During most of the Hazard Identification workshops, including Ashby's, at least ½ of the time was spent on beaver related issues. These hazards of course relate directly to other hazards such as rain storms, hurricanes, floods, and winter related storms.

Beaver-caused flooding in Ashby can create valuable wetlands and improve flood storage capacity for certain areas thus acting as a positive factor in flood hazard mitigation. However, when beavers in Ashby build their dams in areas where there is increased residential development, roads and agricultural use of the land, the flooding that results can cause serious public and private property damage, often threatening homes, septic systems, low-lying roadways, and other public infrastructure. (For specific documentation see below, "Ashby: Critical infrastructure in Beaver Hazard Areas.")

Over the last several years, there has been an increase in problems with beaver dams in the Ashby region with beaver-induced flooding causing health and safety problems. Flooding has compromised septic systems throughout the Region, and state and local governments have responded to this crisis with a complex regulatory process. The process places its highest priority on protecting in-ground septic systems and road networks. Most of the regulatory process has been developed to respond to threats to the public health and safety.

Natural History

The beaver is a valuable component of Massachusetts' fauna. Beavers have played an active role in New England's ecology for thousands of years. Beavers are natural "engineers" of the land, they are agents of change, creating wetlands out of uplands and streams, and providing habitat for a variety of plants and animals.

For native peoples, beavers were a source of meat, skins and medicine. As Europeans colonized New England, beaver pelts served as a form of currency, creating an incentive for settlers to move further west and changing the relationship between Native Americans and Europeans - and Native Americans and beavers. Intensive hunting and trapping, and deforestation that came along with European colonization eliminated beavers throughout much of North America, including Ashby.

Not long ago the beaver was absent from Ashby. In fact, they were absent from the late 1700s to the early 1900s. Intensive unregulated hunting and trapping, combined with deforestation to clear land for agriculture, led to the disappearance of beaver habitat and the beaver. In the early 1900's, forested habitat started to recover when many farmers abandoned their farms in order to take jobs in cities or to start new farms in the more fertile Midwestern United States. With the forests able to retake the landscape, the beaver was able to return. In 1928, beaver were found in West Stockbridge. This was the first recorded occurrence of beaver in the state since 1750! The return of beaver was greeted with enthusiasm by the public and efforts to restore a beaver population were undertaken. Specific actions taken included the acquisition of three additional beaver from New York that were released in Lenox in 1932. In 1946 there were some 300 beavers in 45 colonies all located west of the Connecticut River. By 1951 the beaver population was such that the legislature authorized the establishment of a beaver trapping season. Consequently, in 1952 regulations were put in place to allow the regulated harvest of beaver. The regulations were designed conservatively to insure the perpetuation and continued growth of the beaver population.

When the beavers returned, an important component of Ashby's native ecosystems was restored. However, beavers returned to a landscape that had been substantially altered by people. In some areas, beaver activity in Ashby conflicted with human needs. Property damage, Giardia (a parasite that causes gastrointestinal illness in humans), and the flooding of roads, buildings and septic systems continue to be sources of concern for Ashby. Finding ways to co-exist with beavers that allow residents to benefit from their role in the environment yet minimize conflict between beavers and residents can be a challenge.

Beavers are North America's largest native rodents, weighing between 35 and 80 pounds as adults. They can range from two to two and a half feet in length, with an additional ten to eighteen inches in their tail used as a prop while standing upright, and for communication (beavers slap their tails on the water when alarmed). Although they are slow moving and awkward out of water, they do venture out on land in search of food.

Beavers look for a habitat containing shrubs and softwood trees, flat terrain, and perennial streams that can be dammed to create ponds. Beaver are generally associated with rivers, ponds, lakes, and areas that can be converted to beaver ponds. The water must be deep enough to provide suitable aquatic habitat under winter ice. Ashby's forestland provides excellent beaver habitat, and beaver have been fully restored in Ashby. As with the deer population, most likely there are more beavers in Ashby today, than in the past several hundred years.

There is no size difference between males and females. Beavers stay with the same mate for life and breed during winter (January through March). The females give birth to 1-9 kits (4 kits is the average) inside a lodge between April and June. Beavers are semi-aquatic mammals spending approximately 80% of their time in water. They are unique among mammals in that they alter their habitat to meet their needs, primarily by damming up small rivers and streams to form ponds. These ponds allow beavers to have access to food, protection from terrestrial predators, and shelter in winter. Their dams are structures built out of sticks and mud, with the base of the dam consisting of mud and stones. Beavers are constantly on the look-out for leaks or breaches in the dam; they are tipped off by the sound of escaping water.

Beavers do not eat fish; they are strict vegetarians, also known as herbivores. As such, they feed on a variety of aquatic plants (especially water lilies) and the shoots, twigs, leaves, roots, and bark of woody plants. In particular, the bark and inner bark of trees and shrubs are important foods, especially in winter. Poplar, aspen, birch, alder, maple, and willow are favored food plants. Beavers eat bark and cambium (the softer growing tissue under the bark of trees). Trees and shrubs are felled by beavers to gain access to twigs, leaves, and bark. Bark and leaves may be stripped where they fall or transported back to the safety of water. Cellulose, which usually can not be digested by mammals, is a major component of their diet. Beavers have microorganisms in their cecum (a sac between the large and small intestine) that digest this material.

Well-used beaver trails typically lead from a beaver pond to upland stands of important food trees. Trails near the pond often fill with water forming canals that are used by beavers to float sticks and logs from uplands to the pond. As winter approaches, branches are stockpiled on the pond bottom near the lodge. Beavers rely on this cache for food in winter. Once stripped of leaves and bark, branches and logs are often used as construction material for dams of lodges.

Adult beavers have few predators, and may live up to twenty years or more in the wild. For over ten thousand years, humans and timber wolves were the most significant predators of beavers in Massachusetts, hunting and utilizing beavers and thereby controlling the population. Timber wolves preyed extensively on beavers and undoubtedly exerted some control on beaver numbers. However, wolves were eliminated from Massachusetts in the early 1800s and are unlikely to return. Although otters, coyotes, and bobcats occasionally prey on beavers, they generally take too few to significantly influence beaver populations. Humans (through the regulated trapping season) are the primary mechanism available for removing beavers from the population and controlling their numbers. If the beaver population were allowed to grow uncontrollably (as it has been) it would inevitably result in increased property damage and flooding in Ashby.

Young beavers (kits) are very vulnerable, and are threatened by bears**,** wolves**,** wolverines**,** lynx**,** fishers and otters. An adult beaver's size is a deterrent to most predators, and though natural predators pose a very real danger to kits, man has proven to be, by far, the most dangerous predator to beavers. Killing beavers for their pelts, disrupting them through a change in habitat, and slowly poisoning them through pollution, which is known to infect wounds, all have lead to the threat which man poses on beavers.

If left unregulated, beaver populations can increase dramatically over a period of time. Depending on the number of offspring (4 to 9); a family of two beavers can reach over 100 adults and several hundred kits in a 10 year period.

<u>Beavers and Ashby</u>

Humans have utilized beavers as a fur and food product in New England for several thousand years. Like early colonists and Native Americans, people continue to harvest beavers for their fur, meat, leather, and glands. The difference between the harvest of beavers today and that of colonial times is that the beaver harvest is now closely regulated by our state wildlife agencies.

Beavers are a protected species in Massachusetts and there are laws and regulations that control when and how beavers may be taken. Historically in Massachusetts, approximately 1,300 beavers were harvested annually, providing a total of $40,000 in income for households in the state. Aside from using pelts to make garments like coats, hats, gloves, and blankets, over one-third of the fur harvesters utilize beaver as a food source for themselves or their pets. Parts of beavers are used to make perfumes; other parts are used to make customized leather products like wallets. Regulated harvests can serve to maintain beaver populations in Ashby at levels that are consistent with available habitat.

The most serious threat to the long-term survival of beavers in Ashby is the encroachment of human development on their habitats. With the slow, but steady increase in population growth in Ashby, homes and eventually commercial development will have a significant impact on beaver habitat. As human developments continue to fragment the landscape, areas available for beavers and other wildlife in Ashby are diminishing. As people encroach on wetland habitats, conflicts between people and beavers will occur more frequently.

Residential, commercial, and agricultural development in low lying areas adjacent to streams and ponds are vulnerable to inundation when beavers move into the area. A common concern is the flooding of roads. Culverts are particularly susceptible to the beavers' unceasing drive to stop flowing water. Drinking water can become contaminated when wells and septic systems are flooded. Houses and other structures that are inappropriately located in floodplains are also vulnerable.

Threats to Human Health and Safety

Threats to human health and safety in Ashby may include, but are not restricted to, beaver: (a) occupancy of a water supply; (b) flooding of drinking water wells; (c) flooding of sewage beds and septic systems; (d) flooding of public or private ways, driveways; (e) flooding of electrical, gas, or telephone transmission or distribution facilities, or other public utilities; (f) flooding affecting emergency facilities, homes for the elderly; (g) flooding affecting hazardous waste sites or facilities, incineration or other situations which may result in the release of hazardous materials; (h) gnawing, chewing, etc. of electrical or gas generation equipment, cables, or facilities; and (i) flooding or structural instability on private property.

Giardia / Beaver Fever

Beavers are often associated with concerns about the quality of drinking water. Water exiting a beaver pond is high in organic chemicals and may be a cause for concern if beaver ponds are located near water supplies. Giardia is an intestinal ailment cause by a Giardia parasite, and is referred to by some as "beaver fever" because beaver are known to carry the organism.

Giardia lamblia is a common, single-celled parasite, which can cause an illness of the intestines known as Giardiasis. The disease can be found throughout the world and is widespread among mammalian, avian, and reptile species; including humans, companion animals, wildlife, sheep and cattle, and wading birds. Giardia goes through two stages: during the trophozoite stage, or "active" stage, it is in the intestine of the host and cannot survive on its own. It becomes infectious when it enters the tough, protected cyst stage, and is shed in the feces of the host. In the cyst form, Giardia can be killed between 54-56º C (dies instantaneously at boiling point, 100º C), but it can last 2-3 months in cold water (<10º C).

When humans become sick with Giardia, the Giardia parasite is predominantly spread via person-to-person contact. Due to poor hygiene practices, it can often result in transmission in developing nations, day-care facilities, and institutional settings. Contamination of food and water sources from human or animal infected fecal material is also a means of transmission. Symptoms of the disease usually appear from nine to twelve days after exposure; however, they can appear within five to twenty-five days. Some people don't show any signs of illness at all although they may still shed the parasite. The disease is characterized by numerous intestinal symptoms that can last from one week to a few months, and may include diarrhea, flatulence, abdominal cramping and discomfort, fatigue, and weight loss. Treatment is available through prescribed antibiotics. Some individuals recover without the need for medication.

Giardia and Beaver

Research has shown that Giardia of human origin can be transmitted to several wildlife species. More research is needed, however, to determine the role wildlife plays in transmitting Giardia to humans. Being a highly visible species in Ashby area watersheds, the beaver has often been unfairly implicated as the source of Giardia contamination of fresh water resources. The term “beaver fever” is often used to describe waterborne outbreaks. However, current research shows that contamination from humans is regarded as a more probable source. In fact, humans are now considered to be the most common reservoir, as they shed 900 million cysts per day. Giardia from human sources can enter waterways by many different methods, such as washed-out septic systems, untreated human sewage discharged into waterways, cabin toilets, and backpackers and campers who inadvertently deposit contaminated feces in the environment that is washed away by rain and ends up in rivers and streams.

Other Beaver Hazards

Beavers do not appear to be able to control where trees they cut down will fall. Occasionally, beavers are crushed by trees that they themselves cut down. In Ashby where people and beavers occur together, it is only natural to expect that some trees will fall on cars, roads, railroad tracks, power lines, houses, or other structures. Although less common than other forms of damage in Ashby, it can be a cause for serious concern. Beavers are also noted for damaging ornamental trees and shrubs, as well as orchards and nurseries in their quest for food and building materials.

Cold-Water Fish

A hazard many in Ashby are unaware of is the cold water fishery. When beavers dam up a stream to produce a pond they also change the physical and chemical nature of the stream. Currents are slowed, water temperatures rise, and dissolved oxygen levels drop. Warm water fish, like perch and bass, benefit from the change. Trout which prefer cold, well oxygenated water have a more difficult time. In addition fish are prevented from migrating to upstream spawning areas.

Beaver Benefits

While many people think about beaver only when they are causing problems, it is important to remember the beneficial aspects of beavers. Since European settlement, more than half of the wetlands in the lower 48 states have been lost. By damming streams and forming shallow ponds, beavers create wetlands. These wetlands provide habitat for a tremendous diversity of plants, invertebrates, and wildlife, such as deer, bats, otter, herons, waterfowl, songbirds, raptors, salamanders, turtles, frogs, and fish. But it is not just wildlife that benefits from beaver-created wetlands; people benefit too. Wetlands control downstream flooding by storing and slowly releasing floodwater. They also improve water quality by removing or transforming excess nutrients, trapping silt, binding and removing toxic chemicals, and removing sediment. Flooded areas can also recharge groundwater.

Beaver Hazard Prevention and Management

Prior to 1996, Massachusetts Division of Fisheries and Wildlife (DFW) managed the beaver population through education, research, and regulated trapping. Because of the lack of natural predators on beavers, the main method DFW used to manage the beaver population was through regulated harvest by licensed trappers. In 1994, DFW started conducting surveys of beaver colony densities in three study areas within Massachusetts. One purpose of these surveys was to gather data that would help MDFW estimate the size of the beaver population within its current range. These surveys also enabled DFW to collect accurate information on current active colony densities, which not only would aid DFW in monitoring the population, but consequently would assist DFW in making decisions on how best to manage the beaver population at levels compatible with suitable habitat and public acceptance. In 1996, the voters of Massachusetts passed a ballot referendum known as "Question One". This referendum prohibited or restricted (by permit only) the use of many types of traps, which had been used by researchers and licensed trappers.

After "Question One" was enacted, statewide harvests dropped from 1,136 beaver, in the 1995-1996 season, to 98 in the 1997-1998 season, and the average annual harvest has been 157% below pre-1996 averages. Consequently, the beaver population experienced extreme growth from 24,000 in 1996 to some 70,000 five years later. In response to increasing conflicts between beaver and people, the Massachusetts Legislature modified "Question One" in 2000 and gave the local Boards of Health authority to issue emergency permits that allow the use of restricted traps and trapping outside the regulated trapping season.

Ashby – Critical Infrastructure in Beaver Hazard Areas

Information obtained from the Ashby Hazard & Vulnerability Session indicated that there are several areas of significance in the town regarding beaver hazards:

1) Brook crossing Bennett & Watatic Mountain Rd: A series of dams downstream causes flooding along these roads routinely. The culverts are showing signs of failure, but there is no money to repair them. An 80-100 foot section of Bennett Road is flooded in times of heavy rains. There is also one home is this area that has well water issues due to this problem.

2) Richardson Rd, north of Upper Wrights Pond: Beaver activity in this area creates flooding/swamping that backs-up a home-owners septic system creating health problems.

3) Harris Rd, west of New Ipswich Rd: This is a gravel road with a 36" squashed culvert and two 18" bypass pipes. Beavers are blocking up the culverts causing flooding and washing out of the road. This road is a dead-end, with a few homes that have no access other than Harris Rd. This could cause significant problems in an emergency response situation.

4) Pond north of Jones Hill Rd: Beaver activity and damming has created this pond. This dam has a potential to breach, wash across several roads and flood the meadow south of Foster Road. A potential breach would also have a domino affect on the culvert beneath Harris Road to the south.

5) Locke Brook, at Greenville Rd (Rt. 31): Beaver activity and damming has created flooding/swamping west of Greenville Rd.

6) Locke Rd, west of Hillside Dr: Beaver activity is blocking up the culvert causing occasional flooding. The highway department spends a lot of time trying to keep this culvert clear of debris. The homeowner to the south experiences occasional problems with their water well.

7) Body of water, east of New Ipswich & Harris Rd: Beaver activity and damming has actually created this body of water.

8) Body of water, west of Greenville Rd & north of Foster Rd: Beaver activity and damming has actually created this body of water.

9) Northeast corner of Lower Wrights Pond- Beaver activity and damming has caused flooding/swamping, occasionally creating sewer back-ups at the properties in this location.

Also noted was that the town recently placed beaver diverters at three locations throughout the town. The diverters have worked, as the areas have not needed clearing in at least one year.

Map 3 (see appendix 3) shows the beaver hazards that were indicated at the *Ashby* Hazard & Vulnerability Session.

GIS Analysis was performed relative to the location of Critical Infrastructure and other buildings that have the potential to be affected by beaver hazards. If any part of a parcel, building or structure intersected this hazard area then the building was considered to have the potential to be inside the beaver hazards. It should be noted that the hazard data is very approximate in nature; therefore it is not intended to depict exact locations of hazards, rather general areas where hazards may occur.

Through this analysis it was determined that approximately 6 pieces of critical infrastructure have the potential to be affected by these beaver hazards (see table 17 Critical Infrastructure in Beaver Hazard Areas below). It should be noted that other infrastructure such as roadways and rail lines may be affected by beaver hazards but are not included in the critical infrastructure. In addition, potential monetary damages due to loss of all buildings in these beaver hazards are approximately $10,981,400 (source: *Ashby* Assessor's Office). These figures do not take into account monetary damages to property and personal property as well as Critical Infrastructure that are not buildings such as bridges and dam.

Table 17

Critical Infrastructure in Beaver Hazard Areas	
NAME	**TYPE**
Bridge 799	Bridge
Bridge 7NJ	Bridge
Bridge 7NR	Bridge
Bridge 7QU	Bridge
Mount Watatic Dam NJ	Dam
Pines Campground	Public Water Supply

*Critical Infrastructure data were derived from various sources including MassGIS, EOT/MHD, MEMA, MA DCR, MA Dept of Early Education & Care, MART, MRPC and the Town of Ashby.
**Flood Zone data was downloaded from MassGIS.

Composite Natural Hazards

Using GIS, a Local Composite Natural Hazards data layer was developed. Local natural hazards identified in the Ashby Hazard & Vulnerability Session were overlaid with the FEMA Q3 Flood Zone. Each hazard area was given a value of one and the resulting overlay was added up to determine the Local Composite Natural Hazard value.

Map 13 (see appendix 3) shows the Local Composite Natural Hazards, the Critical Infrastructure and Potentially Developable Lands (from the buildout Analysis performed in 2000/2001) for the town of Ashby. Through GIS analysis, it was determined that Potentially Developable Lands comprise approximately 16.06 square miles of land. Of that area approximately 2.15 square miles (13.39%) are within the Local Composite Natural Hazards.

Ashby Critical Infrastructure and Local Composite Natural Hazards

GIS Analysis was performed relative to the location of Critical Infrastructure and other buildings that have the potential to be affected by the Local Composite Natural Hazards. At the recommendation of the Federal Insurance Administration a 250ft buffer was applied to the FEMA Q3 Flood Zones in determining whether structures are located within the Special Flood Hazard Area boundaries. If any part of a parcel, building or structure intersected this area then it was considered to have the potential to be inside the Local Composite Natural Hazards.

Through this analysis it was determined that approximately 30 pieces of critical infrastructure, 51% of a total 58 pieces of critical infrastructure, have the potential to be affected by at least one of the natural hazards that comprise the Local Composite Natural Hazards (see Table 18 Critical Infrastructure in Local Composite Natural Hazards below). It should be noted that other infrastructure such as roadways and rail lines may be affected by these hazards but are not included in the critical infrastructure. In addition, potential monetary damages due to loss of all buildings in these fire hazards are approximately $61,868,900 (source: Ashby Assessor's Office). These figures do not take into account monetary damages to property and personal property as well as Critical Infrastructure that are not buildings such as bridges and dams.

Table 18
Critical Infrastructure in

Local Composite Natural Hazards

NAME	TYPE
Bridge 25C	Bridge
Bridge 25D	Bridge
Bridge 25E	Bridge
Bridge 25F	Bridge
Bridge 284	Bridge
Bridge 285	Bridge
Bridge 70F	Bridge
Bridge 798	Bridge
Bridge 799	Bridge
Bridge 7NJ	Bridge
Bridge 7NK	Bridge
Bridge 7NL	Bridge
Bridge 7NN	Bridge
Bridge 7NP	Bridge
Bridge 7NQ	Bridge
Bridge 7NR	Bridge
Bridge 7QR	Bridge
Bridge 7QT	Bridge
Bridge 7QU	Bridge
Bridge AA9	Bridge
Bridge AEP	Bridge
Ashby Reservoir Dam	Dam
Damon Pond Dam	Dam
Fitchburg Reservoir North Dam	Dam
Fitchburg Reservoir S.E. Dam	Dam
Fitchburg Reservoir South Dike	Dam
Mount Watatic Dam (NJ)	Dam
4-H Camp Middlesex	Other Critical Facility
Crossroads For Kids/camp Lapham	Public Water Supply
Fitchburg Reservoir	Public Water Supply
Pines Campground	Public Water Supply

Part IV Mitigation Strategy

Some Disaster Mitigation Measures for Ashby

Capital Improvements

Mitigation may be achieved by constructing new drainage facilities, re-locating structures, purchasing new equipment, or improving emergency access. These capital projects are generally quite expensive and are a challenge for Ashby to fund. Besides local funding, federal and state money is available for projects that may include mitigation measures.

The use of federal transportation funds is determined through a regional planning process under the control of the Montachusett Metropolitan Planning Organization (MPO). The MRPC produces a prioritized project list known as the Transportation Improvement Program (TIP) that schedules transportation improvements over a four year period. Ashby participates in the TIP Program. On a yearly basis, the Montachusett TIP incorporates approximately 30 to 40 projects for federal transportation funding. While the primary focus of these projects is improving transportation efficiency and safety, some projects include features that address mitigation concerns such as drainage improvements to alleviate flooding, bridge upgrading to support emergency vehicles, or capacity expansion that could support evacuation needs.

An additional source of funds has been grants for dam improvements through the Bureau of Dam Control and Hazard Mitigation Planning Grant (HMPG) funding. Very few MRPC communities have participated in these programs. These programs have been very competitive and given the tight federal and state fiscal conditions, it appears the need will continue to be much greater than funds. Another obstacle for Ashby's interest in the HMPG funds has been the matching requirement. The 25% match is often more than the local budget can spare. If and when new PDM funds become available Ashby should have additional opportunities for matching funds for mitigation projects.

With regard to forest fires, the Massachusetts Bureau of Forest Fire Control has a limited budget for establishing fire-breaks, constructing water holes, and conducting fuel suppression work. The Bureau also works to meet the equipment needs of small rural communities such as Ashby through the Federal Excess Property Program and the USDA's Rural Community Fire Protection program.

Bylaws, and Regulations

Bylaws, ordinances, codes, and regulations that regulate development can promote disaster mitigation. The most established of these is, of course, flood plain zoning. The federal government played a major role in this area by mapping flood plains and establishing a flood insurance program. The advantages of participating in the National Flood Insurance Program (NFIP) acted as an incentive for local communities to adopt the regulations required by the federal government. Other regulations in Ashby could be used to support disaster mitigation including provisions that address soil erosion problems, drainage design, and limits to impervious coverage.

Maintenance and Enforcement

Beyond the bylaws and regulations, daily maintenance and enforcement in Ashby is a part of the community's effective disaster mitigation plan. Two concerns, which fall under the public works department, are the maintenance of drainage facilities and the trimming of trees within the street right-of-way. If drainage swales are filled with grass clippings or cluttered with fallen branches, they can stop working effectively and exacerbate flooding problems.

Ashby's DPW finds that keeping these areas clear is a time-consuming job. The typical level of maintenance is an annual clearing. This is an area where private homeowners, if properly trained, can be helpful in terms of calling when they see a problem, and monitoring activity to ensure that no improper dumping is occurring.

Trimming dead limbs and limbs near power lines can prevent the blocking of streets, injuries, and power outages. The utility provider in Ashby conducts annual trimming along their lines.

State Assistance to Libraries, Historical Societies and Museums

The State Library Commission is working cooperatively with the New England Document Conservation Center to develop an on-line planning template for conservation planning. This program is aimed at libraries, historical societies, and museums that store sensitive materials. Once completed, the conservation plan template will take each organization through a set of instructions for determining if their holdings are at risk and what actions they might pursue. According to the State Library Commission, libraries have suffered from flood losses. These were floods in many cases were related to plumbing and heating equipment failures, but the potential for damage from natural floods exists. The State Library Commission has held training sessions on developing a conservation plan.

Goals, Objectives and Strategies for the Town of Ashby

The following sections of the plan will provide the Goals, Objectives, and Strategies developed by the Town of Ashby to implement a comprehensive Natural Hazard Mitigation Program. These goals, objectives and strategies are based on research data compiled from the town and state and federal agencies, and utilizes the information provided in meetings, and in previous sections of this Plan, especially the Risk and Vulnerability Assessment, the Hazard Mitigation Matrixes, and Community Action Plans.

Overall Goal Statement: To prepare to reduce the loss of life, property, infrastructure and cultural resources throughout the community from natural disasters through a multiple hazard mitigation program that involves increased coordination, planning, education, and capital improvements.

Objective: To organize and prepare to provide adequate shelter, water, food, and basic first aid to displaced residents in the event of a natural disaster, and to provide adequate notification and information regarding evacuation procedures, etc., to residents in the event of a natural disaster.

Objective*:* To inventory supplies at existing shelters and develop a needs list and storage requirements; and to establish arrangements with local or neighboring vendors for supplying shelters with food and first aid supplies in the event of a natural disaster.

Objective: To have the EMD lead an effort to increase coordination between departments in pre-disaster planning, and implementation of hazard mitigation projects.

Objective: Increase awareness of hazard mitigation among town officials, private organizations, businesses, and the general public.

Objective*:* To examine and update the current notification system including the progress made by the Central Mass Homeland Security Committee's development of a county-wide Reverse 911.

Objective*:* To collect, periodically update, and disseminate information on which local radio stations provide emergency information, what to include in a 'home survival kit,' how to prepare homes and other structures to withstand flooding and high winds, and the proper evacuation procedures to follow during a natural disaster.

Specific Natural Hazard Goals

<u>Goal Statement for Flooding</u>: To prepare emergency staff and volunteers in order to minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to flooding.
Objective: To continue to participate in the National Flood Insurance Program, and to have the flood maps periodically updated.

Objective*:* To Develop a priority list and seek funding through the Hazard Mitigation Grant Program (HMGP) for the replacement of undersized culverts throughout the town.

<u>Goal Statement for Protection from Beavers</u>: To minimize the threat to health, the damage to roads and property, and the disruption of governmental services and general business activities due to flooding caused by beavers.

Objective: Support local town departments to continue present methods to prevent beaver caused flooding.

Objective: Seek assistance from beaver management professionals, including trappers.

Objective: Install beaver management devices.

<u>Goal Statement for Hurricanes and Tornadoes</u>: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to high winds associated with hurricanes and tornadoes. (The objectives listed above, under flooding, address the flooding that can result from a hurricane.)

Objective: To educate residents and volunteers regarding the safe methods and actions necessary to deal with Hurricanes and Tornadoes.

<u>Goal Statement for Winter Related Hazards</u>: To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to severe snow and ice storms.

Objective: To develop a plan for providing access to water, information, shelter, and food stores to people in remote locations in the event of a severe winter storm.

Goal Statement for Earthquakes: To educate staff, residents and volunteers about the potential for earthquakes and strategies to minimize the loss of life, damage to property, the disruption of governmental services and general business activities due to earthquakes.

Objective: To educate and encourage homeowners and developers to rehab and build using methods to minimize the effects of earthquakes and other disasters.

Documents Reviewed and Incorporated

In order to prepare the PDM Plan and the following matrices, many Ashby documents were reviewed and incorporated to the extent possible. They include the following:

Montachusett Regional Transportation Plan	2007
Zoning Bylaws	2004
E.O. 418 Community Development Plan,	2004
Open Space and Recreation Plan	2004
Town Bylaws	2005
Rules & Regulations of Subdivision of Land	1999
Zoning Bylaws	2005
Annual Report	2002

Reviewing documents such as the Open Space and Recreation Plan and the E.O. 418 Community Development Plan, reveals that Ashby has directed little planning effort toward natural hazard mitigation. The major issues of housing development, the economy, capital planning, facilities development, and open space have occupied much of the planning efforts. Although the OSRP does target protecting water quality in its Action Steps, advocating the passing of a wetland bylaw, and pursuing conservation restrictions on sensitive upland buffer areas, this PDM Plan for natural disasters is a new direction.

This is the first Hazard Mitigation Plan written for Ashby, yet hazard mitigation actions have of course been undertaken in the past. The following is what is already being done to mitigate hazards by listing the things already in place which work toward solving problems and preventing future losses. This section brings to light gaps in existing protections that helped to inform the development of this plan. This Protection Matrix was not prioritized, and the changes and needed improvements have been included the following Analysis of Potential Mitigation Projects.

This Matrix deals with the Existing Protections in Ashby. It includes a description, who is responsible, and improvements and changes that may be needed.

Ashby's Existing Protection Matrix

Type of Existing Protection	Description	Area Covered	Effectiveness and/or Enforcement	Improvements or Changes Needed
Flood Related Hazards				
Storm water management standards	State Regulation under the Wetlands Protection Act to regulate storm water and other point source discharge	Town-Wide	Enforced by the Conservation Comm. (Wetlands Protection Act) and Planning Board (Subdivision Control Law and site plan review)	
Rivers Protection Act	State Law 310 CMR 10.58 & Local bylaw Article V Sect. 18 development and activity in riverfront area	200-foot [1]	Enforced by the Conservation Comm. & DEP	
Wetlands Protection Act (state) and Wetlands Protection Bylaw (local)	State and local laws regulating development and activity within wetland buffer zone	100-foot state buffer around wetland area [2]; local bylaw policy requires a 30 foot no disturb area closest to wetland	Enforced by the Conservation Commission	

100 Year Flood Zone (3) Town Bylaw Sec. III. H. Flood Plain Districts	State law and local bylaw requiring elevation above 100-year flood level of new and substantially improved residential structures in floodplain	100-year floodplain as shown on Flood Insurance Rate Map dated Nov. 19, 1986	Enforced by the Building Inspector and Conservation Commission	Update Insurance Flood Rate Maps
Maintenance of municipal storm water drainage system	Regular cleaning of catch basins, storm drains, and culverts	Town-Wide	Directed by the Department of Public Works	Additional Personnel and Equipment Needed
Culverts replacement	Replacement of Culverts that are Undersized and/or Deteriorated	Town-Wide	Directed by the Department of Public Works	Culverts in Flood Areas to be Evaluated for Replacement
Maintenance of public water bodies (ponds, streams, brooks, wetlands)	Periodic cleaning of waterways needed, e.g., remove trash, debris	Town-Wide	Directed by the Department of Public Works with guidance from Conservation Commission	

Existing Protection Matrix (Continued)

Wind Related Hazards				
State Building Code	State Law related to design loads to include wind effects	Town-Wide	Enforced by Building Department	
Tree Maintenance	Regular inspection and tree maintenance to cut branches threatening power lines and overhead utilities	Town-Wide	Utility Companies	Additional Staff
Winter Storms Related				
Clearing Snow from Major Arterial Routes	Ensure Access to Emergency Services	Town-Wide	Department of Public Works	Additional personnel and equipment needed

An analysis of the potential mitigation projects for Ashby is summarized below.

Ashby's Analysis of Potential Mitigation Projects

A = Acceptable S/A = Somewhat Acceptable

EVALUATION OF FLOOD RELATED HAZARDS MITIGATION ALTERNATIVES								
ALTERNATIVES TO STRUCTURAL PROJECTS	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Public Education and Awareness	A	A	A	A	A	A	A	Low
Public Education and Awareness Disseminate emergency information and instructions concerning flood preparedness and safety to children and families	A	A	A	A	A	A	A	Low
Land Acquisitions	A	A	A	SA	SA	SA	A	High
Explore options for incentives to encourage property owners to engage in mitigation efforts	A	A	SA	SA	A	A	A	Low
Continue participation in the	A	A	A	A	A	A	A	Low

National Flood Insurance Program (NFIP)								
Identify opportunities to update Flood Insurance Rate Maps	A	A	SA	A	A	A	SA	Low
Store important documents and irreplaceable objects where they will not be damaged.	A	A	A	A	A	A	A	Low
Evaluate or relocate furnaces, hot water heaters and electrical panels.	A	SA	SA	SA	A	SA	A	High
Identify structures that need to be evaluated above flood levels.	A	A	A	A	A	SA	SA	Low
Identify existing shelters outside of flood prone areas	A	A	A	A	A	A	A	Low

EVALUATION OF WIND RELATED HAZARDS MITIGATION ALTERNATIVES								
ALTERNATIVES TO STRUCTURAL PROJECTS	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Building Codes including enforcement of state building codes related to design loads to include wind effects.	A	A	A	A	A	A	A	Low
Maintenance including regular inspection and tree maintenance to cut branches threatening power lines and overhead utilities.	A	A	A	A	A	A	A	Low
Readiness	A	A	SA	A	A	A	A	Moderate
Consider feasibility of underground utilities in new developments	A	A	A	A	A	SA	A	High
Retrofit public buildings and critical structures	A	A	A	SA	A	SA	A	High

A = Acceptable SA = Somewhat Acceptable

A = Acceptable SA = Somewhat Acceptable

EVALUATION OF FIRE RELATED HAZARDS MITIGATION ALTERNATIVES								
ALTERNATIVES TO STRUCTURAL PROJECTS	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Coordination between Residents and Fire Department - including the consideration of new reverse 911 system that may be available in the next several years.	A	A	SA	A	A	A	A	Low
Coordination between residents and fire department - encourage single family residences to have fire plans and practice evacuation routes.	A	A	A	A	A	A	A	Moderate
Coordination between residents and fire department - Encourage fire inspections in residential homes to increase awareness among homeowners and fire responders.	A	SA	SA	A	A	A	A	Moderate

Coordination between residents and fire department - Require fire department notification of new business applications to ensure appropriate fire plans have been developed.	A	SA	SA	SA	A	A	A	Moderate
Coordination between residents and fire department – Inform residents of the need for adequate access for emergency equipment regarding width and grade of roads and driveways.	A	SA	SA	A	A	A	A	Moderate
Maintenance and Readiness such as brush cleaning to provide access to emergency services and to identify areas with potential for brush fires	A	A	A	A	A	A	A	Moderate
Outreach and Education – Fire Station to hold open houses and allow public to visit and see equipment and discuss wildfire mitigation and develop and distribute and education pamphlet	A	A	A	A	A	A	A	Low

on fire safety and prevention (the SAFE Program)								

A = Acceptable SA = Somewhat Acceptable

EVALUATION OF WINTER STORM RELATED HAZARDS MITIGATION ALTERNATIVES								
STRUCTURAL PROJECTS ALTERNATIVE	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Enhanced Weather Monitoring	A	A	A	A	A	A	A	Low
Maintenance and Mitigation Activities	A	A	A	A	A	A	A	Moderate
Readiness	A	A	A	A	A	A	A	Moderate
Public Awareness	A	A	A	A	A	A	A	Low
Expand residential parking bans to enable snow removal from all streets.	A	A	A	A	A	A	A	Low
Ensure access to emergency services such as shelters.	A	A	A	A	A	A	A	Low
Relocate new utilities underground where feasible	SA	SA	SA	SA	A	SA	A	High
Identify shelters for residents who may need to evacuate due to loss of electricity and heat and make locations know to the public.	A	A	SA	A	A	A	A	Low

A = Acceptable SA = Somewhat Acceptable

EVALUATION OF GEOLOGIC RELATED HAZARDS MITIGATION ALTERNATIVES								
ALTERNATIVES TO STRUCTURAL PROJECTS	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Seismic Strength Evaluations	A	A	A	A	A	A	A	Low
Revise Planning/Zoning Building Codes	A	A	A	A	A	A	A	Moderate
Emergency Response Plans	A	A	A	A	A	A	A	Moderate
Evacuation Routes	A	A	A	A	A	A	A	Low
Slope Stabilization	A	A	A	SA	SA	A	A	Moderate
Reduction of nonstructural and structural earthquake hazards	A	A	SA	A	A	A	A	Moderate
Property Acquisition and Retrofit	A	A	A	SA	SA	A	A	High

A = Acceptable SA = Somewhat Acceptable

EVALUATION OF OTHER NATURAL HAZARD MITIGATION ALTERNATIVES								
ALTERNATIVES TO STRUCTURAL PROJECTS	**Socially Acceptable**	**Technically Feasible**	**Administratively Possible**	**Politically Acceptable**	**Legal**	**Economically Sound**	**Environmentally Sound**	**Cost**
Beaver Mitigation – Prepare heavy gauge "exclosures" around important trees and shrubs.	SA	A	A	A	A	A	SA	Moderate
Beaver Mitigation – Installation of "beaver pipes", water flow control devices and "beaver diverters".	A	A	A	A	A	A	A	Moderate
Beaver Mitigation – Removal of beavers by licensed trappers with board of health permits.	SA	A	A	SA	A	A	SA	Moderate
Climate Change, weather extremes and extreme temperatures. Outreach and education: Prepare, purchase and distribute educational materials to those who are at the greatest risk, and those who care for them, including youth, elderly and those with medical conditions. Materials will detail	A	A	A	A	A	A	A	Low

threats from and methods to prepare for climate change and weather extremes.								
Climate change, weather extremes and extreme temperatures: Identify existing shelters an equip them to deal with extreme weather events.	A	SA	A	A	A	A	A	High

A = Acceptable SA = Somewhat Acceptable

ASHBY'S COMMUNITY ACTION PLAN

IMPLEMENTATION STRATEGY FOR PRIORITY MITIGATION ACTIONS

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	POTENTIAL FUNDING SOURCE(S)	ESTIMATED COST
Work with Neighboring Communities to Establish a Community Emergency Response Team (CERT)	Board of Selectmen, Police & Fire Departments, EMD	On-going	Town Staff/Volunteers	N/A
Identify Existing Shelters that are Earthquake Resistant as well as Outside of Floodplain (and Dam Inundation) Areas	Building Inspector, EMD	On-going	Town Staff	N/A
Develop and Distribute an Educational Pamphlet on Fire Safety and Prevention (SAFE PROGRAM)	Fire Department	On-going	Town Staff	N/A
Collect, Update, and Disseminate Information on Local Radio/TV Stations Emergency Information	EMD	2007	Town Staff	N/A
Inventory Supplies at Existing Shelters and Develop a Needs List and Storage Requirements	Emergency Management Planning Committee, School Facilities Manager	2008	Town Staff	N/A
Develop a Plan for Providing Access to Water, Information, Shelter, and Food Stores to People in Remote Locations of the town in the event of a Severe Winter Storm	EMD	2008	Town Staff/Volunteers	N/A
Develop a Preliminary Project Proposal and Cost Estimate for Updating Current 911 System including Feasibility of Reverse 911	Board of Selectmen, EMD	2009	Town Staff/Volunteers	N/A
Identify all structures throughout the town that need to be Elevated above the Base-Flood Elevation	Building Inspector, Fire Department	2010	Town Staff 75% FEMA FUNDING AVAILABLE	N/A

Prepare a Priority List for the Replacement of Undersized Culverts throughout the town	Board of Selectmen, Highway Department	2009	Town Staff	To be Determined
Update Insurance Flood Rate Maps	Conservation Commission, Board of Selectmen	Ongoing	FEMA/MEMA	N/A
Encourage property owners to engage in mitigation efforts.	EMD, Fire Department	Ongoing	Property Owners	N/A
Continue participation in the National Flood Insurance Program	Board of Selectmen, Conservation Commission	Ongoing	FEMA/MEMA	N/A
Evaluate and relocate valuable and historical items and furnaces, Water heaters, and electrical equipment	EMD, Fire Department	Ongoing	Town and Property Owners	High
Disseminate Flood emergency information	EMD, Fire Department, Schools	2009	EMD/Fire Department	Low
Enforce state building codes related to design loads to include wind effects.	Building Inspector	Ongoing	Contractor and property owners	High
Continue tree maintenance and brush clearing	Department of Public Works	Ongoing	Town Department	Medium
Hold open house at Fire Department	Fire Department	2009	Fire Department	Low
Expand residential parking bans to enable snow removal from all streets.	Department of Public Works and Board of Selectmen	2009	Board of Selectmen	Low
Identify shelters and publicize locations	EMD	2009	EMD/Fire Department	Low
Evacuation Routes (what about them?)	EMD	2010	EMD	Low
Install "beaver diverters" and water control devices	Department of Public Works	2009	Department of Public Works	Low to Moderate
Hire trapper for removal of beavers	Department of Public Works	2009	Department of Public Works	Low to Moderate
Purchase and distribute educational materials regarding protection from natural hazards	EMD	2009	Board of Selectmen	Low
Implement recommendations in existing planning documents including the master plan, open space and recreation plan and the emergency evacuation plan.	Conservation Commission, Board of Selectmen, Planning Board, EMD	2010	Conservation Commission, Board of Selectmen, Planning Board, EMD	Moderate to High

Public Involvement

An introductory session was held on December 13, 2006 for all Commission members. This meeting was targeted to all public officials including Selectmen, Public Safety, Emergency Management Directors, those who have participated in community emergency management activities, and all other interested parties.

Coordinating with the Emergency Management Director, a Hazard and Vulnerability Session was held on April 3, 2007. Following this meeting MRPC staff corresponded with a variety of community employees and volunteers, directly and indirectly, through the phone and e-mail, throughout each step of the planning process.

The participants (See Appendix 2 for a list of participants) were led through a Hazard Identification and Risk Assessment workshop. Participants were asked to identify, assess and map areas of concern for each Natural Hazard listed on the Natural Hazard Matrix spreadsheet (see Table 1), derived from the State's Hazard Mitigation Plan. Using GIS these areas were mapped, notes were taken regarding the impacts or potential impacts of these areas, and values were assigned on the Natural Hazard Matrix for the (1) Likelihood of Occurrence, (2) Location, size, and (3) Impacts. These values were later totaled to determine the Hazard Index. Once the notes and Natural Hazard Matrix were typed, and the draft GIS map was completed, this information was sent out to the participants of this session for their review and comments.

Soon after this the MRPC corresponded with the Emergency Management Director in order to obtain Critical Infrastructure data for the community. A draft database was sent out for review and additions/edits were made to the database based on input from the community. Once this process was completed a follow-up session was coordinated with the Emergency Management Director in order to review the spatial accuracy of the data. Using GIS, each location was placed in the appropriate location based on available information (streets, parcel data, color Orthophotos, etc.).

Hard copies and CD copies of the Draft PDM Plan were distributed to the EMD and the BOS in order to be made available to all departments and interested residents.

This year and the near future has become a critical time for the consideration of funding for mitigation plans. Ashby, as many communities in the state, is faced with anticipated cuts that may begin to eliminate essential services, including public safety.

If the funding and volunteers become available in the future, the community will look to develop a newsletter or a periodic news release to inform residents of the mitigation program as projects are implemented or completed. This will be a very effective way of keeping the lines of communication open between the local government and the affected and interested public.

Communities with interest in Ashby's Plan

As a first step in the planning process, the entire MRPC Region met for a kick-off and informational meeting and a forum for history and concerns. This was followed with numerous sessions in each community. During GIS sessions the community was asked to point out, using maps and examples, areas which may be threatened by hazards from neighboring communities.

A number of areas were indicated such as roads that might provide evacuation routes in times of disasters and roads that might become evacuation routes into Ashby from neighboring communities as well as those that might be evacuated from the larger population centers, especially those to the east. Route 2 traverses the length of the Montachusett Region, and Route 119 may well bring those fleeing from a major disaster in the Boston Region, as well as from the south in Fitchburg and Worcester.

A major threat indicated by some communities was the possibility of dam failures. Not only may the dams not be maintained to the highest standards, but in the event of an earthquake even the best of the regions dams could create problems. The earthquake results in China recently are evidence of the possibilities that needs to be considered.

The Montachusett Region has a great many rivers and streams that flow from one community to another and another in a chain. Most of Ashby is in the Nashua River Watershed with a small portion of the northwest corned in the Souhegan River Watershed. As stated in the text, development in one community's drainage system could increase the flow of rivers and streams by building and paving over water retention areas. (There is definitely something wrong with the previous sentence, but I'm not exactly sure what should be done) Wetland issues cross boundaries and communities are aware of this. Due to the independent nature of most Massachusetts communities, protecting neighbors is not the highest of priorities, except among regional environmental groups.

The community's concerns with the above items were shared between communities during PDM sessions. Ashby and other communities such as those in the flood hazard areas, for example the Nashua River Watershed, have participated in hazard planning. An example such as the Fitchburg-Leominster Flood Plan includes 15 rivers and streams including the Nashua River- all of which cross community boundaries of at least eight adjacent communities, including Ashby.

Another hazard that is dealt with in the text is that of ice jams. These occurrences, such as the 1936 ice jams, can affect a multitude of communities. The ten or more communities of the Nashua River Watershed could be affected.

These are the hazards that were shared with neighboring communities because these are regional problems.

<u>Organized Entities with Interest and Involvement in the PDM Plans.</u>

The Montachusett Regional Emergency Planning Committee (MREPC) is very successful and the only organization of its type in the Montachusett Region. This is the major juncture of communities, academia, hospitals, businesses, media, utilities, and community agencies such as the Red Cross, and the Montachusett Regional Planning Commission. Its meetings are the place that brings all of these entities together to share ideas, problems, needs and accomplishments. The broad membership includes representatives of the following categories: Industry (18), Community (5), Elected State/Local Officials (9), Fire Services/ EMT's/EMD's (12), Public Schools (6), Academia (1), Health Officials (5), Local Environmental (3), Police Officials (5), Public Works (3), Hospitals (2), Transportation (4), Utilities (2), and Media (5).

At the monthly meetings of the MREPC, attended by 20-30 members, presentations are made by the MRPC updating projects, including PDM Planning, GIS, and Transportation projects.

The other organization that covers all of Worcester County is the Central Massachusetts Homeland Security Council. It has representatives from the following categories: Fire Departments, Public Safety and Communications, Regional Transit, Emergency Management, Police Departments, County Sheriff's Department, Town Managers, Mass EMS, Boards of Health, DPW Departments, Medical Center, and Regional Planning Agencies (including the MRPC).

Process Summary and Conclusion

In September of 2006 the Montachusett Regional Planning Commission (MRPC) was contracted by the Massachusetts Emergency Management Agency to develop a regional, multi-jurisdictional natural hazard mitigation plan with local community "annexes." The Montachusett Regional Plan is an umbrella that covers the issues facing the region. Under the umbrella plan, 22 local "annex" plans were prepared with the participation of each of the Montachusett Region communities. These communities included: Ashburnham, Ashby, Athol, Ayer, Clinton, Fitchburg, Groton, Gardner, Harvard, Hubbardston, Lancaster, Leominster, Lunenburg, Petersham, Phillipston, Royalston, Shirley, Sterling, Templeton, Townsend, Westminster, and Winchendon.

The planning process followed the outline in Natural Hazards Mitigation Planning: A Community Guide by Massachusetts Department of Recreation and Conservation, MEMA, and Massachusetts Hazard Mitigation Team. The process involved local officials and town staff ranging from Emergency Management Directors, to police, fire, public works, boards of health, planners, selectmen and administrators. Interested citizens were also invited to attend. Meetings were public and were announced through the local community system and communicated through the local committees.

At meetings, goals and assignments were established to help make progress toward completing a Local PDM Plan. Representatives of each community participated in the planning process. By breaking the process down into achievable goals and tasks the planning remained focused, and a series of smaller tasks were intended to motivate the local teams to stay involved and active throughout the planning effort.

Because the role of the MRPC regarding the Local PDM Plans was one of *encouraging, aiding, and helping* their creation, the MRPC helped to educate municipalities about the DMA (maybe I missed it, but what is the DMA? Act of 2000, its requirements for a local plan, and the basics of hazard mitigation; leading participants through the planning steps. Working through the Emergency Management Directors, the MRPC provided communities with resources to make the job of creating such a plan easier; and by providing GIS mapping, and technical assistance the plans were completed.

A planning structure was established whereby the regional and local plans were developed on a parallel track. While the MRPC was aiding municipalities with their local plans, it was also drafting the regional plan. Ultimately, the results of this planning process were the development of both regional and local GIS mapping, hazard mitigation goals and objectives, hazard identification, risk and vulnerability assessment, action plan mitigation strategies, existing protections, and mitigation projects. The planning developed so that at the end of the preparation period, if a town had kept on a course parallel to the regional plan, they would have generated all of the information needed for a local PDM Plan. Each of the plans is a stand alone "annex" and has had contributors and approvals from each community.

A region-wide meeting was held in December 2006 to kick off the planning process and begin organizing. Most of the communities attended as did staff from MEMA. This event was followed up by on-site meeting in each of the communities. The meetings were hosted by the Emergency Management Directors (EMD) and included those community positions mentioned earlier as well as interested citizens. The EMD's not only announced meetings through the public meeting process, but also made calls to potential participants. Meetings included hazard and vulnerability analysis, GIS mapping, risk determination, existing protections, developing goals, objectives and strategies, potential projects, and an action plan. A composite of goals and objectives collected in meetings with all of the communities was used as a template. Communities reviewed, changed, and developed goals and objectives that they considered appropriate. The plans were then prepared and presented to each community for presentation and approval. As described in the following page, it is expected that this plan will be reviewed on a yearly basis by the local emergency management committee, and that a community update will be prepared every five years.

Part V Plan Adoption and Updates

Ashby Natural Hazard Mitigation Plan Adoption and Implementation

Plan Adoption

Upon completion, copies of the Draft Natural Hazard Pre-Disaster Mitigation Plan for the Town of Ashby were distributed to the Board of Selectmen, and other town boards and departments for their review and comment. A public meeting was held by the Board of Selectmen of Ashby to present the draft copy of the PDM Plan to other town officials and residents and to request comments from the town and the general public. The comments from the public meeting and other input were included in the final draft.

The final draft of the Natural Hazard Pre-Disaster Mitigation Plan was formally approved by the Board of Selectmen and forwarded to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for their approval.

Plan Implementation

The implementation of the Natural Hazard Pre-disaster Mitigation Plan began following its formal adoption by the Board of Selectmen, and approval by MEMA and FEMA. Specific town departments and boards are responsible for ensuring the development of policies, bylaw revisions, and programs as described in this plan. The Ashby Emergency Planning Committee will help to oversee the implementation of the plan.

Plan Monitoring and Evaluation

The measure of success of the Natural Hazard Pre-Disaster Mitigation Plan will be the number of identified mitigation strategies implemented. In order for the town to become more disaster resilient and better equipped to respond to natural disasters, there must be a coordinated effort between elected officials, appointed bodies, town employees, regional and state agencies involved in disaster mitigation, and of course the general public.

The Ashby Emergency Management Committee will meet on an annual basis or as needed (i.e., following a natural disaster) to monitor the progress of implementation, evaluate the success or failure of implemented recommendations, and brainstorm for strategies to remove obstacles to implementation. Following these discussions, it is anticipated that the committee, and the Board of Selectmen, may decide to reassign the roles and responsibilities for implementing mitigation strategies to different departments or boards, and/or revise the goals and objectives contained in the plan.

At a minimum, the committee will review and update the plan every five years, beginning in the fall of 2013. The meetings of the committee will be organized and facilitated by the Emergency Management Director and/or the Board of Selectmen.

CERTIFICATE OF ADOPTION
TOWN OF ASHBY, MASSACHUSETTS

A RESOLUTION ADOPTING THE ASHBY
HAZARD MITIGATION PLAN

WHEREAS, the Town of Ashby established a Committee to prepare the Natural Hazard Pre-disaster Mitigation Plan; and

WHEREAS, several public planning meetings were held regarding the development and review of the Ashby Natural Hazard Pre-Disaster Mitigation Plan; and

WHEREAS, the Ashby Hazard Mitigation Plan contains several potential future projects to mitigate hazard damage in the Town of Ashby, and

WHEREAS, a duly-noticed public hearing was held by the Board of Selectmen of the Town of Ashby on __________, 2008 to formally approve and adopt the Ashby Natural Hazard Pre-Disaster Mitigation Plan.

NOW, THEREFORE BE IT RESOLVED that the Ashby Board of Selectmen adopts the Ashby Natural Hazard Pre-disaster Mitigation Plan.

ADOPTED AND SIGNED this [date]. ______________________________

____
ATTEST
Board of Selectmen of the Town of Ashby

APPENDICES