

# THE TOWN OF GREENFIELD LOCAL NATURAL HAZARDS MITIGATION PLAN

Committee: Text shaded in green requires updating from the Committee including new projected completion dates for action items. See the following pages:

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- 109-118

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# 1- INTRODUCTION

## Hazard Mitigation

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The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazard Mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, earthquakes, and other disasters. Mitigation efforts undertaken by communities will help to minimize damages to buildings and infrastructure, such as water supplies, sewers, and utility transmission lines, as well as natural, cultural and historic resources.

Planning efforts, like the one undertaken by the Town of Greenfield and the Franklin Regional Council of Governments, make 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 a community within the context of each of the specific potential natural hazards that may threaten a community.

Preparing a Local Natural Hazard 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, can be avoided or significantly lessened if a community implements the mitigation measures detailed in the Plan. Many disaster assistance agencies and programs, including FEMA, require that a community have adopted a pre-disaster mitigation plan as a condition for both mitigation funding and for disaster relief funding. For example, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA) and the Community Rating System (CRS), are programs with this requirement.

## Planning Process

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

- Review of the Greenfield 2005 Local Natural Hazards Mitigation Plan, assessment of relevancy of existing materials, status of action items and addition of new materials based upon MEMA recommendations and Committee input.
- Identification of the natural hazards that may impact the community, and past occurrences of hazards at the local or regional level.
- Performance of 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, particularly flooding.
- Identification and assessment of the policies, programs, and regulations a community is currently implementing to protect against future disaster damages. Examples of such strategies include:

- Preventing or limiting development in natural hazard areas like floodplains, wetlands, drinking water recharge areas, and conservation land;
  - Implementing recommendations in planning documents including Stormwater Management Plans, Master (Comprehensive) Plans, Open Space and Recreation Plans, Emergency/Evacuation Plans that address the impacts of natural hazards; and
  - Requiring or encouraging the use of specific structural requirements for new buildings such as buried utilities, flood-proofed structures, and lightning grounding systems.
- Identification of deficiencies in the current strategies and establish goals for updating, revising or adopting new strategies.
  - Identification of specific projects that will mitigate the risk to public safety and damages to infrastructure from natural hazards.
  - Adoption and implementation of the Final Natural Hazards Mitigation Plan.

Additionally, the Town of Greenfield and FRCOG:

- Provided an opportunity for the public to comment on the plan during the drafting and prior to the approval of the plan. Publicity was done with a press release in the Greenfield Recorder in \_\_\_\_\_ as well as through flyers posted in town throughout the planning process. A copy of the draft plan was available to the public at the Town Hall. \_\_\_\_ Public Meetings were held – one each on \_\_\_\_\_.
- Provided an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities and agencies that have the authority to regulate development, and businesses, academia and other private and nonprofit organization to be involved in the planning process. Mention any entities who participated here \_\_\_\_\_.
- Reviewed and incorporated, if appropriate, existing plans, studies, reports and technical information. Plans reviewed and incorporated include the 2009 Greenfield Reconnaissance Report, 2002 Greenfield Downtown Master Plan, the 2006 Greenfield Open Space and Recreation Plan, 2002 Mohawk Trail West Action Plan, Bank Row Urban Renewal Plan of 2005 and data sources cited in footnotes throughout this Plan.
- Documented the planning process, including how it was prepared, and how the public was involved.

Much of this work was carried out by the staff of the FRCOG Planning Department with the assistance of the Greenfield Natural Hazards Mitigation Planning Committee, which includes representatives of the Fire Department, Health Department, Department of Planning and Development, Police Department, Planning Board, Department of Public Works, Historical Commission, Baystate Franklin Medical Center, and PanAm Railroad Company.

## **Plan Updates and Changes**

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As indicated above in the Planning Process section, changes and updates were made to this Plan based upon MEMA recommendations and committee input. The following sections of the 2011 plan were added to and/or substantially updated:

- **Section 2: Local Profile**
  - Cultural and Historic Resources section added ..... 11-12
  
- **Section 3: Risk Assessment**
  - Natural Hazard Identification and Profile
    - Location and Extent for Each Hazard added ..... 13-39
    - Microbursts and Wind Storms are separate categories, per the committee’s request
    - Beaver Dams (Sub-Category of Dam Failure) added ..... 28-30
    - Landslides added..... 31-33
    - Ice Jams added ..... 33-35
    - Manmade Hazards added..... 35-39
  
  - Risk Assessment Methodology
    - All Hazards Risk Assessment Methodology expanded ..... 41-43
    - TABLE 3-21: All Hazards Vulnerability Assessment Table added .....44
  
  - Vulnerability Assessment
    - Environmental Justice text and map added..... 45-47
    - Assessment by Hazard – detailed section for each hazard added ..... 46-71
      - Exposure
      - Damages
      - Loss estimates
      - Population impacts
      - Data deficiencies
    - Zoning Map added .....75
    - Critical Facilities and Infrastructure Map added .....76
  
- **Section 4: Mitigation Strategy**
  - Current Mitigation Strategies were added for new hazards
    - Landslides .....106
    - Ice Jams.....107
    - Manmade Hazards .....108
  - Future Mitigation Strategies modified based on Vulnerability Assessment Table
    - 2011 Action Plan - Prioritization of Goals and Action Items..... 110-111
    - Prioritized Action Plan in new table format ..... 112-121
    - NFIP Community Rating System (CRS) and addition NFIP added ..... 122-124
  
- **Section 5: Plan Implementation**
  - Potential Funding Sources Table added.....126

## 2 – LOCAL PROFILE<sup>1</sup>

### Community Setting

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The Town of Greenfield is located in the middle of Franklin County and surrounds the intersection of two major transportation routes in the county, Interstate 91 which travels north/south and State Route 2 which travels east/west. Greenfield is the largest community in the county with a recorded population of 17,537 people (2009 Census), approximately 25% of the total population for Franklin County. Greenfield's downtown area is densely developed and people from Franklin County and beyond travel to the Town to take advantage of the employment opportunities, cultural and recreational offerings, retail shops, and restaurants.



Greenfield lies between the Rocky Mountain Ridge to the east and the hills of Shelburne to the West.  
*Photo courtesy of Creative Commons.*

In the late 17<sup>th</sup> Century, the Town of Greenfield was known as the Green River District of the Town of Deerfield, an agricultural community populated by settlers looking for land to farm. However, due to the location of this new settlement at the confluence of three major rivers – the Connecticut, Deerfield and Green Rivers – the community rapidly evolved into a trading hub.

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<sup>1</sup> The majority of the information for this section was obtained from the Town of Greenfield's Open Space and Recreation Plan 2000 and from various websites including: [www.townofgreenfield.org](http://www.townofgreenfield.org) and [www.mass.info/greenfield.ma/description](http://www.mass.info/greenfield.ma/description), and the 2008 U.S. Census Population Estimates Program.

In 1753, the Town of Greenfield was officially incorporated. In 1811, Greenfield was named the official County Seat in the newly established Franklin County. With its abundant water resources, Greenfield attracted industrial development that could be powered by water-generated electricity. Many mills and factories were built in Greenfield during the Industrial Revolution in clusters along the many large rivers running through town. The growth of the rest of the town was characterized by a compact downtown area with two- and three-storied brick and wood buildings surrounded by densely developed residential neighborhoods.

Today, the town's densest development is concentrated in the southeastern part of town which is encircled by Interstate 91 and Route 2. Outside this major transportation corridor, the town is characterized by larger residential lots and agricultural uses in the rural areas. According to 2005 land use data provided by MassGIS, the total land area of the Town of Greenfield is approximately 15,624 acres with approximately 29.2% or 4,103 of those acres developed land. The remaining 9,934 acres of land are classified as undeveloped with Forest as the largest category with 6,721 acres (47.9%). Cropland and pastureland represent the second and third largest amount of undeveloped land in the town with a total of 1,936 acres. Crop and pasture land are particularly vulnerable to development pressures because they tend to be flat and cleared with few environmental constraints.

## **Infrastructure**

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Since its incorporation as a town in 1753, Greenfield has been a major east/west and north/south transportation crossroads, first for river traffic on the Connecticut, then as a major stagecoach stop, and later for the transport of passengers and goods via railroad. Today, with the intersection of Interstate 91 and Route 2 located in the middle of town, Greenfield continues to be a transportation crossroads and is often referred to as the "Gateway to the Berkshires."

### **Roads and Highways**

Greenfield has a total of approximately 124 miles of roadway within its borders, including the major transportation arteries Interstate 91 and Route 2. Interstate 91 runs north/south and connects Greenfield and Franklin County with Vermont and New Hampshire to the north and to the south, the larger communities of Northampton, Holyoke and Springfield, Massachusetts and the states of Connecticut and New York. Route 2 is the major east-west route in northern Massachusetts. This road links Greenfield and Franklin County with Boston and other metropolitan areas to the east and the Berkshires and New York State to the west.

### **Rail**

Since the 1840's, railroads have moved people and freight through Greenfield. The Boston and Maine Railroad has two important lines that converge in town, one that runs from Boston to New York State and the other that runs from Springfield, Massachusetts in to Vermont. Currently, rail service in Greenfield is only for the transportation of freight.<sup>2</sup>

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<sup>2</sup> In addition to bus service. Greenfield will have a new Franklin Regional Transit Center (2011), which could become a major hub for improved passenger and freight rail proposed for the Connecticut to Vermont and Boston, Massachusetts to Albany, New York rail lines.

## **Public Transportation**

The Franklin Regional Transit Authority (FRTA) has ten fixed bus routes that all originate at Court Square in front of the Greenfield Town Hall. Buses run regularly throughout the day and provide a vital service to many area residents, particularly elderly residents. The Franklin Regional Transit Center is currently under construction and is slated for completion in December of 2011. This Leed certified, net-zero energy building will serve as the hub of public transportation in and around Greenfield.

## **Public Drinking Water Supply**

Approximately 95% of the town's residents receive their drinking water from the municipal water supply system. The town currently relies on both groundwater pumped from wells and surface waters for its drinking water supply. The three Millbrook wells, which are located in the northeastern section of town near the Bernardston border, provide groundwater. Known as the Leary Wells site, the town has identified a potential well site located in an area between Leyden and Green River Roads. The Leyden Glen Reservoir in Leyden is a 45 million gallon impoundment that supplies approximately 26% of Greenfield's water supply. The Green River also provides drinking water for the town during periods of peak demand in the summer. Water is withdrawn from the river behind the dam off of Eunice Williams Drive.

## **Sewer Service**

Located in the flood plain of the Green River, Greenfield's municipal sewer system services the town's central, urbanized area and approximately 75% of the residential dwelling units in town. One main interceptor and four trunk sewers feed the Water Pollution Control Plant located on the Green River at the very southern end of town. This facility has been expanded and upgraded to comply with a 1987 DEP Administrative Order. The plant discharges its effluent into the Deerfield River. This facility underwent a \$9.2 million dollar upgrade – including flood proofing – in 2000 and discharges to the Deerfield River.

## **Natural Resources**

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Greenfield is located in the Connecticut River Valley lowland physiographic region, which is characterized by gently rolling hills and large expanses of flat land bordered by steep, forested hills and ridges. Rocky Mountain, on the town's eastern border, rises to an elevation of 490 feet and separates the center of town from the Connecticut River. To the northeast, the topography is characterized by small, rounded hills with elevations that range from 500 to 550 feet and the steep slopes and flat, narrow valley of the Fall River. The remaining land in the town is open and relatively flat with the exception of the area adjacent to the Green and Deerfield Rivers in the southwestern part of town.

## **Hydrology**

Rivers and streams are prevalent in Greenfield. Also, there are a few small ponds within the town's borders, mostly in the northeastern section of town.

Though more densely populated than other towns in Franklin County, Greenfield has a wealth of natural resources. Four rivers flow through town, namely the Fall, Green, Deerfield, and Connecticut Rivers. The Connecticut River separates Greenfield from the Town of Montague to

the east while the Fall River marks the northeastern limits of the Town of Greenfield and forms the border with the neighboring town of Gill. To the south, the Deerfield River separates Greenfield from the Town of Deerfield. The Green River, which flows in a southerly direction through the middle of the town, provides both drinking water and recreational opportunities for residents.

### ***Connecticut River Watershed***

The Connecticut River watershed consists of approximately 11,260 square miles and includes portions of Massachusetts, New Hampshire, Vermont and Connecticut. The Connecticut River flows for 410 miles, beginning at the Canadian border and emptying into the Long Island Sound. Approximately 80% of the watershed is forested, 12% is agricultural, 3% is developed and 5% is water.

### ***Deerfield River Watershed***

The Deerfield River watershed is a sub-watershed of the Connecticut River watershed and consists of approximately 665 square miles in the Southern Green Mountains in Vermont and the Northern Berkshires in Massachusetts. The Deerfield River flows approximately seventy miles from Stratton Mountain in Vermont to the Berkshire Mountains where it flows into the Connecticut River. Approximately 78% of the basin is forested and about 3% is urbanized.

### ***Green River Watershed***<sup>3</sup>

The Green River is the second largest tributary to the Deerfield River; therefore its watershed is a sub-basin of the Deerfield River watershed. The Green River watershed is comprised of approximately 88.9 square miles; the river begins in Marlboro, Vermont and ends as it flows into the Deerfield River in the Town of Greenfield. About 8.5 miles of the River are in Greenfield (<http://www.deerfieldriver.org/GreenRiver/index.htm>).

The Green River travels the entire length of Greenfield, starting in the northwest, continuing between Leyden and Plain Roads until it reaches Greenfield Meadows, an area known for its rich agricultural soils. Traveling south, the river enters into the Municipal Swimming Area where a dam allows a small storage capacity. The River then flows under Route 2A, and parallels Routes 5 and 10, Deerfield Street, before it discharges into the Deerfield River.

The Green River has four dams in Greenfield. From North to South the dams are located at the Eunice Williams Bridge, Green River Municipal Swimming Area, Mill Street, and Meridian Street. The Green River serves multiple purposes for the town. North of Greenfield in the Town of Leyden, the Green River provides part of Greenfield's municipal water supply at the Leyden Glen Reservoir, and again further downstream just before the dam at the Eunice Williams Bridge. The river is used more heavily in the summer months to assist with peak water demands. The Town's pattern of seasonal use emphasizes the importance to maintain the high water quality of the Green River for the town's municipal water needs.

The Army Corps of Engineers has proposed removing the two lower dams, the Mill Street and Meridian Street dams. There is currently discussion around how removal of the dams may affect

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<sup>3</sup> Text from the 2006 Greenfield Open Space and Recreation Plan, Town of Greenfield Planning Department.

the ecosystems that have adapted to the current habitats and what types of mitigation can be put into place to minimize impacts to those organisms while still facilitating the dam removals.

### ***Fall River***

The Fall River forms the remainder of Greenfield's eastern boundary to the north. This river, with its valley bottom and steep adjacent land, has high potential for conservation and recreation use.

### **Forest**

Greenfield is fortunate to have forested open space/conservation lands located throughout the Town. Approximately 48 percent of Greenfield is forested. The public forest lands are used for walking, snowshoeing, and nature study along with being an important habitat for wildlife. While forest quality is generally good, it does require ongoing management efforts.

## **Cultural and historic Resources**

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The importance of integrating cultural resource and historic property considerations into hazard mitigation planning is demonstrated by disasters that have occurred in recent years, such as the Northridge earthquake in California, Hurricane Katrina in New Orleans, or floods in the Midwest. The effects of a disaster can be extensive—from human casualty to property and crop damage to the disruption of governmental, social, and economic activity. Often not measured, however, are the possibly devastating impacts of disasters on historic properties and cultural resources. Historic structures, artwork, monuments, family heirlooms, and historic documents are often irreplaceable, and may be lost forever in a disaster if not considered in the mitigation planning process. The loss of these resources is all the more painful and ironic considering how often residents rely on their presence after a disaster, to reinforce connections with neighbors and the larger community, and to seek comfort in the aftermath of a disaster.<sup>4</sup>

Historic properties and cultural resources can be important economic assets, often increasing property values and attracting businesses and tourists to a community. While preservation of historic and cultural assets can require funding, it can also stimulate economic development and revitalization. Hazard mitigation planning can help forecast and plan for the protection of historic properties and cultural resources.

Cultural and historic resources help define the character of a community and reflect its past. These resources may be vulnerable to natural hazards due to their location in a potential hazard area, such as a river corridor, or because of old or unstable structures. For instance, as described on Page 32, the Green River Cemetery, a cultural and historic resource was impacted by erosion.

In 2009, Massachusetts Department of Conservation and Recreation (DCR) and the Franklin Regional Council of Governments (FRCOG) assisted the Town of Greenfield in a Heritage Landscape Inventory Program. The purpose of the final Greenfield Reconnaissance Report was to help communities identify a wide range of landscape resources - including cultural and

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<sup>4</sup> Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning, State and Local Mitigation Planning How-To Guide, FEMA 386-6 / May 2005.

historic resources - particularly those that are significant and unprotected, and to provide communities with strategies for preserving heritage landscapes. As a result of this plan, several Priority Landscape areas were identified including:

- Town Common area
- Franklin County
- Fairgrounds
- Mohawk Trail
- Rocky Mountain area
- The Meadows

Within these areas, specific cultural and historic sites, buildings and other resources have been identified. As Greenfield continues to refine its priorities in protecting its community from natural and manmade hazards, the Heritage Landscape Inventory is an excellent resource.

Additionally, the Massachusetts Cultural Resource Information System (MACRIS)<sup>5</sup> lists a total of 462 areas, buildings, burial grounds, objects, and structures of cultural and/or historic significance in Greenfield. Some of these include Greenfield's Main Street Historic District, Green River Cemetery, Greenfield Tap and Die Plant #1, Beacon Field, and Guiding Star Guild, to name just a few. A complete list is located in the Appendix of this document. Designation on this list does not provide any protective measures for the historic resources but designated sites may qualify for federal and state funding if damaged during a natural or manmade hazard. The Greenfield Historical Commission noted that many of the buildings on the list are located on or in the floodplain or in areas subject to occasional flooding and that much of Greenfield has a high water table, subjected building to – at the minimum – flooding of cellars.

Another resource for identifying cultural resources is the Greenfield Comprehensive Emergency Management Plan, which resides with the director of Emergency Management in the Town.

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<sup>5</sup> <http://mhc-macris.net/Results.aspx>

## 3 - RISK ASSESSMENT

### Natural Hazard Identification and Profile

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Historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases were used to identify the natural hazards which are most likely to have an impact on the Town of Greenfield.

#### Floods

##### *General Description*

The average annual precipitation for Greenfield and surrounding areas in northwestern Massachusetts is 44 inches.<sup>6</sup> There are three major types of storms that bring precipitation to Greenfield. Continental storms that originate from the west continually move across the region. These storms are typically low pressure systems that may be slow-moving frontal systems or more intense, fast-moving storms. The second major storm type are coastal storms; there are two kinds that bring major precipitation and wind – nor'easters and hurricanes. Nor'easters bring heavy rain, high winds, ice storms or blizzards into New England from the coast of Maine and Canada. In late summer or early fall, hurricanes may reach Massachusetts from the tropics and result in significant amounts of rainfall and wind. The third type of storm is the result of local convective action. Thunderstorms that form on warm, humid summer days can cause locally significant rainfall.

Floods are classified as either *flash floods*, which are the product of heavy, localized precipitation in a short time period over a given location or *general floods*, which are caused by precipitation over a longer time period in a particular river basin. Since the town is located at the confluence of three major rivers, Greenfield has also experienced what is known locally as *backwater flooding* due to ice jams on the Connecticut and Deerfield Rivers. There are several local factors that determine the severity of a flooding event, including: stream and river basin topography, precipitation and weather patterns, recent soil moisture conditions, amount of impervious surface area, and the degree of vegetative clearing. Floods occur more frequently and are the most costly natural hazard in the United States.

*Flash flooding* events typically occur within minutes or hours after a period of heavy precipitation, after a dam or levee failure, or from a sudden release of water from an ice jam. Most often, flash flooding is the result of a slow-moving thunderstorm or the heavy rains from a hurricane. In rural areas, flash flooding often occurs when small streams spill over their banks. However, in urbanized areas, flash flooding is often the result of clogged storm drains (leaves and other debris) and the higher amount of impervious surface area (roadways, parking lots, roof tops).

In contrast, *general flooding* events may last for several days. Excessive precipitation within a watershed of a stream or river can result in flooding particularly when development in the

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<sup>6</sup> Massachusetts Department of Conservation and Recreation 2009 precipitation data, <http://www.mass.gov/dcr/watersupply/rainfall/index.htm>.

floodplain has obstructed the natural flow of the water and/or decreased the natural ability of the groundcover to absorb and retain surface water runoff (e.g., loss of wetlands and higher amounts of impervious surface area in urban areas).

A floodplain is the relatively flat, lowland area adjacent to a river, lake or stream. Floodplains serve an important function, acting like large “sponges” to absorb and slowly release floodwaters back to surface waters and groundwater. Over time, sediments that are deposited in floodplains develop into fertile, productive farmland like that found in the Connecticut River Valley. In the past, floodplain areas were also often seen as prime locations for development. Industries were located on the banks of rivers for access to hydropower. Residential and commercial development occurred in floodplains because of their scenic qualities and proximity to the water. Although periodic flooding of a floodplain area is a natural occurrence, past and current development and alteration of these areas ensures that flooding will continue to be a costly and frequent hazard.

### ***Location and Extent***

Franklin County has several major rivers and numerous tributaries which are susceptible to flood events. The major rivers in the region include the Connecticut, the Deerfield, and the Millers, running through Greenfield. Some of the tributaries to these rivers which are prone to flooding include the Green River and the Sawmill River. Flooding poses a significant threat to life and public health and can cause severe property damage.



One river prone to flooding in Greenfield, the Green River, rushes past low-lying structures on River Street.

The Connecticut, Deerfield and Green Rivers all flow through Greenfield, with the Green River prone to occasional flooding. Table 3-1 shows occurrences of flooding in Franklin County since 1993 and Table 3-2 shows occurrences of flooding specific to Greenfield, both taken from NOAA data.

**Table 3-1: Flood Events in Franklin County Since 1993**

Year	# of Flood Events	Annual Property Damage	Annual Crop Damage
2010	1	\$150,000	\$0
2009	0	\$0	\$0
2008	3	\$38,000	\$0
2007	1	\$250,000	\$0
2006	0	\$0	\$0
2005	5	\$11,435,000	\$0
2004	2	\$10,000	\$0
2003	1	\$10,000	\$0
2002	0	\$0	\$0
2001	1	\$0	\$0
2000	1	\$0	\$0
1999	0	\$0	\$0
1998	4	\$75,000	\$0
1997	0	\$0	\$0
1996	11	\$1,800,000	\$0
1995	3	\$0	\$0
1994	2	\$0	\$0
1993	5	\$0	\$0
<b>18</b>		<b>\$764,889</b>	<b>\$0</b>
# of Years		Average Annual Property Damage	Average Annual Crop Damage

Source: <http://www4.ncdc.noaa.gov>

**Table 3-2: Flood Events in Greenfield Since 1993**

Date	Time	Type	Property Damage	Crop Damage	Excerpts from storm details for FC only
6/13/1996	4:00 PM	Urban/Small Stream Flood	\$0	\$0	
9/18/2004	10:15 AM	Flash Flood	\$10,000	\$0	Deerfield and Green Rivers Heavy rainfall associated with the remains of Ivan caused flash flooding in Franklin and Hampshire Counties in western Massachusetts. Storm totals of 3 to 5 inches were widely observed and caused rapid rises on the Deerfield and Green Rivers in Franklin County. The two rivers caused minor flooding of their respective low lying areas. In Hampshire County, a trained spotter reported several small brooks out of their banks which flooded low lying areas and caused minor damage. No injuries were reported.
7/18/2005	2:18 PM	Flash Flood	\$5,000	\$0	Slow moving (almost stationary) thunderstorms produced a significant flash flood event in north

					central Franklin County, Massachusetts. Two maximum rainfall totals of 9 inches were reported from Bernardston, where the worst flooding had been reported. In this town, the police station experienced flooding; and approximately 50 homes either experienced property damage or basement flooding. In addition, 30 roads were either washed out, closed or partially closed, or had culverts blown out due to flooding.
2/13/2008	15:40 PM	Flood	\$5,000	\$0	Several streets in Greenfield were flooded. A low pressure system developed off the Mid-Atlantic coast and moved up the east coast southeast of Nantucket producing snow, rain, and ice across Southern New England. Widespread two to four inch rainfall amounts resulted in small stream and poor drainage flooding as well as some minor river flooding. In addition, there was some minor wind damage from strong northeast winds, especially along the coast.
8/7/2008	17:00 PM	Flood	\$8,000	\$0	Several thunderstorms with heavy rain moved through Greenfield resulting in flooding. Ten basements were flooded and there was some sewage backup on Silver Street. There was heavy rain associated with some of the storms as well which resulted in some urban flooding and some flash flooding in Worcester, Massachusetts.
9/28/2003	2:00 PM	Flash Flood	\$10,000	\$0	Torrential rainfall caused flash flooding in the Connecticut River Valley. Nearly 4 inches of rain fell in a few hours, causing significant urban flooding from Agawam to Northampton. Several roads were closed in Westfield, Agawam, Chicopee, West Springfield, Easthampton, and Northampton where flood waters rose up to the doors of vehicles. In Greenfield, the Green River rose out of its banks and forced the closure of Nash's Mill Road between Colrain and Leyden Roads.

Source: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~260419>

Some recent examples of significant flooding in Greenfield occurred between October 8th and October 15th of 2005. During this time, the Connecticut River Valley received between 12-22 inches of rain from Tropical Storm Tammy and a subtropical depression. Greenfield experienced 100 year flood events in many areas throughout town. The majority of the flooding occurred along the Green River from Nash's Mill Road south to the mouth of the Deerfield River. Greenfield's Green River Recreational Swimming Area was severely affected with flood waters damaging the bath house and the public beach.

In addition, flood waters topped the banks of the Green River and left debris along the then recently constructed bike trail. The flood caused the evacuation of the Wedgwood Gardens Trailer Park leading to just under three million dollars in evacuation costs and damages to the landowner and to the town. The flooding also left 75 residents of the Wedgwood Gardens trailer park homeless. The development was subsequently leveled and the residents assisted with relocation.



Flood in Greenfield, MA, October 2005. Photo courtesy of MassLive.

Areas of chronic localized flooding include:

- Green River Cemetery, where water has periodically pooled and then caused mudslides down hill.
- Factory Hollow Road along the Fall River has chronic flooding.
- Nash's Mill Road floods annually.
- The Meadow's Golf Course floods annually.
- Hastings, Heywood and Riddell Streets neighborhoods flood during heavy rain events when the Maple Brook Culvert backs up.
- Green River Park floods every few years.
- Green and Cooke Streets and Greenway Lane – this neighborhood floods during heavy rain events.

## Severe Winter Storms

### *General Description*

Severe winter storms can pose a significant risk to property and human life because the rain, freezing rain, ice, snow, cold temperatures and wind associated with these storms can disrupt utility service, phone service and make roadways extremely hazardous. Severe winter storms can be deceptive killers. The types of deaths that can occur as a result of a severe winter storm include: traffic accidents on icy or snow-covered roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to cold temperatures. Infrastructure and other property are also at risk from severe winter storms and the associated flooding that can occur following heavy snow melt. Power and telephone lines, trees, and telecommunications structures can be damaged by ice, wind, snow, and falling trees and tree limbs. Icy road conditions or roads blocked by fallen trees may make it difficult to respond promptly to medical emergencies or

fires. Prolonged, extremely cold temperatures can also cause inadequately insulated potable water lines and fire sprinkler pipes to rupture and disrupt the delivery of drinking water and cause extensive property damage.

Franklin County regularly experiences severe winter storm events between the months of December and April. According to the National Climatic Data Center (NCDC), there have been a total of 111 snow and ice events reported in Franklin County between February 1, 1993 and February 26, 2010, including heavy snow, snow, ice storms, snow squalls, freezing rain and winter storms.<sup>7</sup> The NCDC web site has more detailed information about each of the listed storms. Seven out of the 111 snow and ice events that impacted Franklin County (as well as other areas of Massachusetts) resulted in Presidential Disaster Declarations or Emergency Declarations, which then made the state, residents and businesses eligible for federal disaster relief funds. Table 3-3 lists the seven recent severe winter disasters that have led to Presidential Disaster or Emergency Declarations in Massachusetts.

**Table 3-3: Major Disaster and Emergency Declarations 1993 - 2009**

Disaster Name	Date of Event	Declared Areas	Disaster #/Type of Assistance	Federal Share Disbursed	Non-Federal Share Disbursed	Total Disbursement
Blizzards, High Winds and Record Snowfall	March 1993	All 14 Counties	FEMA-3103-EM (PA)	\$1,284,873	\$183,649	\$1,468,522
Blizzard	January 1996	All 14 Counties	FEMA-1090-EM (PA)	\$16,177,860		\$16,177,860
Snowstorm	March 2001	Counties of Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, and Worcester. The cost share is 75% federal and 25% local.	FEMA-3165-EM (PA)	\$21,065,441		\$21,065,441
Snowstorm	February 2003	All 14 Counties. The cost share is 75% federal and 25% local.	FEMA-3175-EM (PA)	\$28,868,815		\$28,868,815
Snowstorm	December 2003	Counties of Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, and Worcester	FEMA-3191-EM (PA)	\$35,683,865		\$35,683,865

<sup>7</sup> <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

Disaster Name	Date of Event	Declared Areas	Disaster #/Type of Assistance	Federal Share Disbursed	Non-Federal Share Disbursed	Total Disbursement
Snowstorm	January 2005	All 14 Counties	FEMA-3201-EM (PA)	\$49,945,087		\$49,945,087
Severe Winter Storm	December 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, and Worcester *(Figure as of 9/8/2009)	FEMA-3296-EM-MA	\$66,509,713		
Severe Storms and Flooding	December 2008	All 14 Counties (6-month lock-in \$7,200,000)	FEMA-1813-DR-MA(PA)	Greenfield not affected	Greenfield not affected	Greenfield not affected

Notes: **Public Assistance (PA) Project grants.** Supplemental disaster assistance to states, local governments, certain private non-profit organizations resulting from declared major disasters or emergencies.

### ***Location and Extent***

Although ice storms occur much less frequently than snow storms (4 out of 111 in the NCDC database), the effects can be devastating. On December 11, 2008, Franklin County residents awoke to a landscape coated with ice. Half an inch of ice accumulated on exposed surfaces across Franklin County. This major ice storm affected interior Massachusetts and southern New Hampshire as well as much of northern New England. The ice buildup on exposed surfaces combined with breezy conditions resulted in numerous downed trees, branches, and power lines, which resulted in widespread power outages. More than 300,000 customers were reportedly without power in Massachusetts and an additional 300,000 were without power in the state of New Hampshire.

Because of the breadth of this December 2008 storm (from Pennsylvania to Maine), extra crews to reinstate power were harder to come by. Power crews from states as far away as South Carolina, as well as local National Guard teams, were called out to help with power restoration and clean up. While most people had their power restored within a week, others were still without power at Christmas (nearly 2 weeks later). During this period, temperatures were mostly below normal and at least one major snowstorm affected the same area. At the time of the December 19th snowstorm, which dumped 7 – 12 inches of snow in eastern Franklin County and 9 – 14 inches of snow in western part of the county, over 100,000 customers were still without power in the two states combined. Two days later, on December 21<sup>st</sup>, 5 – 7 inches of new snow blanketed eastern Franklin County.

Greenfield was fortunate; the storm did not cause power outages in town. There was some property damage from the winds that required clean up and disposal of debris. However, because Greenfield did not lose power it became a refuge. Many residents from around Franklin County relied on the hospitality of Greenfield’s hotels, motels and inns and restaurants, cafes, and coffee shops to weather the storm and power outages. More data and information related to Severe Winter Storms is located in the Vulnerability Assessment section of this plan.



The ice storm of 2008 caused power outages in neighboring towns due to downed trees and power lines, as shown in this photo taken in Ashfield. *Photo courtesy of WMECO.*

## Hurricanes

### *General Description*

Hurricanes are violent rainstorms associated with tropical storms with strong winds that can reach speeds of up to 200 miles per hour. Hurricanes generally occur between June and November and can result in flooding and wind damage to structures and above-ground utilities. August, September, and the first half of October are when most hurricanes occur in New England.

### *Location and Extent*

While there have been no reports of hurricane events in Greenfield, a substantial hurricane could have a large area of occurrence and could have a critical impact with multiple injuries possible and a potential a significant percentage of property in affected area damaged or destroyed. In Massachusetts, major hurricanes occurred in 1904, 1938, 1954, 1955, 1960 1976, 1985, and 1991. In most cases, hurricanes are not a significant threat to interior New England. Table 3-4 shows the occurrences of hurricanes and tropical storms in Franklin County in the last 20 years.

**Table 3-4: Damage from Hurricanes and Tropical Storms in Franklin County.**

Begin Date	End Date	Injuries	Fatalities	Property Damage	Crop Damage	Remarks
10/4/1990	10/4/1990	0	0	\$3,571	\$0	High Winds

Begin Date	End Date	Injuries	Fatalities	Property Damage	Crop Damage	Remarks
10/18/1990	10/19/1990	0.07	0	\$3,571	\$0	High Winds
8/19/1991	8/19/1991	0.22	0	\$ 5,555,556	\$ 555,556	Wind
12/23/1994	12/24/1994	0	0	\$35,714	\$0	High Winds
10/28/1995	10/28/1995	0.2	0	\$0	\$0	HIGH WINDS
10/1/1998	10/1/1998	0	0	\$62,500	\$0	Strong Wind
12/1/1998	12/1/1998	0.23	0	\$769	\$0	Strong Wind
3/22/1999	3/22/1999	0	0	\$7,692	\$0	Strong Wind
10/15/2003	10/15/2003	0	0	\$35,714	\$0	
11/13/2003	11/14/2003	0	0	\$91,667	\$0	
12/1/2004	12/1/2004	0	0	\$37,778	\$0	High Wind
9/29/2005	9/29/2005	0	0	\$33,889	\$0	High Wind
1/15/2006	1/15/2006	0	0	\$8,125	\$0	Strong Wind
2/17/2006	2/17/2006	0.33	0.11	\$211,111	\$0	High Wind (G68)
10/20/2006	10/20/2006	0.2	0	\$43,000	\$0	High Wind (G50)
10/29/2006	10/29/2006	0	0	\$12,625	\$0	High Wind (G53)
12/1/2006	12/1/2006	0	0	\$3,000	\$0	High Wind (G55)

Source: Sheldus Database.

## Tornados

### *General Description*

Tornados are swirling columns of air that typically form in the spring and summer during severe thunderstorm events. In a relatively short period of time and with little or no advance warning, a tornado can attain rotational wind speeds in excess of 250 miles per hour and can cause severe devastation along a path that ranges from a few dozen yards to over a mile in width. The path of a tornado may be hard to predict because they can stall or change direction abruptly. Within Massachusetts, tornados have occurred most frequently in Worcester County and in communities west of Worcester. In the past 50 years, approximately 20 tornados have occurred in Franklin County. High wind speeds, hail, and debris generated by tornados can result in loss of life, downed trees and power lines, and damage to structures and other personal property.

Tornados can have devastating effects on infrastructure, property and human health. Striking at random, their conical winds leave trails of devastation, at times more than a mile wide, in their wake. Small tornados, known as “gustnadoes,” have been known to strike in Franklin County, most recently in Sunderland in 2009. The gustnado does not appear in data compiled on tornados for this report, however, even gustnadoes can cause damage; the 2009 occurrence destroyed a barn and downed trees in Sunderland.

### *Location and Extent*

The most recent information on tornados is from the NOAA Database, Table 3-5, indicating 4 tornados touched down in Franklin County in the last 15 years. According to the NOAA database, no tornados have been observed directly in Greenfield, however, on July 11, 1958, a

tornado was reported in nearby Erving and was ranked F2 (Significant Tornado) on the Fujita Scale of Tornado Intensity. The tornado touched down on the Connecticut River in an uninhabited area near Warner Road in Erving. The extent of damage it caused is unknown.

**Table 3-5: Tornadoes Events in Franklin County**

Year	# of Tornado Events	Annual Property Damage	Annual Crop Damage
2010	0	\$0	\$0
2009	0	\$0	\$0
2008	0	\$0	\$0
2007	0	\$0	\$0
2006	1	\$200,000	\$0
2005	0	\$0	\$0
2004	0	\$0	\$0
2003	0	\$0	\$0
2002	0	\$0	\$0
2001	0	\$0	\$0
2000	0	\$0	\$0
1999	0	\$0	\$0
1998	0	\$0	\$0
1997	2	\$100,000	\$0
1996	0	\$0	\$0
1995	0	\$0	\$0
1994	0	\$0	\$0
1993	0	\$0	\$0
1992	1	\$25,000	\$0
1991	0	\$0	\$0
<b>20</b>		<b>\$16,250</b>	<b>\$0</b>
# of Years		Average Annual Property Damage	Average Annual Crop Damage

High wind speeds, hail, and debris generated by tornadoes can result in loss of life, downed trees and power lines, and damage to structures and other personal property (cars, etc.). Since the 1950s, there have been over twenty tornadoes in Franklin County. In the last fifteen years, three tornadoes have been reported in Franklin County, in the towns of Heath, Charlemont, and Wendell. A July 2006 tornado in Wendell was rated F2 (Strong) on the Fujita Scale with winds estimated near 155 mph.

More data and information related to Hurricanes and Tornadoes is located in the Vulnerability Assessment section of this plan.

**Microbursts (Includes Thunderstorms and Wind-Related Events)**

*General Description*

The category Microbursts includes thunderstorm events, and associated storm effects including wind storms, hail and lightning. Microbursts can often cause tornado-like damage and can be

mistaken for tornadoes. In contrast to the upward rush of air in a tornado, air blasts rapidly downward from thunderstorms to create microbursts. Thunderstorms bring strong winds, rain and, at times, hail, potentially causing damage to property, crops and utilities and injuries or deaths to residents. Persistent rain can also cause flooding.

### ***Location and Extent***

In July of 1994, a brief microburst in Greenfield caused a state disaster declaration and in nearly \$60 K of Public Assistance Project Grants to aid in storm recovery. A more recent microburst event in Greenfield, packed quite a punch. On May 26, 2010 as a result of being pummeled by storms that ripped through the region, Greenfield declared a state of emergency. All public schools were closed and many roads were closed to all but emergency vehicles. More than 100 reports of downed trees, utility poles, and wires were received. The storms left more than 27,000 Western Massachusetts Electric Co. customers in the region without power.<sup>8</sup> Assessment by the Greenfield DPW of total costs of the storm to the Town of Greenfield is approximately \$98,000 while costs to private home owners are estimated to be about \$150,000, see Table 3-38 in the Vulnerability Assessment section of this plan for more information.



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Damage such as this seen in Greenfield was common in the aftermath of the 2010 microburst.

Thunderstorms are much more common in western Massachusetts than tornados and microbursts and can cause significant damage. While thunderstorms generally do not hit with the force of a tornado or microburst, their higher frequency and more widespread extent – and their associated hail and lightning – make them a hazard to be taken seriously. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared

<sup>8</sup> [http://www.masslive.com/news/index.ssf/2010/05/storms\\_force\\_greenfield\\_to\\_dec.html](http://www.masslive.com/news/index.ssf/2010/05/storms_force_greenfield_to_dec.html)

for these events. More information and data on microbursts and thunderstorms is located in the Vulnerability Assessment section of this plan.

## Wildfires/Brush Fires

### *General Description*

According to FEMA, there are three different classes of wildland fires: *surface fires*, *ground fires* and *crown fires*.<sup>9</sup> The most common type of wildland fire is a surface fire which burns slowly along the floor of a forest, killing or damaging trees. A ground fire burns on or below the forest floor and is usually started by lightning. Crown fires move quickly by jumping along the tops of trees. A crown fire may spread rapidly, especially under windy conditions. While wildland fires have not been a significant problem in Greenfield, there is always a possibility that changing land use patterns and weather conditions will increase a community's vulnerability. For example, drought conditions can make forests and other open, vegetated areas more vulnerable to ignition. Once the fire starts, it will burn hotter and be harder to extinguish. Soils and root systems starved for moisture are also vulnerable to fire. Residential growth in rural, forested areas increases the total area that is vulnerable to fire and places homes and neighborhoods closer to areas where wildfires are more likely to occur.

### *Location and Extent*

The Town of Greenfield Fire Department responds to approximately 450 brush fires each year. Most of these fires are started on residential lots to clear grass, leaves, brush and other woody debris and become a problem when the homeowner can no longer control them. According to the Massachusetts Fire Incident Reporting System, between 2004 and 2009, thirty five (35) brushfires were reported in Greenfield. (See Table 3-6.) There were no fires of significance in 2010, according to Emergency Management Director, Robert Strahan.

**Table 3-6: Massachusetts Fire Incident Reporting System – Brushfires 2004-2009**

Department	Total # of Brush Fires	2004	2005	2006	2007	2008	2009
BERNARDSTON	44	5	14	7	5	8	5
CHARLEMONT	15	3	1	0	8	1	2
COLRAIN	8	3	1	0	3	0	1
CONWAY	25	4	5	5	3	4	4
DEERFIELD	23	6	5		1	4	7
ERVING	10	4	2	1	0	3	0
GILL	14	0	1	7	4	1	1
<b>GREENFIELD</b>	<b>35</b>	<b>0</b>	<b>1</b>	<b>4</b>	<b>11</b>	<b>13</b>	<b>6</b>
HAWLEY	2	0	0	2	0	0	0
HEATH	6	1	1	0	0	2	2
LEVERETT	11	1	1	3	5	0	1
LEYDEN	3	1	0	0	2	0	0
MONTAGUE CENTER	38	3	8	10	7	1	9
NEW SALEM	14	0	0	3	5	1	5

<sup>9</sup> FEMA, "Fact Sheet: Wildland Fires", September 1993.

Department	Total # of Brush Fires	2004	2005	2006	2007	2008	2009
NORTHFIELD	1	0	0	0	0	1	0
ORANGE	25	4	3	3	9	0	6
SHELBURNE CTR	13	4	2	5	2	0	0
SHELBURNE FALLS	7	0	0	1	4	1	1
SHUTESBURY	4	0	1	0	0	1	2
SOUTH DEERFIELD	18	4	2	3	5	2	2
SUNDERLAND	17	4	6	6	0	1	0
TURNERS FALLS	29	8	5	4	7	1	4
WARWICK	4	2	1	1	0	0	0
WENDELL	9	0	0	6	2	0	1
WHATELY	23	6	7	6	1	3	0
Total	398	63	67	77	84	48	59

While wildfires have not been a significant problem in Greenfield, there is always a possibility that changing land use patterns and weather conditions will increase a community's vulnerability. For example, drought conditions can make forests and other open, vegetated areas more vulnerable to ignition. Once the fire starts, it will burn hotter and be harder to extinguish. Soils and root systems starved for moisture are also vulnerable to fire. Residential growth in rural, forested areas increases the total area that is vulnerable to fire and places homes and neighborhoods closer to areas where wildfires are more likely to occur.

The Town issues approximately 430 burn permits annually. Education in the form of guidelines and rules are included in each burn permit issued and each applicant is required to read, understand and sign the permit.

## Dam Failures

### *General Description*

Although dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control, they also pose a potential risk to lives and property. Dam failure is not a common occurrence but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is instantly released, oftentimes with catastrophic consequences, as the water rushes in a torrent downstream flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Many dams in Massachusetts were built in the 19<sup>th</sup> Century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events.

### ***Location and Extent***

Greenfield is particularly susceptible to disastrous flooding because of its location at the confluence of the Connecticut and Deerfield Rivers. Both have major dams. The Connecticut has 16 large dams (Table 3-7) stretching from Holyoke Dam to the Moore Dam near Littleton New Hampshire. The Turners Falls Dam is just east of Greenfield.

**Table 3-7: Dams on the Connecticut River Mainstem:**

1. Holyoke, MA	2. Cabot Station, MA
3. Turners Falls, MA	4. Vernon, VT-NH
5. Bellows Falls, VT	6. Wilder, VT-NH
7. Ryegate, VT-NH	8. McIndoes Station, VT-NH
9. Comerford Station, NH	10. Moore Reservoir, NH
11. Gilman Project, VT-NH	12. Lower, VT-NH
13. Murphy, NH	14. First Connecticut Lake, NH
15. Second Connecticut Lake, NH	16. Moose Fall, NH <sup>10</sup>

There are 10 hydroelectric dams along the 73-mile length of the Deerfield River, earning it its nickname, "The Hardest Working River." Of particular note are the projects on the Deerfield River owned by TransCanada Corporation and licensed by the Federal Energy Regulatory Commission (FERC). These projects include the Somerset Dams and Harriman Dams (the two largest storage reservoirs), Sherman and Fife Brook Dams, and Bear Swamp Upper Reservoir, all of which are classified as High Hazard Dams. The Emergency Action Plans for these projects include a series of inundation maps for each dam which illustrate potential flooding conditions for downstream areas including portions of Greenfield adjacent to the Green, Deerfield and Connecticut Rivers.<sup>11</sup>

A catastrophic failure of any one of these High Hazard dams would likely result in the cascading failure of all the downstream dams (both High and Low Hazard dams), resulting in widespread flooding of downstream areas in a matter of hours. For example, on a sunny day (no additional precipitation added to released water), water from a catastrophic failure of the Harriman Dam would reach the Route 5 Bridge which spans the Deerfield River (67.6 miles from origin) in 4.6 hours and the confluence of the Deerfield and Connecticut Rivers (68.9 miles from origin) in 5 hours. Under "Probable Maximum Flood" (PMF) conditions, the worst-case scenario, floodwaters from a catastrophic failure of the Sherman Dam would reach the Route 5 Bridge in 3.2 hours. Both "Sunny Day" and PMF conditions are presented on the inundation maps for the five US GEN New England High Hazard Dams. According to inundation mapping for the Moore Dam, in the event of a catastrophic failure under PMF conditions, floodwaters would reach the Deerfield and Connecticut Rivers in approximately 25 hours.

The remaining five TransCanada dams on the Deerfield River are classified as Low Hazard Dams; therefore, no Emergency Action Plan or inundation mapping are required by FERC. Consultants hired by TransCanada examined a "Sunny Day" failure scenario for these dams to determine the downstream flooding hazard potential. Next, the incremental impact was

<sup>10</sup> Two other dams, Enfield Dam in Connecticut and Groverton Dam are breached.

<sup>11</sup> "Emergency Action Plans for the Deerfield River FERC Licensed Projects Nos. 2323 and 2669," prepared for US GEN New England, Inc., by Kleinschmidt Energy and Water Resource Consultants, November 2003.

determined for a dam failure that occurred at a flow equivalent to the 100-year frequency flood. For these two scenarios, the study indicates that the additional flooding above the 100-year flood stage was insignificant and therefore these projects do not present a significant hazard to life and property.<sup>12</sup> However, the cascading failure of one or more of these dams that would occur if one of the High Hazard dams failed would result in the catastrophic flooding shown on the inundation maps in the EAP.

The 100-year flood plain in Greenfield encompasses approximately 1,449 total acres. Of those acres, 63 acres are developed land, including an estimated 43 acres of developed residential land and 38 dwellings. The area inundated by a catastrophic failure of one of the TransCanada dams would cover substantially more acreage. Emergency responders should review inundation areas presented in the EAP and identify possible evacuation routes, since significant portions of Greenfield and neighboring communities such as Deerfield and Montague, including sections of Route 5/10, may be flooded.

The Massachusetts Department of Conservation and Recreation (MA DCR) is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). Until 2002, DCR was also responsible for conducting dam inspections when state law changed placing the burden of inspections on the owners of the dams. In accordance with the new regulations, which went into effect in 2005, dam owners must register, inspect and maintain dams in good operating condition. Owners of High Hazard Potential dams and certain Significant Hazard Potential dams are also required to prepare, maintain and update Emergency Action Plans. The state has three hazard classifications for dams:

- High Hazard Potential: 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: 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: Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

The inspection schedule for dams is as follows:

- Low Hazard dams – 10 years
- Significant Hazard dams – 5 years
- High Hazard dams – 2 years

The time intervals represent the maximum time between inspections. More frequent inspections may be performed at the discretion of the state. Dams and reservoirs licensed and subject to inspection by the FERC are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to the DCR. All other dams are subject to the regulations unless exempted in writing by DCR.

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<sup>12</sup> Ibid.

In 2005, the MA DCR Office of Dam Safety provided data for the 10 dams in Greenfield. Of these ten dams, seven were classified as *Significant Hazards*, two were classified as *Low Hazard* and one dam had no hazard classification. Four of the dams assigned to the Significant Hazard category were last inspected between June 1998 and May 1999. Two of these dams were found to be in good condition and the remaining two dams were found to be in fair condition. Of the three remaining dams classified as Significant Hazard dams, two have not been inspected since the mid 1970's and one has not been inspected since 1985. No current information is available on the condition of these dams. One of the Low Hazard dams was inspected in July 2003 and found to be in fair condition. The other Low Hazard dam was last inspected in June 2001 but its condition was not documented in the information received from DCR. The dam with no hazard classification was last inspected in January 1975. No information is available regarding the condition of this dam.

In 2011, the MA DCR Office of Dam Safety's Legal Department provided updated data on dams in Greenfield. The data was generated using new software and a new reporting system, according to the Legal Department. The results are incomplete, with only 4 dams being reported in Greenfield. After attempts to clarify the data discrepancies were unsuccessful, MEMA advised using the information from the previous Hazard Mitigation plan and confirming the information directly with the town.

According to the Town Engineer, there are only nine dams in town rather than the ten reported by DCR in 2005. The Town of Greenfield is the Owner and Caretaker of record for six of these nine dams. According to DCR records, four of the dams the Town is responsible for are classified as Significant Hazards and the remaining two dams are Low Hazard. The remaining three dams in town are under private ownership. All three are classified as Significant Hazard dams.

Along with manmade dams, failure of beaver dams can cause flooding as well. Alteration of the landscape by beavers is a natural process that creates habitat for shore birds, mammals and rare amphibians. However, beaver ponds can flood structures, roads and utilities, causing costly and potentially dangerous situations. Beaver activity can also pollute drinking water supplies. Mitigation measures suggested by Massachusetts Division of Fish and Wildlife (MassWildlife) and other agencies can help communities and homeowners deal with nature's master builders.

Until 1996, when a ballot initiative passed restricting the practice, Massachusetts residents were permitted to trap beavers. That change in policy caused a spike in the beaver population, which, in turn, led to a sharp increase in complaints about beaver activity and its effects. The law was modified in 2000 so that town Board of Health members could issue emergency trapping permission outside of the usual trapping season. But an increased beaver population, combined with land development reducing beaver habitat, means that humans and beavers continue to clash. Several mitigation measures, when applied thoughtfully, legally and with maintenance measures in mind, can help with beavers' negative effects, while preserving beavers' positive impact on the land.<sup>13</sup>

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<sup>13</sup> *Otsego County (NY) All Hazards Mitigation Plan*, 2010.

State law makes it illegal for any person to disturb or tear open a beaver dam or beaver lodge without written permission from MassWildlife and the local Conservation Commission or Department of Environmental Protection. Permits are needed to disturb a beaver dam for any reason in Massachusetts. Even dams that cause flooding require permits to be breached.<sup>14</sup>

While trapping beaver can have short-term benefits, the right conditions for beaver habitat will eventually lure new beavers. It may be best to combine trapping with measures that discourage beaver activity that's bad for humans. Techniques used to mitigate the flooding damage caused by beaver include breaching of beaver dams, protecting road culverts with fences or guards, and controlling water levels with water flow devices. All these techniques require a certain degree of effort and regular maintenance to insure water levels that can be tolerated (thereby preserving the positive aspects of the associated wetland). See the MassWildlife publication *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts* for details on these mitigation measures. The following techniques were adapted from that publication.

- Dam breaching is an immediate but very short-term solution to flooding problems caused by beaver. Potato hoes or stone hooks are the best tools for dismantling dams by hand. Shovels and spading forks are ineffective. Good water control is possible if the breach is kept shallow and broad so that the water level falls slowly. Opening a deep breach creates a dangerous situation and may cause serious flooding and erosion downstream. Tractor- or truck-mounted excavators may be used by town, county or state highway employees to remove large amounts of material from beaver dams but care should be taken to avoid downstream flooding. Neighbors should be told where, when, and why a dam excavation is going to be done. If the method is justified and must be used, it is best done in mid-summer when the water level is low.
- Beavers build dams instinctively. When they sense running water, they start to build or repair dams. Culverts, especially ones made out of metal, will amplify the sound of the water rushing through them. Thus, beaver will commonly block road culverts with sticks, mud and rocks. This can cause flooding upstream. Culverts blocked from the inside are difficult to clean and potentially dangerous. The use of meshes and grills, placed on both the upstream and downstream ends of the culvert, can prevent beavers from entering. Several strategies are listed in *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts*.
- Water Level Control Devices (WLCDs) keep beavers away from an intake pipe that lowers the water level of the pond. It's been estimated that only 4.5% of beaver problems in Massachusetts will respond to these devices. Using and maintaining a WLCD in conjunction with trapping young beavers can allow coexistence for years. Several types of WLCDs are available. For construction details, see *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts*.

Town of Greenfield Department of Public Works engineer, Alan Twarog, identified some sites where beaver dams are having an notable impact on the landscape. They include:

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<sup>14</sup> Langlois, S.A. and T.A. Decker. 2004. *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts* (Rev. Ed.). MA Division of Fisheries and Wildlife. 18pp.

- Cherry Rum Brook behind Silvercrest Condominium project and behind Cherry Rum Plaza. These beaver dams have been breached several times.
- Allen Brook off Plain Road. The Town is currently working with landowner to address this issue.

## Earthquakes

### *General Description*

An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath the Earth's surface. Earthquakes can occur suddenly, without warning, at any time of the year. The northeast states experience an average of 30 to 40 earthquakes each year although most are not noticed by people.<sup>15</sup> Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as landslides, avalanches, flash floods (dam failure) and fires. Unreinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.<sup>16</sup>

### *Location and Extent*

**Table 3-8: Northeast Earthquakes with a Magnitude of 4.2 or more 1924 - 2007**

Location	Date	Magnitude
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH Quebec Border, NH	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5
Plattsburg, NY	April 20, 2002	5.1

Source: Northeast States Emergency Consortium: [www.nesec.org/hazards/earthquakes.cfm](http://www.nesec.org/hazards/earthquakes.cfm)

On June 22, 2010 there was a magnitude 5.8 earthquake in Canada which could be felt in Greenfield. No damage was reported, but residents stated they felt the quake and were unnerved by the experience.

Massachusetts introduced earthquake design requirements into their building code in 1975. However, these specifications apply only to new buildings or to extensively modified buildings. Existing buildings, bridges, water supply lines, electrical power lines and facilities, etc. have generally not been designed to withstand the forces of an earthquake.

**Table 3-9: Northeast States Record of Historic Earthquakes**

<sup>15</sup> Northeast States Emergency Consortium web site: [www.nesec.org/hazards/earthquakes.cfm](http://www.nesec.org/hazards/earthquakes.cfm)

<sup>16</sup> Federal Emergency Management Agency web site: [www.fema.gov/hazards/earthquakes/quake.shtm](http://www.fema.gov/hazards/earthquakes/quake.shtm)

State	Years of Record	Number Of Earthquakes
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755

Source: Northeast States Emergency Consortium Web site: [www.nesec.org/hazards/earthquakes.cfm](http://www.nesec.org/hazards/earthquakes.cfm)

## Landslides

### *General Description*

Landslides are geological phenomena that include a wide range of ground movement, such as rock falls, failure of slopes and shallow debris flows. They can occur in coastal, mountain, and river edge environments.

Landslides occur when the stability of a slope changes from a stable to an unstable condition. A change in the stability of a slope can be caused by a number of factors, acting together or alone. Natural causes of landslides include:

- Groundwater pressure acting to destabilize the slope
- Loss or absence of vertical vegetative structure, soil nutrients, and soil structure (e.g. after a wildfire)
- Erosion of the toe of a slope by rivers
- Weakening of a slope through saturation by snowmelt or heavy rains
- Earthquakes adding loads to barely-stable slopes
- Earthquake-caused liquefaction destabilizing slopes
- Volcanic eruptions

Landslides are created by human activities as well, including deforestation, cultivation and construction, which destabilize already fragile slopes. These activities can include:

- Vibrations from machinery or traffic
- Blasting
- Earthwork which alters the shape of a slope, or which imposes new loads on an existing slope
- In shallow soils, the removal of deep-rooted vegetation that binds colluvium to bedrock
- Construction, agricultural or forestry activities (logging) which change the amount of water which infiltrates the soil.

### *Location and Extent*

Landslides in New England occur along highways where rock cuts have been made or along river corridors where the river bank collapses due to erosion that undercuts the shore.



Residential property in Greenfield, MA was inundated with mud due to a landslide from neighboring Green River Cemetery. Photo taken by Jeff Brown and courtesy of MassLive.com.

In recent years, relatively small landslides have been reported on Factory Hollow Road along the Fall River, on Mead Street and Wisdom Way, Brook Road and Shelburne Road. Another incident of note affecting a cultural and historic resource involved the 90-acre Green River Cemetery. This cemetery contains the grave sites of many notable historical figures including a governor and state legislators. The site also includes exemplary funerary art and sculpture such as the Russell family monument carved by Daniel Chester French, one of America's foremost sculptors.<sup>17</sup>

In a recent landslide event, the Green River Cemetery's banks gave way again. In the early morning of March 7, 2011, torrential rains swept away a piece of cemetery into the backyards of homes and nearby streets, about 100 feet below the Cemetery. The landslide sent silt, mud, and debris slid down from the Green River Cemetery into homes on Meridian Street. According to the Greenfield Recorder, state geologists estimated that about 1,500 to 3,000 cubic yards of mud and debris came down into the yards but that no graves were involved. Three inches of rain in Greenfield over a day and a half contributed to the disaster that caused thousands of dollars worth of damage. The company called in to divert water away from homes below and help clear their yards of some of the mud found that a drainage system that had been installed in 1986 was

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<sup>17</sup> <http://www.jsrockwell.com/historic.htm>

been plugged and buried by the mudslide. The drainage system was cleaned out and was found to be in good shape and should handle any future rains adequately. The Town indicated that it is the responsibility of the Cemetery board to make sure the system is evaluated and cleared of any silt accumulation on a regular basis.



The aftermath of the mudslide from the Green River Cemetery included cleanup on a nearby street and bridge..

## Ice Jams

### *General Description*

Ice jams (or ice dam) occurs when water builds up behind a blockage of ice. Ice dams can occur in various ways, but in New England they predominantly form on rivers and streams and mainly threaten infrastructure.

When the upstream part of a river thaws first and the ice is carried downstream into the still-frozen part of the watercourse, ice can form an ice dam and flood low lying areas upstream of the jam. Also, once an ice dam breaks apart, the sudden surge of water that breaks through the dam can flood areas downstream of the jam. Ice jams and flooding usually occur in spring; however, they can happen as winter sets in when the downstream reach of a river freezes first. Where floods threaten, the blockage can be removed mechanically.

### *Location and Extent*

According to the committee, there have been only minor ice jams by the intersection of Shelburne Road and Route 2 near Davenport's under the bridge. Ice jams occurring in and near Greenfield could have an impact similar to flooding or dam failure, depending upon the size and impoundment associated with the jam. Historical data from the U.S. Army Cold Regions Research and Engineering Laboratory<sup>18</sup> from 2008 show ice jams occurrences, located by river. Since recording began there have been no ice jams on the Connecticut River in Greenfield but there have been two in Turners Fall, just upstream from Greenfield. See Table 3-10. On the Deerfield River, no ice jams have been recorded since 1959 (Table 3-11) and on the Green River none have been recorded since 1970 (Table 3-12).

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<sup>18</sup> [www.crrel.usace.army.mil](http://www.crrel.usace.army.mil)

**Table 3-10: Ice Jam Occurrences on the Connecticut River in or near Greenfield**

Date	Type	Latitude	Longitude	Town	Description or other information
01/24/1957	unknown	42° 34' 48" N	72° 34' 43" W	Montague City	Maximum annual gage height of 23.78 feet. Discharge 36,000 cfs
03/01/1947	Break-Up	42° 6' 5" N	72° 35' 25" W	Springfield	Weather Bureau reports ice jam upstream from gage Connecticut River at Springfield on March 1 (stage 4.5 ft) and 2, 1947 (stage 4.2 ft). Gage datum 37.3 ft MSL, flood stage 20 ft.
03/10/1946	unknown	42° 34' 48" N	72° 34' 43" W	Montague City	Maximum annual gage height of 27.41. Discharge "about" 71,000 cfs
03/01/1946	Break-Up	42° 19' 30" N	72° 38' 30" W	Northampton	As reported by The Hartford Courant on 03/12/46, "The Connecticut River crested at the 18-foot level in Hartford about 7 p.m. Monday and by 8 p.m. had subsided to 17.5 feet as freeze-up gripped the whole Connecticut Valley and reduced the danger of a spring flood. Waters were receding at Northampton, Mass, despite an ice jam there.
12/21/1945	unknown	42° 12' 50" N	72° 36' 36" W	Holyoke	Stage 2.7 ft. Gage datum 97.47 ft, flood stage 9 ft. NWSFO/NERFC flood stage 19 ft.
03/13/1936	unknown	42° 19' 30" N	72° 38' 30" W	Northampton	Gigantic ice jam in the Connecticut River, with ice piled 18 to 20 feet high at spots. This put terrific pressure on the Boston and Maine railroad embankment bordering the river and at one point a bulge was noticeable.
03/13/1936	Break-Up	42° 12' 15" N	72° 37' 0" W	Holyoke	Nearly the entire flow of the swollen river was diverted across the inner part of the Hockanum Meadows, where it threatened to establish a new channel. This diverted stream returned to its normal channel near Mount Tom Junction when the huge ice barrier broke during the evening of March 15, floated downstream at a rate of more than 6 miles per hour, and passed over the Holyoke dam at a stage of 9.5 feet above the crest.

**Table 3-11: Ice Jam Occurrences on the Deerfield River in or near Greenfield**

Date	Type	Latitude	Longitude	Town	Description or other information
01/22/1959	unknown	42° 32' 9" N	72° 39' 54" W	West Deerfield	Maximum annual gage height of 11.46 feet
01/23/1957	unknown	42° 32' 9" N	72° 39' 54" W	West Deerfield	Maximum annual gage height of 7.49 feet. Discharge 9,570 cfs
02/08/1941	unknown	42° 32' 9" N	72° 39' 54" W	West Deerfield	Maximum annual gage height of 8.31 feet. Discharge "about" 10,000 cfs
03/12/1936	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 19.9 feet
02/05/1934	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 8.80 feet

02/17/1930	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 8.22 feet
02/12/1925	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 15.97 feet. Discharge 9,330 cfs
03/23/1923	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 20.0 feet
03/21/1918	unknown	42° 37' 33" N	72° 51' 12" W	Charlemont	Maximum annual gage height of 11.75 feet

**Table 3-12: Ice Jam Occurrences on the Green River in or near Greenfield**

Date	Type	Latitude	Longitude	Town	Description or other information
02/12/1970	unknown	42° 42' 12" N	72° 40' 1" W	Colrain	Maximum annual gage height, 6.39 feet due to an ice jam. Discharge 300 cfs
03/12/1965	unknown	42° 11' 31" N	73° 23' 32" W	Great Barrington	Maximum annual gage height, 3.90 feet due to backwater from ice. Discharge 95 cfs
02/08/1965	unknown	42° 42' 32" N	73° 11' 15" W	Williamstown	Maximum annual gage height, 3.14 feet due to an ice jam. Discharge 50 cfs
01/21/1959	unknown	42° 42' 32" N	73° 11' 15" W	Williamstown	Maximum annual gage height of 4.93 feet
01/23/1957	unknown	42° 42' 32" N	73° 11' 15" W	Williamstown	Maximum annual gage height of 4.63 feet

## Manmade Hazards<sup>19</sup>

### General Description

Most non-natural or manmade hazards fall into two general categories: intentional acts and accidental events, although these categories can overlap. Some of the hazards included in these two categories, as defined by MEMA, consist of intentional acts such as explosive devices, biological and radiological agents, arson and cyberterrorism and accidental events such as nuclear hazards, invasive species, infrastructure failure, industrial and transportation accidents. Accidental events can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials.

*Note: This plan does not address all manmade hazards that could affect Franklin County. A complete hazards vulnerability analysis was not within the scope of this update. For the purposes of the 2010 plan, FRCOG has evaluated those non-natural hazards that are of an accidental nature. They include industrial transportation accidents and industrial accidents in a fixed facility.*

Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products are shipped daily on the nation's highways, railroads, waterways, and pipelines. Chemical manufacturers are one source of hazardous materials, but there are many others, including service stations, hospitals, and hazardous materials waste sites. Hazardous materials come in the form of explosives, flammable

<sup>19</sup> Content adapted from Commonwealth of Massachusetts State Hazard Mitigation Plan 2010

and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants.

A release may occur at a fixed facility or in transit. Communities with a large industrial base may be more inclined to experience a hazardous materials release due to the number of facilities such materials in their manufacturing process. Communities with several major roadways may be at a greater risk due to the number and frequency of trucks transporting hazardous materials passing through.

***Industrial Accidents - Transportation***

Franklin County transportation systems include road, rail, and air. Accessible and efficient freight transportation plays a vital function in the economy of the region. Most freight and goods being transported to and from Franklin County are by truck; however, a significant amount of freight that moves through the county is being hauled over the three main rail lines. Given that any freight shipped via air needs first to be trucked to an airport outside the region, air transportation is not being evaluated in this plan.

The major trucking corridors in Franklin County are Interstate 91, running north/south, and Route 2, running east/west, both of which travel through – and intersect in – Greenfield. These two highways also represent the busiest travel corridors in the region for non-commercial traffic. According to the Franklin County Hazardous Material Emergency Plan<sup>20</sup>, approximately 13 to 15 trucks per hour traveling through the region contain hazardous materials (Table 3-13). Interstate 91 and Route 2 carry approximately 12 per hour. Other major roadways passing through Greenfield include Routes 5/10 and 2A.

**Table 3-13: Estimated Levels of Hazardous Material Transported on Area Roadways**

Roadway	Number of Tank or Van Trucks Carrying Hazardous Materials per hour
Interstate 91	10
Route 2	2
Other major roadways ( <i>Routes 5/10, 63, 47, 116,202, 8A, 78, 122, 142, and 2A</i> )	1 or 0

**Table 3-14: Estimated Level of Hazardous Material Transport on Area Train Lines**

Train Line	Trains per Day (General Merchandise)	Average Number of Cars per Train	Average Number of Cars per Train with Hazardous Waste
Main Freight Line, Pan Am Systems	10 to 24	50	4
Connecticut River Line, Pan Am Systems	2 to 3	30	2
East Deerfield Rail Yard, Pan Am Systems	10 to 15 trains passing through yard	n/a	2 to 5
New England Central	2	60	5

<sup>20</sup> Franklin County Local Emergency Planning Committee, Franklin County Hazardous Material Emergency Plan and Maps, 2006. Based on a one-time survey conducted in 2003.

Safe and efficient transportation routes for trucks to and through the region are important to the region's economy to and to the safety of its citizens. The safer the transportation routes are, the less likely a transportation accident will occur. Some challenges to safe transportation routes were identified in the FRCOG 2007 Regional Transportation Plan and include:

- The lack of climbing and turning lanes on Route 2 East. Freight trucks are susceptible to the hazard of rapid stops, as they cannot slow the momentum of their vehicles quickly.
- The severity of the exit ramp curves impacts the safety of exiting for top-heavy vehicles such as freight trucks.
- Steep declines, including those on Route 2 eastbound west of Greenfield. The feasibility of adding runaway truck lanes is being evaluated.

Ten to 24 trains per day travel on the Pan Am Systems Main Freight line which runs through Greenfield (Table 3-14). On each of these trains, an average of 4 cars carries hazardous waste. Additionally, the Deerfield Switch Yard is located just across the Connecticut River in Deerfield, close enough to Greenfield to have an impact, should a hazardous waste spill occur at that site.

On January 28th, U.S. Department of Transportation awarded of \$70 million for final design and construction of the "Knowledge Corridor" along the Connecticut River rail line in western Massachusetts. The Knowledge Corridor - Restore Vermonter Project will restore Amtrak's intercity passenger train service to its original route by relocating the Vermonter from the New England Central Railroad back to its former route on the Pan Am Southern Railroad. The Pan Am Southern route provides a shorter and more direct route for the Vermonter between Springfield and East Northfield, and improves access to densely populated areas along the Connecticut River. The Pan Am Southern route would include station stops at the former Amtrak station at Northampton and the new intermodal station at Greenfield.<sup>21</sup>

With these improvements to the rail line pending, additional trains are expected to run daily, possibly increasing risks to nearby neighborhoods. Speeds for freight trains are expected to increase from 10 to 40 mph with track improvements. These improvements may entice freight truckers to switch to rail. The EOT expects that by 2030, freight traffic will increase by 50-100% along the route.<sup>22</sup>

It must be noted that improvements to rail lines can have positive economic and social implications as well as the potentially negative discussed in this section.

#### *Industrial Accidents – Fixed Facilities*

An accidental hazardous material release can occur wherever hazardous materials are manufactured, stored, transported, or used. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas. Those facilities using, manufacturing, or storing toxic chemicals are required to report their locations and the quantities of the chemicals stored on-site to state and local governments.

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<sup>21</sup> <http://www.massdot.state.ma.us/knowledgecorridor/>

<sup>22</sup> "Knowledge Corridor: Passenger Rail Study", Alyssa Larose, Robert Ratzenberger and Matthew Viens, December 2009 UMass Student Project

The Greenfield CEM Plan identifies facilities that manufacture, store, transport or use hazardous materials in Greenfield. Because of their potentially sensitive nature, they are not listed in this report but can be accessed by the Emergency Management Director as needed. In addition, the Toxics Release Inventory (TRI) contains information about more than 650 toxic chemicals that are being used, manufactured, treated, transported, or released into the environment. Table 3-15 shows those facilities in Greenfield identified by TRI.

A bio-diesel plant slated to be built in the I-91 Industrial Park will also potentially house and use hazardous materials.

**Table 3-15: Toxics Release Inventory (TRI)**

Facility Name	Facility Address	Chemical Name	Date Updated
Greenfield Armory	71 Hope Street	Fuel Oil #2	2003
Federal St. Sunoco	295 Federal Street	Diesel, Gasoline	2003
Greenfield Industries	34 Sanderson St	Nitrogen, Fuel Oil #2	2003
Greenfield Neighbors	223 Mohawk Trail	Gasoline	2003
Rogers, Lunt & Bowlen	298 Federal St	Petroleum Hydrocarbon	2003
Main Street Sunoco	155 Main St	Gasoline	2003
Greenfield Mobil	486 Bernardston Rd	Gasoline	2003
Mountain View Tire	109 Mohawk Trail	Diesel, Gasoline	2003
Verizon-Greenfield	11 Church St.	Battery Sulfuric Acid, Kerosene	2003
Rice Oil Company	34 Montague City Rd	Fuel Oil #2, Kerosene, Propane	2003
Rice Oil Company	400 Chapman St.	Fuel Oil #2, Kerosene, Propane	2003
A.R. Sandri	400 Chapman St	Diesel, Gasoline	2003
A.R. Sandri	191 Cleveland St	Fuel oil #2, Kerosene, Motor/Lubricant Oils, Quenching Oils	2003
Stop Smart Sunoco	416 Federal St	Gasoline, Fuel Oil #2	2003
WTE Recycling	75 Southern Ave	Carbon Steel Scrap, Lead Alloy Scrap, Petroleum Hydrocarbon, Stainless Steel Scrap	2003
J.K. Electronics	201 Munson St.	Acetylene, Aluminum Foil, Canola Oil RBD, Carbon Blk, Blu Ink Tubes, Epic-Epoxy-Resin Titanium Dioxide, Copper Wire, Epoxies, Epoxy Resin, Polyamine, Epoxy-Hardener, Ethyl Acetate, Ethyl Alcohol, Ethylene Glycol Anti-Freeze, Aluminium, Tributyl Phosphate, Lead Chromate Ink, Lead Wire Foil, Mercury, Mineral Spirits, Molybdenum, Naphtha, VM+P Naphtha Paint, Tin, Trichloroethylene, Epoxy-Micares X1087-WE R20, Epoxy-Hardner Micares P980	2003
Merriam Graves	1159 Bernardston Rd	Cryogenic Liquid Oxygen, Anhydrous Ammonia	2003
Amerigas Propane LP	44 Montague City Rd	Liquid Petroleum gas, Methanol	2003

Source: EPA Toxic Release Inventory, 2010. *Note: Table 3-9: Toxics Release Inventory (TRI) in no way indicates any issues with any of the sites but rather is an inventory of those facilities meeting TRI reporting requirements.*

In addition to facilities potentially housing hazardous compounds, the Committee identified the transportation of hazardous materials through Greenfield as a potential manmade hazard. Route 2 and the Pan Am Systems Railroad both serve as primary routes for transportation of cargo, some of which is of a hazardous nature. According to the HMEP<sup>23</sup> Hazardous Materials Survey Results, the Pan Am Systems Railroad carries 5-12 freight trains in each direction daily with an average train length of 50 cars, an average of four of which carry hazardous materials. The hazardous materials regularly carried on these trains passing through Greenfield include:

- Hydrocyanic acid
- Sulfuric acid
- Liquified petroleum gas
- Hydrochloric acid
- Chlorine
- Caustic soda
- Methanol
- Sodium chloride

The same plan identifies hazardous materials being carried on highways. On Route 2, which runs through Greenfield, an average of 2 hazardous materials tank or van trucks travel per hour. The hazardous materials regularly carried on these trucks passing through Greenfield include:

- Gasoline
- Fuel oil
- Kerosene
- Liquified petroleum gas
- Propane
- Sodium aluminate
- Sulfuric acid
- NOS liquids 3082

In addition to hazardous materials related manmade hazards, the Committee identified both the Mill Street Dam and the Meridian Street Dam as possible manmade hazards. At least one of the dams is in poor condition and both should undergo inspections. This information is included as an action items under Dam Failure.

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<sup>23</sup> [http://www.frcog.org/pubs/emergency/Franklin\\_County\\_HMEP.pdf](http://www.frcog.org/pubs/emergency/Franklin_County_HMEP.pdf)

## **Risk Assessment Methodology**

In updating Greenfield's Natural Hazard Mitigation Plan, the Franklin Regional Council of Governments developed the All Hazards Risk Assessment methodology for assessing the risk of natural hazards. The All Hazards Risk Assessment is an interactive table that the Greenfield Committee completed with the FRCOG staff to evaluate all the natural hazards that can impact the town based on frequency of occurrence, severity of impacts, area of occurrence and preparedness. The methodology yields a Weighted Hazard Index, which is a measure of the likelihood of future occurrence for each hazard as well as the potential impacts each hazard may have on the built and natural environments, the population and the infrastructure. The methodology yields a Weighted Hazard Index, which is a measure of the likelihood of future occurrence for each hazard as well as the potential impacts each hazard may have on the built and natural environments, the population and the infrastructure.

The completed table also gives the town an overall understanding of the natural hazards, provides guidance on which hazards the Town may want to focus mitigation efforts on, reaffirms that Greenfield's planning and preparedness is on track, and shows residents that town departments and agencies are organized in case of a natural disaster. Note that the Assessment does not include manmade hazards, given lack of data assessed for this plan.

In rating the hazards, the committee considered the following issues for each category:

Issues considered when ranking frequency of occurrence:

- 1) Known risk
- 2) Historical data (previous occurrences)

Issues considered when ranking severity of impacts:

- 1) Building stock
- 2) Critical facilities
- 3) Transportation systems
- 4) Lifeline utility systems
- 5) Communications systems and networks
- 6) High potential loss facilities
- 7) Hazardous material facilities
- 8) Economic elements
- 9) Special consideration areas
- 10) Historic, cultural, and natural resource areas
- 11) Natural resources

Issues considered when ranking preparedness:

- 1) Status of current plans
- 2) Training status
- 3) Availability of backup systems
- 4) Community resources (equipment, personnel, etc.)

The following rating charts were used to determine the rating for each event.

**Table 3-16: Frequency of Occurrence Rating Chart**

Classification	#	Frequency of Occurrence
Very High	5	events that occur at least once each year (100% per year)
High	4	events that occur from once in 2 years to once in 4 years (25% to 50% per year)
Medium	3	events that occur from once in 5 years to once in 50 years (2% to 20% per year)
Low	2	events that occur from once in 50 years to once in 100 years (1% to 2% per year)
Very Low	1	events that occur less frequently than once in 100 years (less than 1% per year)

**Table 3-17: Severity of Occurrence Rating Chart**

Classification	#	Severity of Multiple Impacts
Catastrophic	4	Multiple deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.
Critical	3	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
Limited	2	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
Minor	1	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

**Table 3-18: Severity of Impacts Definitions**

Severity of Impact Category	Severity of Impact Category Definitions
Built	Building Stock includes residential, commercial, industrial, and institutional buildings.
Built	Hazardous Material Facilities include facilities housing industrial/hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins.
Built	Historic, Cultural, and Natural Resource Areas may include buildings, structures, objects, sites, national and local historic or significant districts, and historical archival storage facilities.
Infrastructure	Critical Facilities are essential to the health and welfare of the whole population and are especially important following hazard events. Since vulnerability is based on service losses as well as building structure integrity and content value, assess the effects on the service function interruption of critical facilities as well as their physical aspects. For purposes of this mitigation planning guidance, critical facilities may include emergency service facilities such as hospitals and other medical facilities, jails and juvenile detention centers, police and fire stations, emergency operations centers, public works facilities, evacuation shelters, schools, and other uses that house special needs populations.
Infrastructure	Transportation Systems include airways (including airports, heliports, etc.), roadways (including highways, bridges, tunnels, roadbeds, overpasses, transfer centers, etc.), railways and public transit (including trackage, tunnels, bridges, rail yards, depots, etc.), and waterways (including canals, locks, seaports, ferries, harbors, dry-docks, piers, etc.).
Infrastructure	Lifeline Utility Systems such as potable water, wastewater, oil, natural gas, electric power, substations, power lines, etc.

Severity of Impact Category	Severity of Impact Category Definitions
Infrastructure	Communications Systems and Networks such as telephones, emergency service radio systems, repeater sites and base stations, television and radio stations, etc.
Natural	Natural Resources include agricultural land, water supply lands, rivers.
Population	High Potential Loss Facilities include facilities that would have a high loss associated with them, such as nuclear power plants or dams.
Population	Economic Elements include major employers, financial centers, and other business or retail districts in the community that could significantly affect the local or regional economy if interrupted.
Population	Special Consideration Areas include areas of high density residential, commercial, institutional, and industrial development that, if damaged, could result in economic and functional losses and in high death tolls and injury rates.

**Table 3-19: Area of Occurrence Rating Chart**

Classification	#	Percentage of Town Impacted
Large	3	More than 50% of the town affected.
Medium	2	10 to 50% of the town affected.
Isolated	1	Less than 10% of the town affected.

**Table 3-20: Preparedness Rating Chart**

Classification	#
Poor	3
Fair	2
Good	1

To determine the final hazard index for each hazard, each category was assigned a weight. Frequency of Occurrence was given the most weight (45%), followed by Severity of Impacts (30%), Area of Occurrence (15%), and Preparedness (10%). Ratings were entered into a spreadsheet which calculated the weighted hazard index for each hazard. The Weighted Hazard Index represents the probability of occurrence of future events. Hazards with higher index scores represent the events most in need of organization focus and resources for emergency planning and mitigation projects.

The results of the All Hazards Vulnerability Assessment can be seen in Table 3-21. The hazards receiving a Weighted Hazard Index of 5 or more are – in order of vulnerability – Microbursts (including wind related events) (6.8), Hurricanes and Tornados (6.1), and Severe Winter Storms (5.2).

The committee evaluated microbursts and associated thunder and wind storms as particularly problematic, with issues such as power outages and debris removal common in the aftermath of such a storm. This is true of snow and ice storms as well. Given these issues and given the frequency of microbursts and wind-related storms, microbursts rated highest on the Weighted Hazard Index with a 6.8 rating. Hurricanes and severe winter storms rated next highest on the Index, with severe winter storms causing issues of power outages and debris removal, among other effects.

The hazards rated on the Weighted Hazard Index between 4 and 5 include floods, tornados, earthquakes and wildfires. In the case of floods, earthquakes and wildfires, there were all evaluated as having a high frequency of occurrence but relatively low severity of impact and limited area of occurrence. The Committee acknowledged that earthquake occur quite frequently in New England, but are rarely large enough to be felt. Landslides, ice dams and dam failures were rated lowest on the Weighted Hazard Index.

In terms of preparedness, the Committee rated the Town as being fair or good for all hazards, while acknowledging the need for improvements such a:

- Implementing Reverse 911 system
- Purchasing equipment for tree and debris removal
- Increasing debris disposal sites
- Sharing of equipment and sites on a multiple town or regional basis
- Conducting a hazardous tree assessment
- Purchasing emergency back-up generators for all emergency facilities
- Addressing animal control and sheltering during emergencies
- Inspecting the Mill and Meridian Street Dams

These needed improvements are included as action items in the Action Plan.

The Weighted Hazard Index is a crucial tool in helping the Committee and Town prioritize its action items. See the Action Plan to understand how this information was applied to action item prioritization.

**Table 3-21: TOWN OF GREENFIELD All Hazards Vulnerability Assessment**

EVENTS	Frequency of Occurrence (FOO)*	FOO Weighted Value	Severity of Impacts* (SOI)				SOI Weighted Value	Area of Occurrence*	Add Weighted Value	Preparedness	Prep. Weighted Value	Weighted Hazard Index
			Built 1-4*	Natural 1-4*	Population 1-4*	Infrastructure 1-4*						
<b>ASSIGNED WEIGHTING FACTOR</b>	<b>45%</b>		<b>30%</b>					<b>15%</b>		<b>10%</b>		
<b>INDEX VALUE</b>	<b>1-5</b>		<b>Built 1-4*</b>	<b>Natural 1-4*</b>	<b>Population 1-4*</b>	<b>Infrastructure 1-4*</b>		<b>1-3</b>		<b>1-3</b>		
<b>HAZARDS</b>												
Microbursts (Includes Thunderstorms and Wind Related Events)	5	2.25	3	3	4	3	3.9	3	0.45	2	0.2	6.8
Hurricanes	4	1.8	3	3	3	3	3.6	3	0.45	2	0.2	6.1
Severe Winter Storms	5	2.25	2	2	2	2	2.4	3	0.45	1	0.1	5.2
Floods	5	2.25	2	1	2	2	2.1	1	0.15	2	0.2	4.7
Tornados	3	1.35	2	3	2	2	2.7	1	0.15	2	0.2	4.4
Earthquakes	5	2.25	1	1	1	1	1.2	3	0.45	2	0.2	4.1
Wildfires / Brush Fires	5	2.25	1	2	1	1	1.5	1	0.15	1	0.1	4.0
Landslides	3	1.35	2	2	1	2	2.1	1	0.15	2	0.2	3.8
Ice Jams	3	1.35	1	2	1	1	1.5	1	0.15	2	0.2	3.2
Dam Failures	1	0.45	2	2	2	2	2.4	1	0.15	2	0.2	3.2

## **Vulnerability Assessment**

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### **Vulnerability Overview**

This section presents exposure, damages, loss estimates, population impacts and data deficiencies for each of the hazards addressed in the Natural Hazard Identification and Profile Section of the Plan. Additionally, an overall vulnerability assessment is provided for each hazard. This analysis is an in-depth look at each hazard in Greenfield. Coupled with the All Hazards Vulnerability Assessment from the previous section, these findings will support planning efforts based on a better understanding of the potential impacts associated with each hazard and provide a foundation for the mitigation strategy presented in Section 5.

### ***Vulnerability Assessment Methodology***

The Vulnerability Assessment is a series of tables that enabled FRCOG staff to determine the vulnerability of Greenfield to flooding and to calculate the potential costs of flooding to the town.<sup>24</sup> Estimated losses for all other hazard events were also determined, based on damages from past recorded events. The potential implications for vulnerable populations such as senior and low income populations in the event of a hazard are also assessed.

### ***Environmental Justice***

Identifying vulnerable populations in a town can be challenging. It can be assumed that senior populations are more vulnerable—and thus might be more at risk for certain hazards—due to their possible loss of mobility and the increased likelihood that elderly people live alone and may have less access to information. People of low income may also face higher risks due in part to less access to information and the higher likelihood of living in undesirable or poor quality housing and/or locations, such as those adjacent to areas zoned industrial or in the floodplain, for example.

In 1994, President Clinton issued Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” directing federal agencies to address environmental injustices in their operations and in communities across the country. Since then, states and municipalities have developed policies and programs to proactively address environmental equity concerns to help ensure that minority and low-income communities are not disproportionately impacted by environmental hazards.<sup>25</sup>

There are many obstacles that make it challenging for Environmental Justice (EJ) populations to participate in such things as planning and development decisions in their communities. These residents are more likely to be unaware of environmental issues due to social issues including language barriers and limited access to educational resources. In addition, EJ populations are often unable to participate in environmental decision-making processes because they often must work longer hours to compensate for lower hourly wages.<sup>26</sup> Thus decisions that may directly impact where they live may be made by a town without their voices being heard.

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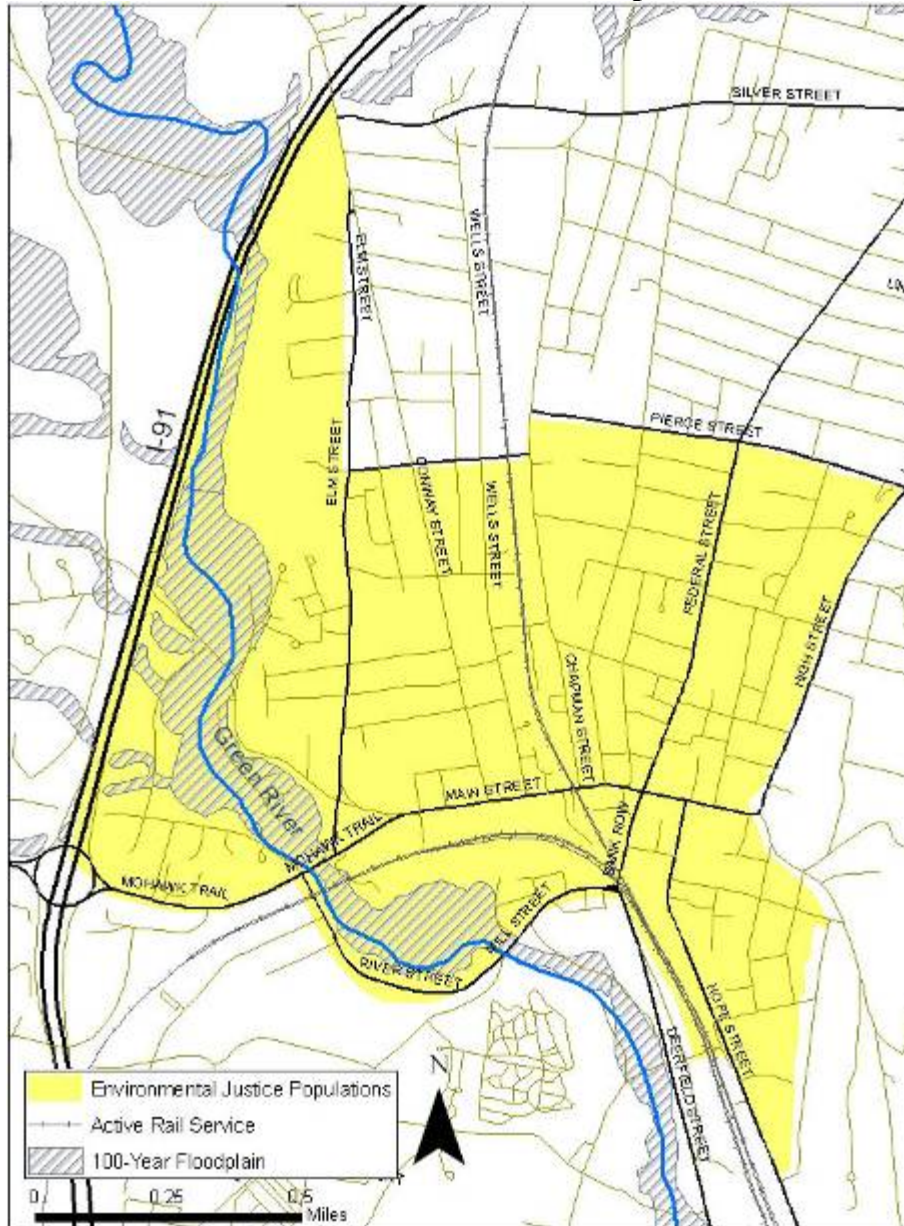
<sup>24</sup> These tables were developed to provide towns with a template for calculating and estimating potential losses and costs of flooding. They draw from and integrate the work of other Natural Hazard Mitigation Plans, specifically the Natural Hazard Mitigation Plan for Thurston County, Washington, September 2009, but the tables can be linked to the most recent demographic, land use, and infrastructure information (databases) and automatically calculate and estimate the cost of flooding to each town or region.

<sup>25</sup> <http://www.mass.gov>

<sup>26</sup> [http://www.mass.gov/envir/smart\\_growth\\_toolkit/pages/mod-ej.html](http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-ej.html)

In 2003, based upon 2000 census data, MassGIS produced Environmental Justice Populations layers representing neighborhoods across the state with high minority, non-English speaking, low-income, and foreign-born populations.<sup>27</sup>

### Town of Greenfield Environmental Justice Populations



Source: Mass GIS Data

EJ Populations in Massachusetts are determined by the following criteria:

- Households earn 65% or less of the statewide household median income; or
- 25% or more of the residents are minority; or

<sup>27</sup> [http://www.mass.gov/mgis/cen2000\\_ej.htm](http://www.mass.gov/mgis/cen2000_ej.htm)

- 25% or more of the residents are foreign-born; or
- 25% or more of the residents are lacking English language proficiency

Based upon these criteria, the Franklin County towns with Environmental Justice populations are Greenfield, Montague and Orange. Sections of all three towns were categorized as such based on the low income criteria. In Greenfield, the EJ area is roughly bounded by Interstate 91 to the west, Pierce Street to the north, High Street to the east and River Street to the south. Some of the EJ area also overlaps with areas in the floodplain, is along the rail line, and/or is adjacent to areas zoned industrial. See Manmade Hazard for additional information on impacts to populations related to rail on pages 36-37.

As Greenfield works to mitigate hazards in Town, concentrating public education and outreach in the EJ area could be a priority. The Town could also evaluate action items to determine if their implementation could have a disproportionately high and adverse impact to Environmental Justice populations. Some hazard mitigation projects with the potential to cause these effects include flood control projects, and stormwater management projects.

## **Floods**

### ***Hazard Summary***

Flooding can be caused by severe storms, such as hurricanes, nor'easters, and microbursts, as well as ice jams and snow melt. To determine the vulnerability of the Town, properties within the flood hazard area were identified and damage assessments were then generated for the various classes of property — residential, commercial, industrial, public and institutional land uses. The damage estimates presented in the following tables are rough estimates and reflect a worst-case scenario. These estimates should be used only within the context of this Natural Hazard Mitigation planning effort. Computing detailed damage assessments is a complex task and is the reason FRCOG developed the linked tables, which use town demographics and values.

In updating the Hazard Mitigation Plan for Greenfield, more detailed data was gathered and calculated for the value of residential, commercial, industrial and public/institutional properties as well as agricultural lands. Transportation and waste disposal land uses were beyond the scope of the assessment.

### ***Data Collected and Used***

National weather databases and Town of Greenfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center website. This data was used to support an evaluation of exposure and potential impacts associated with this hazard. Available historic data were presented in Tables 3-1 and 3-2. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on flooding.

***Impact on the Community***

**Exposure and Loss Estimation**

Flooding can cause a wide range of issues, from minor nuisance roadway flooding and basement flooding to major impacts such as roadway closures. Specific damages associated with flooding events include the following primary concerns:

- Blockages of roadways or bridges vital to travel and emergency response
- Breaching of dams
- Damaged or destroyed buildings and vehicles
- Uprooted trees causing power and utility outages
- Drowning, especially people trapped in cars
- Contamination of drinking water
- Dispersion of hazardous materials
- Interruption of communications and/or transportation systems
- Debris management issues including debris removal and identification of disposal sites

**Property Damage**

The following discussion and tables examine the potential cost of flooding to Greenfield for land uses and facilities located in the floodplain should catastrophic flooding occur resulting in a worst-case scenario. Of Greenfield’s total of 14,037 acres, 1,449 acres – or about 10% – lie within the 100-year floodplain. Table 3-22 shows the number of dwelling units in the flood hazard area (floodplain) in Greenfield. The figures in the last two columns of the table are calculated using data from the U.S. Census and MassGIS. In Greenfield less than 1% of the population resides in the floodplain.

**Table 3-22: Number of Dwelling Units in the Flood Hazard Area**

Total Town Population <sup>28</sup>	Average per household population <sup>29</sup>	Number of Dwelling Units in Flood Hazard Area <sup>30</sup>	Estimated population in Flood Hazard Area	% of total population that reside in the Flood Hazard Area
17,456	2.19	38	83	0.005%

Table 3-23 shows the total acreage of each type of land use – commercial, industrial and public/institutional – in Greenfield; the total acreage for each of the three types of land use in the floodplain in town; and the percentage of the total acreage for each type of land use in the floodplain in Greenfield.<sup>31</sup> In all, 2% of the land in the floodplain is used for commercial, industrial and public/institutional purposes.

**Table 3-23: Acres of Commercial, Industrial and Public/Institutional Land Uses in the Flood Hazard Area**

	Total acres of land use in Town	Acres of land use in Flood Hazard Area	% of land use acres in the Flood Hazard Area of the Town

<sup>28</sup> U.S. Census, 2010.

<sup>29</sup> U.S. Census, 2000.

<sup>30</sup> Mass GIS

<sup>31</sup> Mass GIS

Commercial	402.98	13.57	3%
Industrial	183.13	1.86	1%
Public/Institutional	239.31	4.81	2%

Table 3-24 summarizes the average assessed value of the five types of land uses in Greenfield in the floodplain – residential, commercial, industrial, public/institutional and agricultural.<sup>32</sup> The total worth of lands in the floodplain is assessed at almost \$4.5 billion. This is of concern because should a catastrophic flooding event befall Greenfield, the assessed values of these structures and facilities would likely be significantly reduced which in turn would severely impact the town’s tax revenues.

**Table 3-24: Average Assessed Value of Land Use in Flood Hazard Area**

	Total Acres in Town	Total Assessed Value	Average Assessed Value Per Acre	Acres in Floodplain	Average Assessed Value in Floodplain
<b>Residential</b>	2,598.51	\$253,678,000	\$97,624	42.99	\$4,196,873.29
<b>Commercial</b>	11.3	\$1,992,179	\$176,299	0.49	\$86,387
<b>Industrial</b>	2.7	\$793,900	\$294,037	0.48	\$141,138

Table 3-25 lists the estimated value of the contents of the different classes of buildings and facilities. The value is presented as a percentage of the replacement value of the building and the class of structure.<sup>33</sup> The percentages vary for certain classes because the replacement cost of the contents is different from institution to business to service.

**Table 3-25: Estimates of Building Contents by Class**

Occupancy Class	Contents Value % (as a percentage of building replacement value)
Residential (including temporary lodging, dormitory, and nursing homes)	50%
Commercial (including retail, wholesale, professional, services, financial, entertainment & recreation)	100%
Commercial (including hospital and medical office/clinic)	150%
Commercial Parking	50%
Industrial (including heavy, light technology)	150%
Agriculture	100%
Religion/Non-Profit	100%
Government Emergency Response	150%
Government General Services	100%
Education Schools/Libraries	100%
Education Colleges/Universities	150%

Table 3-26 shows the total value of replacing the structures and contents of buildings located in the floodplain in Greenfield. In total, the structures and building contents are valued at \$293,805,621. It is evident that catastrophic flooding would cause significant economic, financial and environmental damage.

<sup>32</sup> Massachusetts Department of Revenue.

<sup>33</sup> Town of Clay Hazard Mitigation Plan

**Table 3-26: Total Building Value in Flood Hazard Area**

	Building Structure Value in Flood Hazard Area	Building Contents Value in Flood Hazard Area	Total Building Value in Flood Hazard Area
Commercial	\$243,076,431	100%	\$24,307,643
Industrial	\$33,819,460	150%	\$50,729,190
Public/Institutional	\$184,675	150%	\$277,013

Table 3-27 identifies the average assessed value of all residential, commercial, and industrial land uses located in the floodplain in Greenfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a major flooding event

**Table 3-27: Potential Estimated Loss in Flood Hazard Area by Land Use**

Land Use	Average Assessed Value of Land in Floodplain	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	\$17,460,450.61	\$174,605	\$873,023	\$1,746,045
Commercial	\$8,185,386.79	\$81,854	\$409,269	\$818,539
Industrial	\$343,494.76	\$3,435	\$17,175	\$34,349
<b>Total</b>	<b>\$25,989,332.17</b>	<b>\$259,893.32</b>	<b>\$1,299,466.61</b>	<b>\$2,598,933.22</b>

Source: Massachusetts Dept. of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

Repetitive Loss Properties

Repetitive loss properties are those for which two or more losses of at least \$1000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978. According to MEMA, there are no repetitive loss structures in Franklin County. See pages 122-124 for more information on NFIP.

Population Impacts – Senior Citizens and People of Low Income

Certain segments of Greenfield’s population – seniors and people of low income and/or Environmental Justice populations– may be more vulnerable to flooding and other events (see Environmental Justice section, pages 45-47). The Town should be aware of the potential needs of these residents in the event of a hazard occurrence Table 3–28 displays the number of senior and people of low income residents in Greenfield. It should be noted that there may be overlap within the two categories, so that the total number of individuals exposed may be lower than what is shown in the table. See also Environmental Justice section on pages 45-47.

**Table 3-28: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

### ***Overall Vulnerability Assessment***

Flooding is common in New England, and can cause significant impacts to the roads, structures, facilities, utilities, and populations, including Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. Particular areas of vulnerability include Environmental Justice and elderly populations, trailer homes, and infrastructure such as and the low-lying areas that can be impacted by flooding related to ice jams or rapid snow melt.

### ***Data Deficiencies***

In assessing the risks to Greenfield from flood hazards, the following data deficiencies were identified:

- The towns of Franklin County rely on farming for one of its income sources. Little data exists on localized crop damage due to flooding.
- Data for the location and condition of dams within Greenfield resides with the DCR Office of Dam Safety and with FERC. New software and reporting systems within the Office of Dam Safety has resulted in missing data and questions as to the status of some dams. Requests for additional information have been referred to the Office of Dam Safety's Legal Department, which charges for any requests for information.

## **Severe Winter Storms**

### ***Hazard Summary***

Severe snow and ice storms are common in Greenfield, often impacting the Towns' roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events. Severe winter storms cause significant concern because they happen often and can be quite severe; they cost residents money; they require snow and ice removal, which can limit access to facilities and can cause health problems; they can cause utility failure and flooding from ice jams; and they put stress on community resources.

### ***Data Collected and Used***

National weather databases and Town of Greenfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center website. This data was used to support an evaluation of exposure and potential impacts associated with this hazard. Available historic data are presented in Table 3-29. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on severe winter storm hazard data and mitigation measures.

### ***Impact on the Community***

#### ***Exposure and Loss Estimation***

Heavy snowfall coupled with low temperatures often results in increases in traffic accidents; disruptions in transportation, commerce, government, and education; utility outages due to falling trees, branches, and other objects; personal injuries associated with slippery surfaces and

freezing temperatures; and numerous other problems. Specific damages associated with severe winter storm (snow) events include the following primary concerns:

- Injuries and fatalities associated with accidents, low temperatures, power loss, falling objects and accidents associated with slippery surfaces and snow accumulation
- Increases in the frequency and impact of traffic accidents, resulting in personal injuries
- Ice-related damage to trees, building and infrastructure inventory, and utilities (power lines, bridges, substations, etc.)
- Roads damaged through freeze and thaw processes
- Stress on the local shelters and emergency response infrastructure
- Lost productivity that occurs when people cannot go to work, school, or stores due to inclement conditions
- Debris management issues including debris removal and identification of disposal sites

New England’s climate offers no immunity to the potential damaging effects of severe winter storms. Some minimum damage is anticipated annually, with potential extensive damage occurring about once every 10 years.

Property Damage

As presented in Table 3-29, historic data for severe winter storm (heavy snow) events indicate that between 1993 and 2010, 111 heavy snow events were recorded in Franklin County. An average of 6.1 heavy snow and ice events occur each year, causing an average annual property damage county-wide of \$4.5 million.

**Table 3-29: Severe Winter Storm Events in Franklin County**

Year	# of Heavy Snow/Ice Events	Annual Property Damage	Annual Crop Damage
2010	3	\$30,000	\$0
2009	5	\$0	\$0
2008	12	\$6,020,000	\$0
2007	7	\$10,000	\$0
2006	0	\$0	\$0
2005	9	\$625,000	\$0
2004	3	\$0	\$0
2003	5	\$50,000	\$0
2002	7	\$1,605,000	\$0
2001	7	\$11,000,000	\$0
2000	7	\$0	\$0
1999	6	\$0	\$0
1998	3	\$0	\$0
1997	6	\$10,030,000	\$0
1996	10	\$47,000,000	\$0
1995	6	\$0	\$0
1994	8	\$5,050,000	\$0
1993	7	\$0	\$0
<b>18</b>	<b>111</b>	<b>\$4,523,333</b>	<b>\$0</b>

Source: NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

As indicated in the Risk Assessment section of this plan, a winter storm in 2008 left residents in Franklin County without power for several days. Greenfield was fortunate; the storm did not cause power outages in town. There was some property damage from the winds that required clean up and disposal of debris. However, because Greenfield did not lose power it became a refuge. Many residents from around Franklin County relied on the hospitality of Greenfield's hotels, motels and inns and restaurants, cafes, and coffee shops to weather the storm and power outages. Total property damage from this storm total was not available. Estimated costs to the Town for storm response, including staffing shelters and providing food and water, were approximately was also not available.

According to information obtained from the highway department, other notable winter storm events from the last few years include: Please indicate if town-wide and estimated cost to town.

Population Impacts

Populations considered most vulnerable to severe winter storm impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-30 summarizes the population in Greenfield over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-30: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

The entire built environment of Greenfield is vulnerable to a severe winter storm. Table 3-31 identifies the assessed value of all residential, commercial, and industrial land uses in Town, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a severe winter storm.

**Table 3-31: Potential Estimated Loss by Land Use**

Land Use	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
Commercial	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
Industrial	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Severe winter storms are common in New England, often causing significant impacts to the roads, structures, facilities, utilities, and population of Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. The cascade effects of severe winter storms include utility losses, transportation accidents, and flooding. Losses associated with flooding are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding related to ice jams or rapid snow melt.

### ***Data Deficiencies***

In assessing the risks to Greenfield from severe snow and ice storms, the following data deficiencies were identified:

- The towns of Franklin County rely on farming for one of its income sources. Little data exists on localized crop damage due to these hazards.

## **Hurricanes**

### ***Hazard Summary***

Hurricanes and tropical storms are rare in Greenfield but could cause severe impacts such as flooding, power outages, flying debris, damage to property and injury and loss of life. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Hurricanes or tropical cyclones, can spin off tornadoes and bring thunderstorms, high winds and, in coastal areas, storm surges in the sea, possibly resulting in beach erosion and loss or damage to property. (See Tornadoes and Microbursts Section) Inland, hurricanes mainly bring heavy rains that can cause flooding.

### ***Data Collected and Used***

National weather databases and Town of Greenfield data were collected and analyzed. According to the committee, no hurricanes have been experienced in Greenfield. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center website, and the Spatial Hazard Events and Losses Database (SHELDUS). This data was used to support an evaluation of exposure and potential impacts associated with this hazard. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on thunderstorms, hurricanes and tornadoes hazard data and mitigation measures.

### ***Impact on the Community***

#### **Exposure and Loss Estimation**

High winds and heavy rain associated with hurricanes and tropical storms can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death.

Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

Property Damage

As presented in Table 3-32, historic data for hurricane and tropical storm events indicate one hurricane and 16 tropical storms have been recorded in Franklin County. Hurricane Bob in 1991 caused over 5.5 million dollars in property damage in the county, and over \$500,000 in crop damage. Overall, tropical storms and hurricanes have caused an average annual property damage of just over \$300,000 over the last 20 years.

**Table 3-32: Hurricane and Tropical Storm Events in Franklin County**

Year	# of Hurricane/Tropical Storm Events	Annual Property Damage	Annual Crop Damage
2009	0	\$0	\$0
2008	0	\$0	\$0
2007	0	\$0	\$0
2006	5	\$277,861	\$0
2005	1	\$33,889	\$0
2004	1	\$37,778	\$0
2003	2	\$127,381	\$0
2002	0	\$0	\$0
2001	0	\$0	\$0
2000	0	\$0	\$0
1999	1	\$7,692	\$0
1998	2	\$63,269	\$0
1997	0	\$0	\$0
1996	0	\$0	\$0
1995	1	\$0	\$0
1994	1	\$35,714	\$0
1993	0	\$0	\$0
1992	0	\$0	\$0
1991	1	\$5,555,556	\$555,556
1990	2	\$7,142	\$0
<b># of Years</b>	<b>Total # of Events</b>	<b>Average Annual Property Damage</b>	<b>Average Annual Crop Damage</b>
<b>20</b>	<b>17</b>	<b>\$307,314</b>	<b>\$27,778</b>

Source: Spatial Hazard Events and Losses Database (SHELDUS), <http://webra.cas.sc.edu/hvri/>.

**Population Impacts**

As discussed above, some traffic accidents associated with storm events include injuries and deaths. However, the number of injuries and deaths reported for accidents is generally low.

Populations considered most vulnerable to hurricane and tropical storm impacts in Greenfield are identified based on a number of factors including their physical and financial ability to react or

respond during a hazard and the location and construction quality of their housing. Table 3-33 summarizes the population over the age of 65 or living in households with an annual income below \$20,000. See also Environmental Justice section on pages 45-47.

**Table 3-33: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

### ***Overall Vulnerability Assessment***

Hurricanes and tropical storms are uncommon in Franklin County, but could cause significant damage if they do occur. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events. The cascade effects of severe storms include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding.

### ***Data Deficiencies***

In assessing the risks to Greenfield from hurricanes and tropical storms, no data deficiencies were identified.

## **Tornados**

### ***Hazard Summary***

While uncommon in Greenfield, tornados could potentially cause severe wind-related damage, including downed trees and power lines, power outages and damage to the built and natural environment.

### ***Data Collected and Used***

National weather databases and Town of Greenfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration's (NOAA) National Climactic Data Center website, and the Spatial Hazard Events and Losses Database (SHELDUS). This data was used to support an evaluation of exposure and potential impacts associated with this hazard. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on tornado hazard data and mitigation measures.

### ***Impact on the Community***

#### ***Exposure and Loss Estimation***

High winds and heavy rain and/or hail associated with tornados can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

#### ***Property Damage***

As presented in Table 3-34, historic data for tornado events indicate that between 1991 and 2010, 4 tornados were recorded in Franklin County. Over 20 years, tornados have caused an average of \$16,000 in property damages yearly.

**Table 3-34: Tornado Events in Franklin County**

<b>Year</b>	<b># of Tornado Events</b>	<b>Annual Property Damage</b>	<b>Annual Crop Damage</b>
2010	0	\$0	\$0
2009	0	\$0	\$0
2008	0	\$0	\$0
2007	0	\$0	\$0
2006	1	\$200,000	\$0
2005	0	\$0	\$0
2004	0	\$0	\$0
2003	0	\$0	\$0
2002	0	\$0	\$0
2001	0	\$0	\$0
2000	0	\$0	\$0
1999	0	\$0	\$0
1998	0	\$0	\$0
1997	2	\$100,000	\$0
1996	0	\$0	\$0
1995	0	\$0	\$0
1994	0	\$0	\$0
1993	0	\$0	\$0
1992	1	\$25,000	\$0
1991	0	\$0	\$0
<b># of Years</b>	<b>Total # of Events</b>	<b>Average Annual Property Damage</b>	<b>Average Annual Crop Damage</b>
<b>20</b>	<b>4</b>	<b>\$16,250</b>	<b>\$0</b>

Source: NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

### ***Population Impacts***

As discussed above, some traffic accidents associated with tornado events can include injuries and deaths. However, the number of injuries and deaths reported for accidents is generally low. Populations assessed as being most vulnerable to tornados impacts in Greenfield are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-35

summarizes the population over the age of 65 or living in households with an annual income below \$20,000. See also Environmental Justice section on pages 45-47.

**Table 3-35: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

The entire built environment of Greenfield is vulnerable to the high winds and/or flooding from a tornado. Table 3-36 identifies the assessed value of all residential, commercial, and industrial land uses in Greenfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a tornado.

**Table 3-36: Potential Estimated Loss by Land Use**

Land Use	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
Commercial	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
Industrial	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Tornado are not at all common in Greenfield, however these and other wind-related storms such as hurricanes and microbursts could impact property, crops, utilities and the population of Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events. The cascade effects of severe storms include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding.

### ***Data Deficiencies***

In assessing the risks to Greenfield from tornados, no data deficiencies were identified.

## **Microbursts (Includes Thunderstorms and Wind Related Events)**

### ***Hazard Summary***

Microbursts are frequent enough in Greenfield to cause the Committee to suggest they be categorized separately from hurricanes and tornados. Their severe impacts include flooding,

power outages, flying debris, damage to property, as Greenfield experienced in May of 2010. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events. Thunderstorms, a sub-category of Microbursts, are common in western Massachusetts and can cause significant damage. Additional data were available for hail and lightning events, and are included in tables 3-29 and 3-30. Hail and lightning are events generally associated with thunderstorms.

***Data Collected and Used***

National weather databases and Town of Greenfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the National Oceanic and Atmospheric Administration’s (NOAA) National Climactic Data Center website, and the Spatial Hazard Events and Losses Database (SHELDUS). This data was used to support an evaluation of exposure and potential impacts associated with this hazard. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on thunderstorms, hurricanes and tornados hazard data and mitigation measures.

***Impact on the Community***

*Exposure and Loss Estimation*

High winds and heavy rain and/or hail associated with microburst and wind-related storms can cause damage to utilities, structures, roads, trees (potentially causing vehicle accidents) and injuries and death. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites. The Committee identified debris management and disposal as an ongoing concern.

*Property Damage*

Microbursts, severe thunderstorms, hail and lightning events brought about significant property wreckage in Franklin County in recent years. Thunderstorms, 115 of them in the last 19 years, caused an average annual property loss of more than \$59,000 (Table 3-37). It is worth noting that the number of thunderstorms has increased in recent years; in the 1990s, there were an average of 3.8 storms per year, according to NOAA data. From 2000 to 2008, NOAA recorded an average of 9.6 storms per year, 2.5 times the previous decade. In 2007 and 2008, the most recent years with data available, 40 storms were recorded countywide for an average number of 20 storms for those two years.

**Table 3-37: Thunderstorm Events in Franklin County**

<b>Year</b>	<b># of Thunderstorm Events</b>	<b>Annual Property Damage</b>	<b>Annual Crop Damage</b>
2008	21	\$602,000	\$0
2007	19	\$0	\$0
2006	9	\$338,000	\$0
2005	9	\$85,000	\$0
2004	4	\$30,000	\$0
2003	1	\$10,000	\$0
2002	6	\$25,000	\$0
2001	5	\$0	\$0
2000	3	\$20,000	\$0
1999	5	\$0	\$0

1998	8	\$2,000	\$0
1997	7	\$10,000	\$0
1996	5	\$0	\$0
1995	3	\$0	\$0
1994	4	\$0	\$0
1993	0	\$0	\$0
1992	2	\$0	\$0
1991	3	\$0	\$0
1990	1	\$0	\$0
<b># of Years</b>	<b>Total # of Events</b>	<b>Average Annual Property Damage</b>	<b>Average Annual Crop Damage</b>
<b>19</b>	<b>115</b>	<b>\$59,053</b>	<b>\$0</b>

Source: NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

As described in more detail in the Natural Hazard Identification and Profile section, a brief microburst in 1994 in Greenfield caused a state disaster declaration and in nearly \$60 K of Public Assistance Project Grants to aid in storm recovery and a May 2010 microburst caused Greenfield to declare a state of emergency. Assessment by the Greenfield DPW of total costs of the storm to the Town of Greenfield is approximately \$98,000 while costs to private home owners are estimated to be about \$150,000 (Table 3-38).

**Table 3-38: Severe Microburst Events in Greenfield**

Date	Event	Location of Event	Property Damage
July 1994	Microburst	Town-Wide	\$60,000
May 2010	Microburst	Town-Wide	\$248,000

As Table 3-39 shows, 24 hail storms between 1993 and 2010 have caused an average of more than \$560,000 in property damage per year. Ten lightning events (Table 3-40) have caused an average of more than \$8,000 in property damage per year over the last 15 years in Franklin County.

**Table 3-39: Hail Events in Franklin County**

Year	# of Hail Events	Annual Property Damage	Annual Crop Damage
2009	0	\$0	\$0
2008	0	\$0	\$0
2007	0	\$0	\$0
2006	5	\$1,928,000	\$0
2005	1	\$305,000	\$0
2004	1	\$340,000	\$0
2003	2	\$1,350,000	\$0
2002	0	\$0	\$0
2001	0	\$0	\$0
2000	0	\$0	\$0

1999	1	\$0	\$0
1998	0	\$0	\$0
1997	0	\$0	\$0
1996	2	\$0	\$0
1995	5	\$0	\$0
1994	4	\$5,050,000	\$0
1993	3	\$550,000	\$0
<b># of Years</b>	<b>Total # of Events</b>	<b>Average Annual Property Damage</b>	<b>Average Annual Crop Damage</b>
<b>17</b>	<b>24</b>	<b>\$560,176</b>	<b>\$0</b>

Source: NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

**Table 3-40: Lightning Events in Franklin County**

Year	# of Hail Events	Annual Property Damage	Annual Crop Damage
2008	1	\$10,000	\$0
2007	0	\$0	\$0
2006	0	\$0	\$0
2005	1	\$50,000	\$0
2004	1	\$35,000	\$0
2003	0	\$0	\$0
2002	1	\$15,000	\$0
2001	1	\$20,000	\$0
2000	0	\$0	\$0
1999	0	\$0	\$0
1998	0	\$0	\$0
1997	1	\$3,000	\$0
1996	0	\$0	\$0
1995	2	\$0	\$0
1994	2	\$0	\$0
<b># of Years</b>	<b>Total # of Events</b>	<b>Average Annual Property Damage</b>	<b>Average Annual Crop Damage</b>
<b>15</b>	<b>10</b>	<b>\$8,867</b>	<b>\$0</b>

Source: NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>.

### ***Population Impacts***

As discussed above, some traffic accidents associated with storm events include injuries and deaths. However, the number of injuries and deaths reported for accidents is generally low.

Populations considered most vulnerable to microburst and wind-related storm impacts in Greenfield are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-41 summarizes the population over the age of 65 or living in households with an annual income below \$20,000. See also Environmental Justice section on pages 45-47.

**Table 3-41: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

The entire built environment of Greenfield is vulnerable to the high winds and/or flooding from a microburst and wind-related storm. Table 3-42 identifies the assessed value of all residential, commercial, and industrial land uses in Greenfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a microburst or wind-related storm.

**Table 3-42: Potential Estimated Loss by Land Use**

Land Use	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
Residential	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
Commercial	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
Industrial	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Microbursts have occurred with some frequency in Greenfield. These and other wind-related storms such as thunderstorms can impact property, crops, utilities and the population of Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events. The cascade effects of severe storms include utility losses and transportation accidents and flooding. Losses associated with the flood hazard are discussed earlier in this section. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways and utilities that can be damaged by such storms and the low-lying areas that can be impacted by flooding.

### ***Data Deficiencies***

In assessing the risks to Greenfield from microbursts and other wind-related storms, the following data deficiencies were identified:

- The towns of Franklin County rely on farming for one of its income sources. Little data exists on localized crop damage due to these hazards.

## **Wildfires / Brush Fires**

### ***Hazard Summary***

According to data from Massachusetts Fire Incident Reporting System of the Massachusetts Department of Fire Services, the Greenfield Fire Department responded to 35 brushfires between

2004 and 2010. Wildfires can damage woodlands, homes, utilities and buildings, and could cause injuries or deaths. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

Burn piles that blaze out of control, lightning strikes in forested land, campfires improperly managed, and arson can cause wildfires. Greenfield is vulnerable to these conflagrations, especially in times of drought.

***Data Collected and Used***

Town of Greenfield data were collected and analyzed. Data on historic property damage and loss, and injuries and deaths, was collected for Franklin County from the NOAA website. Data from this website shows no wildfires have occurred in or impacted Franklin County in the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on wildland fires and brushfires hazard data and mitigation measures.

***Impact to the Community***

*Exposure and Loss Estimation*

A major out-of-control wildfire can damage property, utilities and forested land; create smoke that can cause breathing problems; and injure or kill people. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

*Property Damage*

According to Robert Strahan, no property damage, injuries or deaths were recorded for Greenfield’s wildfires in 2010 and no fires of notable size or scope were reported.

***Population Impacts***

Populations considered most vulnerable to wildfire impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-43 summarizes the population over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-43: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

<b>Population Category</b>	<b>Number of Persons Exposed</b>	<b>Percentage of Total Population</b>
<b>Senior (Over 65 years of age)</b>	3,178	17.5%
<b>Low Income (Persons with annual incomes less than \$20,000)*</b>	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

Because Greenfield has areas that are forested and because it has many historic wooden structures, the entire built environment of the Town could be vulnerable to a wildfire. Table 3-44

identifies the building type and valuation of this inventory as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a wildfire.

**Table 3-44: Potential Estimated Loss by Land Use**

Land Use	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
<b>Residential</b>	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
<b>Commercial</b>	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
<b>Industrial</b>	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

While wildfires have caused minimal damage, injury and loss of life to date in Greenfield, their potential to destroy property and cause injury or death exists. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. Wildfires can also cause utility disruption and air-quality problems. Particular areas of vulnerability include low-income and elderly populations.

### ***Data Deficiencies***

In assessing the risks to Greenfield from wildfire hazards, the following data deficiencies were identified:

- The towns of Franklin County rely on farming for one of its income sources. Little data exists on localized crop damage due to wildfires.
- The Greenfield CEM plan is not available for review by the FRCOG.

## **Dam Failure**

### ***Hazard Summary***

Dams hold back water, and when a dam fails, the potential energy of the stored water behind the dam is instantly released as water rushes in torrent downstream, flooding an area engineers refer to as an “inundation area.” The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for these events.

When a dam fails, huge quantities of water quickly flow downstream. Areas adjacent to a river or stream or on low ground are in danger of being inundated by a large volume of water that could destroy structures, utilities, roadways and bridges, and cause injuries or deaths. Many dams in Massachusetts were built in the 19<sup>th</sup> century without the benefit of modern engineering design and construction oversight. Dams can fail because of structural problems due to age and/or lack of proper maintenance. Dam failure can also be the result of structural damage caused by an earthquake or flooding brought on by severe storm events.

### ***Data Collected and Used***

Data from the National Oceanic and Atmospheric Administration's National Climatic Data Center website shows no dam failures have occurred in or impacted Franklin County in the last 20 years. According to the members of the Local Natural Hazard Mitigation Team, no dam failures have occurred in Greenfield in the last 20 years.

### ***Impact to the Community***

#### ***Exposure and Loss Estimation***

While dam failures are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

#### ***Property Damage***

Historic data for dam failure events indicate that between 1993 and 2010, no events were recorded in Franklin County, causing no property damage or population impacts.

#### ***Population Impacts***

Populations considered most vulnerable to dam failure are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-45 summarizes the population over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-45: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

<b>Population Category</b>	<b>Number of Persons Exposed</b>	<b>Percentage of Total Population</b>
<b>Senior (Over 65 years of age)</b>	3,178	17.5%
<b>Low Income (Persons with annual incomes less than \$20,000)*</b>	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

Structures that lie in the inundation area of each of the dams in Greenfield are vulnerable to a dam failure. Table 3-46 identifies the building type and valuation for all residential, commercial, and industrial uses in Town, as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a dam failure.

**Table 3-46: Potential Estimated Loss by Land Use**

<b>Land Use</b>	<b>Total Assessed Value</b>	<b>1% Damage Loss Estimate</b>	<b>5% Damage Loss Estimate</b>	<b>10% Damage Loss Estimate</b>
<b>Residential</b>	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
<b>Commercial</b>	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
<b>Industrial</b>	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Dam failures, while rare, can destroy roads, structures, facilities, utilities, and impact the population of Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, buildings in the floodplain or inundation areas, and infrastructure such as roadways and utilities that can be damaged by such events. According to the members of the Local Natural Hazard Mitigation Team, no dam failures have occurred in the last 20 years in Greenfield.

As described in the Hazard Identification and Profile section of this plan, there are two significant beavers in Greenfield. The one located on Allen Brook, off Plain road has impacted the private land owner's fields and could potentially cause flooding downstream. The Town is currently working with the landowner to mitigate the issue.

### ***Data Deficiencies***

In assessing the risks to Greenfield from dam failure hazards, the following data deficiencies were identified:

- The towns of Franklin County rely on farming for one of its income sources. Little data exists on localized crop damage due to dam failure, if any.
- Data for the location and condition of dams within Greenfield resides with the DCR Office of Dam Safety and with FERC. New software and reporting systems within the Office of Dam Safety has resulted in missing data and questions as to the status of some dams. Requests for additional information have been referred to the Office of Dam Safety's Legal Department, which charges for any requests for information.

## **Earthquakes**

### ***Hazard Summary***

Earthquakes are rare in Franklin County, however temblors are unpredictable and can cause significant damage to roads, structures, facilities, utilities, and population. Existing and future mitigation efforts should continue to be developed and employed that will enable the Town to be prepared for earthquakes.

While rare in Franklin County, earthquakes have happened in New England. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.<sup>34</sup> Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as landslides, avalanches, flash floods (dam failure) and fires. Un-reinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.<sup>35</sup>

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<sup>34</sup> Northeast States Emergency Consortium web site: [www.nesec.org/hazards/earthquakes.cfm](http://www.nesec.org/hazards/earthquakes.cfm)

<sup>35</sup> Federal Emergency Management Agency web site: [www.fema.gov/hazards/earthquakes/quake.shtm](http://www.fema.gov/hazards/earthquakes/quake.shtm).

### ***Data Collected and Used***

The National Oceanic and Atmospheric Administration recorded no earthquakes for Franklin County in the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on earthquake hazard data and mitigation measures.

### ***Impact on the Community***

#### ***Exposure and Loss Estimation***

A major earthquake could cause severe damage to Greenfield buildings, including older structures that were built before a 1975 law requiring new buildings to withstand earthquakes. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

#### ***Property Damage***

Historic data for earthquake events indicate that between 1991 and 2010, no earthquakes were recorded in Franklin County during this period, causing no damage to property.<sup>36</sup>

#### ***Population Impacts***

Populations considered most vulnerable to earthquake impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-47 summarizes the population over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-47: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

<b>Population Category</b>	<b>Number of Persons Exposed</b>	<b>Percentage of Total Population</b>
<b>Senior (Over 65 years of age)</b>	3,178	17.5%
<b>Low Income (Persons with annual incomes less than \$20,000)*</b>	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

The entire built environment of Greenfield is vulnerable to earthquakes. Table 3-48 identifies the assessed value of all residential, commercial, and industrial land uses in Greenfield, and the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of an earthquake.

**Table 3-48: Potential Estimated Loss by Land Use**

<b>Land Use</b>	<b>Total Assessed Value</b>	<b>1% Damage Loss Estimate</b>	<b>5% Damage Loss Estimate</b>	<b>10% Damage Loss Estimate</b>
<b>Residential</b>	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
<b>Commercial</b>	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
<b>Industrial</b>	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946

<sup>36</sup> NOAA National Climactic Data Center. <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms>

<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>
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Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Earthquakes, while rare, could cause significant impacts and losses to the roads, structures, facilities, utilities, and population of Greenfield. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, trailer homes and buildings erected before 1975, and infrastructure such as roadways and utilities that could be damaged by earthquakes. According to the 2000 U.S. Census, nearly 78% of the housing in Greenfield was built prior to 1970. According to members of the Local Natural Hazard Mitigation Team, no earthquakes have impacted Greenfield in the last 20 years.

### ***Data Deficiencies***

In assessing the risks to Greenfield from earthquakes, no data deficiencies were identified.

## **Landslides**

### ***Hazard Summary***

Landslides rarely occur in Franklin County but Greenfield has experienced several in recent years. Details can be found on page 32. Landslides can impact the built and natural environments and can displace residents.

### ***Data Collected and Used***

National Oceanic and Atmospheric Administration’s National Climactic Data Center website shows no landslide events in Franklin County for the last 20 years. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on landslide hazard data and mitigation measures.

### ***Impact to the Community***

#### ***Exposure and Loss Estimation***

While landslides are rare, their impacts can be devastating, including loss of property, disruption to infrastructure, and injury and death. Continued development, particularly on steep slopes or unstable soils, increases the chances that landslides will be a danger. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites. The Committee identified debris management and disposal as an ongoing concern.

As noted in the Risk Assessment Section, relatively small landslides have been reported on Factory Hollow Road along the Fall River, on Mead Street and Wisdom Way, Brook Road and Shelburne Road, as well as at the 90-acre Green River Cemetery (Table 3-49). A much more significant mudslide impacted some residents in early 2011. See page 32 for details.

**Table 3-49: Landslide Events in Greenfield**

<b>Date</b>	<b>Event Description</b>	<b>Location of Event</b>	<b>Property Damage</b>
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Date	Event Description	Location of Event	Property Damage
Ongoing	Small landslide	Factory Hollow Road on Fall River	
Ongoing	Small landslide	Mead Street and Wisdom Way	
Ongoing	Small landslide	Brook Road and Shelburne Road	
Ongoing	Small landslide	Green River Cemetery	
March 7, 2011	Significant landslide	Green River Cemetery and Meridian Street	

### ***Property Damage and Population Impacts***

Historic data for landslide events indicate that between 1993 and 2010, no significant landslide events were recorded in Franklin County. Populations considered most vulnerable to landslide impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-50 summarizes the population over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-50: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
Senior (Over 65 years of age)	3,178	17.5%
Low Income (Persons with annual incomes less than \$20,000)*	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45).

Source: 2000 U.S. Census.

Table 3-51 identifies the assessed value of all residential, commercial, and industrial uses in Town, as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of a massive landslide.

**Table 3-51: Potential Estimated Loss by Land Use**

Land Use	Total Assessed Value	1% Damage Loss Estimate	5% Damage Loss Estimate	10% Damage Loss Estimate
<b>Residential</b>	\$1,055,388,591	\$10,553,886	\$52,769,430	\$105,538,859
<b>Commercial</b>	\$243,076,431	\$2,430,764	\$12,153,822	\$24,307,643
<b>Industrial</b>	\$33,819,460	\$338,195	\$1,690,973	\$3,381,946
<b>Total</b>	<b>\$1,332,284,482</b>	<b>\$13,322,845</b>	<b>\$66,614,224</b>	<b>\$133,228,448</b>

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010.

### ***Overall Vulnerability Assessment***

Landslides, while rare in Franklin County, can destroy roads, structures, facilities, utilities, and impact the population of Greenfield. Existing and future mitigation efforts should continue to be

developed and employed that will enable Greenfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, and buildings, roadways, and utilities near the foot of slopes, especially when slopes are destabilized. According to the members of the Local Natural Hazard Mitigation Team, no landslides have occurred in the last 20 years in Greenfield.

### ***Data Deficiencies***

In assessing the risks to Greenfield from landslides, no data deficiencies were identified.

## **Ice Jams**

### ***Hazard Summary***

Ice jams (or ice dams) occur when water builds up behind a blockage of ice. Ice jams can occur in various ways, but in New England they predominantly form on rivers and streams and mainly threaten infrastructure.

When the upstream part of a river thaws first and the ice is carried downstream into the still-frozen part of the watercourse, ice can form an ice dam and flood low lying areas upstream of the jam. Also, once an ice dam breaks apart, the sudden surge of water that breaks through the dam can flood areas downstream of the jam. The resulting flow of water when an ice jam is broken can cause flooding downstream, threatening infrastructure, structures, and roadways.

### ***Data Collected and Used***

The National Oceanic and Atmospheric Administration's National Climatic Data Center website shows no ice jam events or damage in Greenfield over the last 20 years and the Committee reports none of significance. The Commonwealth of Massachusetts State Hazard Mitigation Plan 2010 was also reviewed for information on ice jam hazard data and mitigation measures.

### ***Impact to the Community***

#### **Exposure and Loss Estimation**

Losses to ice jams include the rising waters along the river or stream that is being dammed, and the rush of water downstream when the dam either melts or is broken up by human intervention. Buildings, roadways and utilities are threatened by ice blockages. Other issues associated with this type of hazard include debris management issues including debris removal and identification of disposal sites.

#### **Property Damage**

Data on ice jams in Franklin County indicate that no property damage or injuries or deaths occurred as the result of ice jams in the last 20 years. However, the structures and people most at risk from an ice jam are those within the floodplain. The average assessed values of the residential, commercial, and industrial land uses located within the floodplain are displayed in Table 3-52. The total average assessed value for these three land uses within the floodplain is \$4,424,398, with the largest assessed value falling within the residential land use category at \$4,196,873. This is of concern because should a catastrophic flooding event befall Greenfield,

the assessed values of these structures would likely be significantly reduced, which in turn would impact the town's tax revenues.

**Table 3-52: Average Assessed Value of Land Use in Flood Hazard Area**

	Total Acres in Town	Total Assessed Value	Average Assessed Value Per Acre	Acres in Floodplain	Average Assessed Value in Floodplain
<b>Residential</b>	2,598.51	\$253,678,000	\$97,624	42.99	\$4,196,873
<b>Commercial</b>	11.3	\$1,992,179	\$176,299	0.49	\$86,387
<b>Industrial</b>	2.7	\$793,900	\$294,037	0.48	\$141,138

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010; 2005 MassGIS Land Use data.

Population Impact

Populations considered most vulnerable to ice jam impacts are identified based on a number of factors including their physical and financial ability to react or respond during a hazard and the location and construction quality of their housing. Table 3-53 summarizes the population over the age of 65 or living in households with an income below \$20,000 per year. See also Environmental Justice section on pages 45-47.

**Table 3-53: Senior and Low Income Populations in Greenfield Exposed to Natural Hazards**

Population Category	Number of Persons Exposed	Percentage of Total Population
<b>Senior (Over 65 years of age)</b>	3,178	17.5%
<b>Low Income (Persons with annual incomes less than \$20,000)*</b>	5,320	29.3%
<b>Total</b>	<b>8,498</b>	<b>46.8%</b>

\* Low income population was calculated by multiplying 2000 U.S. Census Households with Incomes of Less than \$20,000 (116) by 2000 U.S. Census Average Household Size (2.45). Source: 2000 U.S. Census.

The built environment in the floodplain of Greenfield is vulnerable to ice jam events. Land uses located in the floodplain are discussed in the flooding section above. Table 3-54 identifies the average assessed value for all residential, commercial, and industrial uses in Town, as well as the losses that would result from 1%, 5%, and 10% damage to this inventory as a result of an ice jam.

**Table 3-54: Potential Estimated Loss by Land Use Category**

Land Use	Total Acres in Town	Total Assessed Value	Average Assessed Value Per Acre	Acres in Flood Hazard Area	Average Assessed Value in Flood Hazard Area
<b>Residential</b>	386.05	\$121,791,060	\$315,480	0.98	\$309,170
<b>Commercial</b>	29.44	\$7,227,231	\$245,490	0.12	\$29,459
<b>Industrial</b>	49.29	\$295,631,498	\$5,997,799	5.45	\$32,688,003

Source: Massachusetts Department of Revenue - Division of Local Services, Municipal Databank/Local Aid Section 2010; 2005 MassGIS Land Use data.

### ***Overall Vulnerability Assessment***

Ice jams occur throughout New England, often causing significant impacts and losses to roads, structures, facilities, utilities, and the population. Existing and future mitigation efforts should continue to be developed and employed that will enable Greenfield to be prepared for these events when they occur. Particular areas of vulnerability include low-income and elderly populations, trailer homes, and infrastructure such as roadways near rivers and streams and utilities and low-lying areas. According to the members of the Local Natural Hazard Mitigation Team, no ice jams have occurred in the last 20 years in Greenfield.

### ***Data Deficiencies***

In assessing the risks to Greenfield from ice jams, no data deficiencies were identified.

## **Manmade Hazards**

### ***Hazard Summary***

Manmade hazards are being assessed at the local level for the first time in this plan update. A preliminary assessment was made only of those manmade hazards of an accidental nature, such as transportation accidents or fixed facility accidents involving hazardous materials. The potential for these types of hazardous materials accidents could be quite high – particularly transportation related, given the proximity of Route 2 and the railroad tracks to the rivers and to more densely populated areas of Town. No formal vulnerability assessment was done on manmade hazards, however the potential for accidents, the unknown impact of such accidents and the lack of well-analyzed data make this hazard a high priority on the Action Plan.

### ***Data Deficiencies***

- Need to research available models and data requirements to adequately evaluate the potential impact of hazardous accidents on the rivers, on drinking water supply, and on public health.

## **Development Trends Analysis**

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In assessing development trends for the Town of Greenfield - and the impact those trends might have on hazard mitigation - the Committee was asked to evaluate the probability of development in town and areas most likely to be targeted for development. The Committee was also asked about changes in industry, proposed housing and retail development, and any major highway or public transit improvements that might change accessibility to parts of town. Additionally, data such as number of construction permits issued, change in population, current zoning bylaws and the acres of developable land was considered.

### ***Pending Development***

The Committee forecasted that some development is likely over the next ten years, much of it infill in existing developed areas, including in the downtown. No subdivisions are being proposed at this time. In terms of commercial development, plans have been submitted to the Greenfield Planning Board to build a 135,000-square-foot retail store on a 29.5-acre site northeast of the city's commercial core. There is also the possibility of some development and/or reuse of commercial properties near the rotary. The Bendix site and the Lunt property on Federal Street are also currently under consideration for clean up and redevelopment. None of these properties lie within the floodplain.

Changes in transit include \$12.8 million innovative Franklin Regional Transit Center project, anticipated to be completed in late 2011 and serving as a transportation hub for Franklin County, supporting public and private transit services. The transit center is designed to encourage future passenger rail services along the Connecticut River corridor. The 24,000-square-foot "net zero" building is being designed to drastically minimize energy use through energy efficiency measures and other design features, including the potential for on-site renewable energy generation. The transit center will be located within the Greenfield Bank Row Urban Renewal Zone and is part of the Greenfield Bank Row Private Development Site. Construction of the transit center will be the first project within the Urban Renewal Zone. It is expected to be a catalyst for additional investment and redevelopment in downtown Greenfield, housing offices of the Franklin Regional Transit Authority and the FRCOG.<sup>37</sup>

### ***Other Development Trends***

In addition to the Committee's assessment of development trends, Census data for building permits issued was consulted (Table 3-55). For new privately-owned residential building permits issued in Greenfield, a total of 116 permits were issued between the years 2000 and 2009. The number of annual permits issued has remained relatively stable, except for in 2002, when there number issued was approximately double the number issued in the other years examined.

Although building permits have held fairly steady over the past 10 years, Greenfield's population has actually declined, according to new census information. Total population in 2010 was 17,456, down from 18,168 in 2000 and from 18,866 in 1990. The total 20 year decrease is 1,210, or 6.5%. This is compared to Franklin County overall which saw an increase of 1,280 or 1.8%.

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<sup>37</sup> [http://www.youmovemassachusetts.org/stimulus\\_13\\_GreenfieldTransitCenter\\_041709.pdf](http://www.youmovemassachusetts.org/stimulus_13_GreenfieldTransitCenter_041709.pdf)

**Table 3-55: Decennial Census Total Population Trends - Franklin County Towns**

Area Name	Census Data			10 Year Trend		20 Year Trend	
	1990 Census	2000 Census	2010 Census Redistricting	2000-2010 Difference	2000-2010 Change	1990-2010 Difference	1990-2010 Change
Ashfield	1,715	1,800	1,737	-63	-3.5%	22	1.3%
Bernardston	2,048	2,155	2,129	-26	-1.2%	81	4.0%
Buckland	1,928	1,991	1,902	-89	-4.5%	-26	-1.3%
Charlemont	1,249	1,358	1,266	-92	-6.8%	17	1.4%
Colrain	1,757	1,813	1,671	-142	-7.8%	-86	-4.9%
Conway	1,529	1,809	1,897	88	4.9%	368	24.1%
Deerfield	5,018	4,750	5,125	375	7.9%	107	2.1%
Erving	1,372	1,467	1,800	333	22.7%	428	31.2%
Gill	1,583	1,363	1,500	137	10.1%	-83	-5.2%
Greenfield	18,666	18,168	17,456	-712	-3.9%	-1,210	-6.5%
Hawley	317	336	337	1	0.3%	20	6.3%
Heath	716	805	706	-99	-12.3%	-10	-1.4%
Leverett	1,785	1,663	1,851	188	11.3%	66	3.7%
Leyden	662	772	711	-61	-7.9%	49	7.4%
Monroe	115	93	121	28	30.1%	6	5.2%
Montague	8,316	8,489	8,437	-52	-0.6%	121	1.5%
New Salem	802	929	990	61	6.6%	188	23.4%
Northfield	2,838	2,951	3,032	81	2.7%	194	6.8%
Orange	7,312	7,518	7,839	321	4.3%	527	7.2%
Rowe	378	351	393	42	12.0%	15	4.0%
Shelburne	2,012	2,058	1,893	-165	-8.0%	-119	-5.9%
Shutesbury	1,561	1,810	1,771	-39	-2.2%	210	13.5%
Sunderland	3,399	3,777	3,684	-93	-2.5%	285	8.4%
Warwick	740	750	780	30	4.0%	40	5.4%
Wendell	899	986	848	-138	-14.0%	-51	-5.7%
Whately	1,375	1,573	1,496	-77	-4.9%	121	8.8%
<b>Franklin County</b>	<b>70,092</b>	<b>71,535</b>	<b>71,372</b>	<b>-163</b>	<b>-0.2%</b>	<b>1,280</b>	<b>1.8%</b>
<b>Massachusetts</b>	<b>6,016,425</b>	<b>6,349,097</b>	<b>6,547,629</b>	<b>198,532</b>	<b>3.1%</b>	<b>531,204</b>	<b>8.8%</b>

Source: U.S. Department of Commerce - Census Bureau; Decennial Census Program

As discussed in the Vulnerability Assessment Section of this plan, current development in the flood plain includes 825 acres of commercial, public/institutional and industrial uses and 43 acres of residential use. Given current data available, it is unknown exactly how much of the land in and along the floodplain is undeveloped. Further GIS analysis beyond the scope of the current project would be necessary to determine the exact number of developable acres in and along the floodplain. Further assessment of the possible developable lots should take into consideration constraints such as river buffers, highway setbacks, slopes and other constraining factors. The fact remains there is a potential for more development in floodplains in Greenfield and, with that development, the potential flooding impacts on structures and occupants.



Critical Facilities Map: to be added

## 4 – MITIGATION STRATEGIES

This section of the Hazard Mitigation Plan is the long-term blueprint for reducing the losses identified in the risk assessment. Each hazard includes a detailed of current mitigation strategies, a summary table of same mitigation strategies with suggested additions and changes and, in the Appendix, any detailed language from Zoning Bylaws and/or Subdivision Rules and Regulations.

### Current Mitigation Strategies

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#### Floods

The Critical Facilities, Infrastructure, 2010 Land Use & Natural Hazards Map for the Town of Greenfield shows the 100-year flood zone identified by FEMA flood maps. The 100-year flood zone is the area that will be covered by water by a flood that has a 1% chance of occurring in any given year. The Map also shows the areas in town that are subject to localized flooding problems, such as the Maple Brook culvert in North and Maple Streets. According to the Greenfield Town Engineer, the Maple Brook culvert is the primary drainage system for 1,000 acres of the town's most urbanized area. The culvert was built in the 1930's. The culvert is in poor condition and studies have shown that it is significantly undersized for the current flows. The Town of Greenfield has a Capital Project on the books to replace or rehabilitate the culvert. Estimated project cost as of the 2005 Plan was \$1,750,000. Town Planner Eric Twarog indicated the cost of the project would need to be re-estimated given how long it has been since it was initially estimated.

Residential and commercial development has occurred within the 100-year floodplain along the Deerfield and Connecticut Rivers, especially in the area of town known as Cheapside. Along the downstream section of the Green River, there is residential and commercial development within or adjacent to the floodplain. Upstream, the land use within the floodplain of the Green River is predominantly forest and crop or pasture land. Land use within the floodplain of the Fall River is predominantly forest and crop or pasture land with sparse residential development adjacent to the floodplain.

The major floods recorded in Greenfield during the 20<sup>th</sup> Century have been the result of rainfall alone or rainfall combined with snowmelt. Historic records on the Connecticut and Deerfield Rivers have also cited backwater flooding from ice jams as a significant problem in the past. One of the goals of this Natural Hazards Mitigation Plan is to evaluate all of the town's existing policies, practices, and plans related to natural hazards and identify potential gaps in protection.

#### Existing Policies, Practices, and Plans

##### *Comprehensive Emergency Management (CEM) Plan*

The Comprehensive Emergency Management (CEM) Plan for Greenfield lists the following generic mitigation measures for flood planning and response:

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Ensure that Whately is enrolled in the National Flood Insurance Program. See pages 122-124 for more information of NFIP.
- Strictly adhere to land use and building codes, (e.g. Wetlands Protection Act), and new construction should not be built in flood prone areas.
- Ensure that flood control works are in good operating condition at all times.
- Preserve natural water storage areas.
- Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

The Comprehensive Emergency Management (CEM) Plan for Greenfield lists the following generic preparedness and response measures for floods:

- Place EOC personnel on standby during stage of flood ‘watch’ and monitor NWS/New England River Forecast Center reports.
- Ensure that public warning systems are working properly and broadcast any information that is needed at this time.
- Review mutual aid agreements.
- Monitor levels of local bodies of water.
- Arrange for all evacuation and sheltering procedures to be ready for activation when needed.
- Carry out, or assist in carrying out needed flood-proofing measures such as sand bag placement, etc.
- Regulate operation of flood control works such as flood gates.
- Notify all Emergency Management related groups that will assist with flood response activities to be ready in case flood ‘warning’.
- Broadcast warning/notification of flood emergency.
- Coordinate traffic control and proceed with evacuation of affected populations as appropriate.
- Open and staff shelters and reception centers.
- Undertake, or continue to carry out, flood proofing measures.
- Dispatch search and rescue teams.
- Dispatch emergency medical teams

### ***Flood Control Structures***

The Town of Greenfield has no flood control structures within its corporate boundaries. Floods on the Connecticut River and portions of its major tributaries that are prone to backwater effects are controlled by nine flood control reservoirs located upstream in Massachusetts, New Hampshire, and Vermont. The hydro-power facilities in the upstream reaches of the Deerfield River in Vermont (Harriman and Somerset Reservoirs) provide some flood attenuation capacity. In addition, there are several dams on the Deerfield in Massachusetts controlled by the TransCanada Corporation and Brookfield Renewable Power that offer minimal flood protection. Flashboards at the Shelburne Falls Dam and TransCanada Dam No. 4 are designed to fail when the river reaches flood stage.

In 2009, the University of Massachusetts Transportation Engineering Department developed an evacuation scenario for Franklin County in the event of the failure of Harriman Dam. In 2010, the Franklin Regional Council of Governments prepared a supplement to the Franklin County: Harriman Dam Failure Case Study II done by UMASS. It makes recommendations for evacuating Greenfield and the other towns in the County should the dam fail.<sup>38</sup>

### ***Land Use Regulations that Mitigate Impacts from Flooding***

The Town of Greenfield has adopted several land use regulations that serve to limit or regulate development in floodplains, to manage stormwater runoff, and to protect groundwater and wetland resources, the latter of which often provide important flood storage capacity. These regulations are summarized below and their effectiveness evaluated in Table 4-1.

### ***Zoning Bylaws - See Appendix A for details***

#### **Floodplain Zoning Ordinance: Section 200-4.13 Floodplain Overlay district**

Permitted Uses (Section 200-4.13.E)

Special Permits (Section 200-4.13.F)

Prohibited (Section 200-4.13.I)

Performance Standards Section 200-6.8

Open Space/Cluster Developments Section 200-7.1

Common Open Space Requirements (Section 200-7.1 H)

Earth Removal, Section 200-7.4

Major Development Review, Section 200-7.12

Site Plan Review and Approval (Section 200-8.4)

#### **Subdivision Rules and Regulations - See Appendix A for details**

Greenfield's Subdivision Rules and Regulations (Chapter 880)

Section 880-9.B Definitive Plan Submission Requirements

Section 880-9.E Wetlands Protection Act.

Section 880-10. Design Requirements

Section 880-11. Open Space

Section 880-12. Protection of Natural Features

Section 880.13. Easements

Section 880-14. Environmental Assessment

#### **Town of Greenfield Code - See Appendix A for details**

Wetlands Protection, Chapter 195

Stormwater System Regulations, Chapter 695

Design Criteria Section 695-12

Water Supply Protection District Section 200-4.14

Limitations upon Uses section (200-4.14.10)

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<sup>38</sup> *Draft Recommendations, Town Recommendations: Supplement to the Failure of the Harriman Dam Evacuation Planning Report.*

### ***2006 Greenfield Open Space and Recreation Plan***

As its title implies, the intent of Greenfield's Open Space and Recreation Plan is not to address hazard mitigation or flood control in a direct or comprehensive way. However, the plan inventories the natural features and environments in the town, many of which, such as wetlands, aquifer recharge areas, farms, rivers, streams, and brooks, include floodplain areas.

Greenfield's statement of Open Space and Recreation Goals includes protecting important and strategically located open space and protecting the Town's natural resources and the environment. The Plan's Resource Protection Needs Analysis concludes that it is important to think on a "watershed scale" and coordinate with neighboring communities and other entities on projects involving the Connecticut and Deerfield Rivers. More specifically, the Plan states that lands along the Green River, which runs through the heart of Greenfield, is a priority. Protecting lands located near designated water supply areas is also identified as a priority. Greenfield contains some of the most fertile farmland in the county due in large part to its proximity of rivers which deposit the rich soil in their floodplains. The Open Space and Recreation Plan recommended that the Town take a proactive role in protecting these lands through the Agricultural Preservation Restriction Program (APR), the Chapter 61A programs, and adopting zoning ordinances for farmland preservation such as a Farmland Preservation Overlay District.

### ***2009 Greenfield Reconnaissance Report***

The Massachusetts Heritage Landscape Inventory Program's Reconnaissance Report is a valuable resource for Greenfield, helping to identify those landscapes particularly valued by the community, especially those that are significant and unprotected. It also contains information on cultural and historic resources in Town. This inventory could be used by the Committee to help them prioritize those resources that may be threatened by hazards such as flooding.

### ***2002 Greenfield Master Plan***

The Greenfield Master Plan is a statement of the community values of Greenfield and a directive for the physical development of the town that describes how, why, where and when to build, rebuild or preserve the town. As such, it indirectly addresses flooding potential and mitigation in the Land Use Section of the Master Plan. Among the Goals of the Land Use Section which indirectly address flooding are:

- Preserving agriculture;
- Promoting housing choice and natural resource protection through careful site planning in outlying areas; and
- Siting land uses where the carrying capacity of the land is greatest.

Several Implementation Objectives in the Land Use Section also indirectly address flooding by seeking to preserve open space and encourage environmentally sensitive development patterns. These specific Objectives encourage:

- The initiation of an assertive, coordinated, on-going open space resources acquisition and preservation plan; and

- Identifying ways to achieve cluster development as a preferred development pattern for areas with specific attributes such as water resource protection, agricultural soils, landscape character, and wildlife habitat and corridors.

The Goal of the Natural, Cultural, and Historic Resources Section of the Master Plan is the protection and enhancement of Greenfield’s natural resource systems, cultural resources, and historic buildings. Preserving and enhancing natural resource systems, such as wetlands and floodplains, will help to mitigate or prevent flooding. One of the objectives of this section is to protect environmentally sensitive areas and to try and site development away from these areas or mitigate impacts to these areas. Among the Implementation Measures listed in the Natural, Cultural, and Historic Resources Section of the Master Plan is one that would specifically mitigate or prevent flooding, namely – enforcing the Town’s Zoning Ordinance and existing environmental regulations.

The Open Space and Recreation Section of the Greenfield Master Plan includes the Goal of preserving and providing open space “...to enhance Greenfield’s overall environmental quality.” One of the Objectives listed in this section is to “[i]ncrease public awareness pertaining to recreation and conservation opportunities and educate the public in regards to the protection of the environment.”

#### ***2005 Bank Row Urban Renewal Plan***

This plan addresses a specific area of town – Bank Row – and its historic significance and existing substandard or blighted conditions. The plan could be used to help the Committee identify other similar areas in town, to prioritize those cultural and historic possibly threatened by hazards such as flooding and to develop mitigation strategies.

**Table 4-1: Existing Flood Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
Floodplain Overlay District	<p>Permitted uses are allowed if they do not require structures, fill or storage of materials.</p> <p>No encroachment allowed within the 100-year floodplain without a Special Permit.</p> <p>Special permit conditions require no decrease in flood storage capacity or increase in flood levels. Use must not substantially affect the water table, water quality or drainage patterns.</p>	Special Flood Hazard Areas (Zones A, A 1-30) to indicate the 100-year floodplain.	Effective for regulating new development within the 100-year floodplain.	Consider limiting all new development within the 100-year floodplain.	Still relevant.
Performance Standards	Standard (6.8.3.8) addresses the impacts of uncontrolled surface water runoff and sedimentation of surface waters.	Entire town.	Effective for mitigating localized flooding by regulating stormwater runoff.	None.	N/A
Open Space and Cluster Development Section	Earth Removal: Regulates the removal of soil, loam, sand & gravel through a permitting process and exempts existing sand and gravel operations, and disturbances due to building construction and landscaping activities.	Entire town.	Not Effective for controlling localized flooding. This Ordinance does not include a purpose.	Add reducing or eliminating the potential for localized flooding events as a Purpose of the Ordinance.	Still relevant.
			This Ordinance does not specifically address the potential for localized flooding that soil removal can cause.	Require mitigation of potential impacts from flooding.	Still relevant.

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
			This Ordinance was written to address safety, aesthetics, and potential traffic impacts associated with soil removal.	Add a reference to the Town's stormwater regulations.	Still relevant.
Open Space and Cluster Development Section	<p>Major Development Review:</p> <p>Requires an Impact Statement for certain types of development.</p> <p>The Impact Statement must include an evaluation of the impact of stormwater, runoff, flooding, erosion, sedimentation, grading changes, increased impervious surface, discharges to groundwater, pumping of groundwater, wetlands disruption, and changes to vegetative cover.</p> <p>The Impact Statement must describe proposed mitigation measures for identified impacts.</p> <p>Regulations list the Environmental Standards for Impact Statements that address flooding: specifically, the project shall not cause erosion or flooding of the site.</p>	Entire town.	Effective for mitigating flooding and flood-related impacts for certain types of large-scale developments.	None.	N/A
Open Space and Cluster Development Section	Site Plan Review: Project proponent must submit information regarding measures to prevent flooding and increased runoff and prevent erosion and sedimentation.	Required for all uses that require a Special Permit, any business, commercial, industrial or institutional use (except certain home occupations) and	Effective for preventing flooding and uncontrolled stormwater runoff.	None.	N/A

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
		any site containing more than one (1) principal use.			
<b>Subdivision Rules and Regulations:</b>					
Definitive Plan	Proposed layout (including cross sections and profiles) of sewerage, storm drainage and water supply, including invert elevations, slopes, capacity, and velocity and stormwater management plan	Entire Town	Effective for mitigating localized flooding of roads and other infrastructure.	None	N/A
	An erosion control plan, indicating the erosion control measures to be employed, including description of locations of temporary stockpiles, spoil areas, temporary drainage systems, slope stabilization techniques, sediment basins, etc., and narrative description of how erosion from individual lots onto streets and into drainage systems is proposed to be controlled.	Entire Town	Effective for mitigating localized flooding of roads and other infrastructure.	None	N/A
Wetlands Protection Act	Guidelines establish that the development must be in compliance with the WPA and the applicant shall obtain approval from the Conservation Commission prior to any construction activity in the affected areas.	Entire Town	Effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	None	N/A
Design Requirements	Requires design to reduce where possible, the volume of cut and fill; the area over which existing vegetation will be disturbed, especially if within 200 feet of a river, pond, or stream, or having a slope of more than 15%;the number of	Entire Town	Effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	None	N/A

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
	mature trees removed; the extent of waterway altered or relocated; the erosion and siltation; and flood damage.				
Open Space	Should contain design requirements that can reduce the potential for flooding.	Entire Town	Somewhat effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	Consider adding prevention of flooding as an explicitly stated purpose for this requirement.	Still relevant.
Protection of Natural Features	Should contain design requirements that can reduce the potential for flooding.	Entire Town	Somewhat effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	Consider adding prevention of flooding as an explicitly stated purpose for this requirement.	Still relevant.
Easements	Should contain design requirements that can reduce the potential for flooding.	Entire Town	Somewhat effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	Consider adding prevention of flooding as an explicitly stated purpose for this requirement.	Still relevant.
Flood Hazard Areas	Requires that any portion of a proposed subdivision which is located within the 100-year floodplain shall meet the following requirements:  All requirements of § 200-4.13 Floodplain District (F) of the Greenfield Zoning	Entire Town	Somewhat effective for mitigating localized flooding of roads and other infrastructure and for preventing filling of flood storage areas.	Consider prohibited all subdivision development within the 100-year floodplain.	Still relevant.

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
	<p>Ordinance.</p> <p>The subdivision, including utilities and drainage, shall be designed to be consistent with the needs to minimize flood damage and provide adequate drainage.</p> <p>Subdivisions shall include base flood elevation data.</p>				
<b>Town of Greenfield Code:</b>					
Stormwater System Regulation	<p>Regulations require a permit for all new connections to the stormwater system and any increases in volume from existing development.</p> <p>Stormwater Management Plans are required for all nonresidential uses.</p> <p>Regulations include stormwater management standards, design criteria and mandate coordination with the Greenfield Conservation Commission.</p> <p>Maintenance agreements are required for nonresidential uses.</p>	Entire Town	Effective for mitigating or preventing localized flooding of roads and other infrastructure and for controlling impacts from stormwater runoff.	None.	N/A
Water Supply Protection District	Regulations protect and preserve existing and potential sources of groundwater supply and recharge and watershed areas.	Areas identified on the Zoning Map.	Effective for mitigating the potential for localized flooding by preserving open space in the watershed and regulating stormwater runoff	None.	N/A
<b>Town of Greenfield Plans:</b>					

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
Greenfield Open Space and Recreation Plan	Inventories natural features and environments in the town, including many that contain floodplain areas such as wetlands, aquifer recharge areas, farms, rivers, streams and brooks.	Entire town.	Effective in identifying sensitive resource areas, including floodplains and encourages thinking on a “watershed scale”.  Prioritizes protecting areas along the Green River and recommends that the Town take a proactive role in preserving farmland, much of which lies within the floodplain.	None.	N/A
Greenfield Master Plan	Provides a framework for guiding development in Town.	Entire town.	Effective in establishing priorities for environmentally sensitive development that will mitigate flooding impacts.	None.	N/A
Participation in the National Flood Insurance Program	As of 2003, there were 48 homeowners with flood insurance policies.	Areas identified by the FEMA maps.	Effective.	None.	N/A
State Building Code	The Town of Greenfield has adopted the Massachusetts State Building Code.	Entire Town	Effective	None.	N/A

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
Deerfield River Watershed Regional Open Space & Recreation Plan	This project will be completed by June 30, 2004. A regional Open Space Committee will be formed to implement a Ten-Year Action Plan.	Entire Town and the Deerfield River Watershed.	Effective in raising awareness of water resources in Town and potential negative impacts of uncontrolled development (loss of open space, farmland, stormwater runoff and other nonpoint source pollution). Will encourage thinking on a watershed scale	None.	Still relevant.

## Severe Winter Storms

Winter storms can be especially challenging for Emergency Management personnel because, although the storm has usually been forecast, there is no certain way to predict its length, size or severity. The Massachusetts Emergency Management Agency (MEMA) serves as the primary coordinating entity in the state-wide management of all types of winter storms and monitors the National Weather Service alerting systems during periods when winter storms are expected.<sup>39</sup>

### *Management Plans*

The CEM Plan for Greenfield lists the following generic mitigation measures for severe winter storms:

- Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.
- As it is almost guaranteed that winter storms will occur annually in Massachusetts, local government bodies should give special consideration to budgeting fiscal resources with snow management in mind.
- Maintain plans for managing all winter storm emergency response activities.

To the extent that some of the damages from a winter storm can be caused by flooding, all of the flood protection mitigation measures described in Table 4-1 can also be considered as mitigation measures for severe snowstorms/ice storms.

The CEM Plan for Greenfield lists the following generic preparedness and response measures for severe winter storms:

- Ensure that warning/notification, and communications systems are in readiness.
- Ensure that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order.
- Review mutual aid agreements.
- Designate suitable shelters throughout the community and make their locations known to the public.
- Implement public information procedures during storm 'warning' stage.
- Prepare for possible evacuation and sheltering of some populations impacted by the storm (especially the elderly and special needs).
- Broadcast storm warning/notification information and instructions.
- Conduct evacuation, reception and sheltering activities.
- If appropriate, activate media center. Refer to Resource Manual for media center information.
- Dispatch search and rescue teams.
- Dispatch emergency medical teams.

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<sup>39</sup> Comprehensive Emergency Management Plan for the Town of Greenfield, August 2002.

- Take measures to guard against further danger from power failure, downed trees and utility lines, ice, traffic problems, etc.
- Close roads, and/or limit access to certain areas if appropriate.
- Provide assistance to homebound populations needing heat, food, and other necessities.
- Provide rescue and sheltering for stranded/lost individuals.

### ***Land Use Regulations that Mitigate Impacts from Severe Winter Storms***

#### *Subdivision Rules and Regulations (See Appendix A for details)*

##### Section 3.1.2 Design Standards

#### ***Other Mitigation Measures***

Severe snowstorms or ice storms can often result in a small or widespread loss of electrical service. The public water supply wells and water treatment plant are both equipped with standby power sources. The distribution system functions by gravity; therefore, no auxiliary power is needed. The sewage pump stations and the wastewater treatment plant are also equipped with standby power sources.

#### *State Building Code*

For new or recently built structures, the primary protection against snow-related damage is construction according to the State Building Code, which addresses designing buildings to withstand snow loads. The Town of Greenfield is a member of the Franklin County Cooperative Building Inspection Program, which provides building inspection services.

**Table 4-2: Existing Severe Winter Storms Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Subdivision Rules and Regulations</b>					
<b>Floodplain Overlay District</b>	Standards include street grade regulations (six to 10 percent maximum).	Entire Town.	Effective.	None.	N/A
<b>Shelters</b>	Shelters for victims of natural hazards in Greenfield have been identified.	Entire Town.	Effective.	Ensure that identified shelters have sufficient back-up utility service in the event of primary power failure.	Still relevant.
<b>State Building Code</b>	The Town of Greenfield has adopted the MA State Building Code	Entire Town.	Effective.	None	N/A

## **Hurricanes (Tornados included in this section)**

The flooding associated with hurricanes and tornados can be a major source of damage to buildings, infrastructure and a potential threat to human lives. Therefore, all of the flood protection mitigation measures described in Table 4-1 can also be considered hurricane mitigation measures. High winds that oftentimes accompany hurricanes and tornados can also damage buildings and infrastructure.

### ***Management Plans***

The CEM Plan for Greenfield lists the following generic mitigation measures for hurricane and tornado planning and response:

- Develop and disseminate emergency public information and instructions concerning hurricane preparedness and safety.
- Community leaders should ensure that Greenfield is enrolled in the National Flood Insurance Program.
- Develop and enforce local building codes to enhance structural resistance to high winds and flooding. Build new construction in areas that are not vulnerable to direct hurricane effects.
- Maintain plans for managing all hurricane emergency response activities.

The CEM Plan for Greenfield includes the following generic preparedness and response measures for hurricanes and tornados:

- Ensure that warning/notification systems and equipment is ready for use at the 'hurricane warning' stage.
- Review mutual aid agreements.
- Designate suitable wind and flood resistant shelters in the community and make their locations known to the public.
- Prepare for coordination of evacuation from potentially impacted areas including alternate transportation systems and locations of special needs facilities.
- Activate warning/notification systems to inform public of protective measures to be taken including evacuation where appropriate.
- Conduct evacuation of affected populations.
- Open and staff shelters and reception centers.
- Dispatch search and rescue teams.
- Dispatch emergency medical teams.
- Activate mutual aid activities.
- Take measures to guard against further danger from downed trees and utility lines, debris, etc.

### ***Evacuation Options***

The Greenfield CEM plan, local officials have identified appropriate shelters for residents in the case of a hurricane or tornado.

Also, the University of Massachusetts Transportation Center completed a Four County Scenario of Berkshire, Franklin, Hampshire and Hamden Counties should a hurricane force a full evacuation of Western Massachusetts. The study looks at critical transportation links; what could be done if such links were totally lost or partially constrained; and what alternative routes and other transportation services would be needed in order to evacuate people effectively to a safe location.

***Zoning Bylaws***

Section 200-7.14 Wireless Communications Facilities.

***Restrictions on Development***

The only restrictions on development that are wind-related are the provisions in the zoning Ordinance related to Wireless Communications Facilities. In addition, new mobile homes, which are susceptible to catastrophic damage during high wind events, are prohibited in town.

***State Building Code***

For new or recently built structures, the primary protection against wind-related damage is construction according to the State Building Code which adequately addresses designing buildings to withstand high winds.

**Table 4-3: Existing Hurricanes and Tornados Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
<b>Zoning regulations for wireless communications facilities</b>	<p>Requires a special permit from the Zoning Board of Appeals and a building permit from the Inspector of Buildings before a facility can be erected.</p> <p>Applicant must provide plans for anchoring and supporting the structure.</p> <p>The Ordinance also establishes a “fall zone” for the structure in relation to property lines and road right-of-ways.</p>	Entire town.	Effective.	Add safety and prevention of wind-related damage as a stated purpose.	Still relevant.
<b>State Building Code</b>	The Town of Greenfield has adopted the Massachusetts State Building Code.	Entire Town	Effective	No Changes	N/A
<b>Zoning Regulations Prohibiting new mobile homes</b>	Town of Greenfield Zoning Ordinance prohibits the siting of new mobile homes.	Entire Town.	<p>Effective in reducing the potential for loss of life and property damage.</p> <p>Existing mobile homes are “grandfathered” and can be replaced.</p> <p>Replacements must meet standards of current building code.</p>	Ensure that replacement mobile homes be tied down to reduce the damaging impacts of high winds.	Still relevant.

## **Microbursts (Includes Thunderstorms and Wind Related Events)**

Most damage from microbursts and wind-related events comes from high winds which can fell trees and electrical wires, generate hurtling debris and, possibly, hail.

### ***Management Plans***

The Greenfield CEM Plan lists three generic mitigation measures for wind-related storm planning and response.

- Develop and disseminate emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.
- Strict adherence should be paid to building code regulations for all new construction.
- Maintain plans for managing tornado response activities. Refer to the non-institutionalized, special needs and transportation resources listed in the Resource Manual.

The CEM Plan for Greenfield includes the following generic preparedness and response measures for wind-related storms:

- Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- Periodically test and exercise tornado response plans.
- Put Emergency Management on standby at tornado 'watch' stage.
- At tornado 'warning' stage, broadcast public warning/notification safety instructions and status reports.
- Conduct evacuation, reception, and sheltering services to victims.
- Dispatch search and rescue teams.
- Dispatch emergency medical teams.
- Activate mutual aid agreements.
- Take measures to guard against further injury from such dangers as ruptured gas lines, downed trees and utility lines, debris, etc.
- Acquire needed emergency food, water, fuel, and medical supplies.
- Take measures relating to the identification and disposition of remains of the deceased.

### ***Evacuation Plans***

There are shelters for wind-related storm victims identified in the Greenfield CEM Plan.

### ***Zoning***

See related information under Hurricanes and Tornados, previous section.

***Restrictions on Development***

The only restrictions on development that are wind-related are the provisions in the zoning Ordinance related to Wireless Communications Facilities. In addition, new mobile homes, which are susceptible to catastrophic damage during high wind events, are prohibited in town.

***State Building Code***

For new or recently built structures, the primary protection against wind-related damage is construction according to the State Building Code which adequately addresses designing buildings to withstand high winds.

**Table 4-4: Existing Microbursts Storms (Includes Thunderstorms and Wind Related events) Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
<b>Zoning regulations for wireless communications facilities</b>	<p>Requires a special permit from the Zoning Board of Appeals and a building permit from the Inspector of Buildings before a facility can be erected.</p> <p>Applicant must provide plans for anchoring and supporting the structure.</p> <p>The Ordinance also establishes a “fall zone” for the structure in relation to property lines and road right-of-ways.</p>	Entire town.	Effective.	Add safety and prevention of wind-related damage as a stated purpose.	Still relevant.
<b>State Building Code</b>	The Town of Greenfield has adopted the Massachusetts State Building Code.	Entire Town	Effective	No Changes	N/A
<b>Zoning Regulations Prohibiting new mobile homes</b>	Town of Greenfield Zoning Ordinance prohibits the siting of new mobile homes.	Entire Town.	Effective in reducing the potential for loss of life and property damage. Existing mobile homes are “grandfathered” and can be replaced. Replacements must meet standards of current building code.	Ensure that replacement mobile homes be tied down to reduce the damaging impacts of high winds.	Still relevant.

## Wildfires / Brush Fires

### *Management Plans and Regulatory Measures*

The CEM Plan for Greenfield includes the following generic mitigation measures for wildfire planning and response:

- Promote fire safety measures such as fire-safe landscaping and construction practices to the public and business communities.

The CEM Plan for Greenfield includes the following generic preparedness and response measures for tornados:

- Restrict outside burning etc. based on moisture levels, fuels supply conditions such as drought.
- Identify high vulnerability or problem areas.
- Utilize mutual aid, including the State Fire Mobilization Plan, as needed.

Greenfield also has some specific regulations and programs that pertain to preventing fires.

### *Burn Permits*

The Town of Greenfield Fire Department requires a permit for the outdoor burning of leaves on residential property. The Town issued approximately 600 burn permits between January 15<sup>th</sup> and May 1<sup>st</sup> of 2003 and requires that these permits be obtained in person from the Fire Department. When an individual comes in to obtain a burn permit, Fire Department personnel educate them about safe burning practices. This outreach effort has resulted in lowering the number of outdoor residential brush fires that get out of the homeowner's control.

### *Subdivision Review*

The Fire Department reviews subdivision plans to ensure that their trucks will have adequate access and that the water supply is adequate for fire-fighting purposes.

### *Public Education/Outreach*

The Fire Department implements "Safe Schools", an ongoing educational program in the schools to teach fire safety. As mentioned above, the Fire Department also educates homeowners who apply for burn permits.

### *Restrictions on Development*

There are currently no restrictions on development that are based on the need to mitigate the hazards of wildfires/brushfires.

**Table 4-5: Existing Wildfires / Brush Fires Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
<b>Burn Permits</b>	Residents are required to appear in person to obtain burn permits. Fire Department personnel provide information on safe burn practices.	Entire Town.	Effective.	None.	N/A
<b>Subdivision Review</b>	The Fire Department is involved in the review of subdivision plans.	Entire Town.	Effective.	None.	N/A
<b>Public Education and Outreach</b>	The Fire Department has an ongoing educational program in the schools.	Entire Town.	Effective.	None.	N/A
<b>Forestry Management</b>	A Forestry Management Program for town owned lands.	Entire Town.	Effective.	None.	N/A

## Dam Failures

The only mitigation measures in place are the state regulations that control the construction and inspection of dams and the Emergency Action Plans for the FERC-regulated projects on the Deerfield River.

### *Management Plans and Regulatory Measures*

The Greenfield CEM Plan contains the following generic mitigation measures for dam failure:

- Develop and conduct public education programs concerning dam hazards.
- Maintain up-to-date plans to deal with threat and actual occurrence of dam overspill or failure.
- Emergency Management and other local government agencies should familiarize themselves with technical data and other information pertinent to the dams which impact Greenfield. This should include determining the probable extent and seriousness of the effect to downstream areas.
- Dams should be inspected periodically and monitored regularly.
- Repairs should be attended to promptly.
- As much as is possible burdens on faulty dams should be lessened through stream re-channeling.
- Identify dam owners.
- Determine minimum notification time for downstream areas.

The Greenfield CEM Plan contains the following generic preparedness and response measures for dam failure:

- Pre-place adequate warning/notification systems in areas potentially vulnerable to dam failure effects.
- Develop procedures for monitoring dam site conditions at first sign of any irregularity that could precipitate dam failure.
- Identify special needs populations, evacuations routes, and shelters for dam failure response.
- Have sandbags, sand, and other items to reinforce dam structure or flood proof flood prone areas.
- Disseminate warning/notification of imminent or occurring dam failure.
- Coordinate evacuation and sheltering of affected populations.
- Dispatch search and rescue teams.
- Coordinate evacuation and sheltering of affected populations.
- Activate mutual aid if needed.
- Acquire additional needed supplies not already in place, such as earth moving machinery.
- Establish incident command post as close to affected area as safely possible.
- Provide security for evacuated public and private property.

### ***Evacuation Options***

Evacuation information is contained in the Town of Greenfield CEM Plan.

### ***Permits Required for New Dam Construction***

Massachusetts State Law (M.G.L. Chapter 253 Section 45) regulates the construction of new dams. A permit must be obtained from the Department of Conservation and Recreation (DCR) before construction can begin. One of the permit requirements is that all local approvals or permits must be obtained.

### ***Dam Inspections***

The DCR requires that dams rated as Low Hazards be inspected every ten (10) years and dams that are rated as Significant Hazards be inspected every five (5) years. Of the nine (9) dams in Greenfield, the Town is the Owner and Caretaker of record for six (6) of these dams. According to DCR records, four (4) of the dams the Town is responsible for are classified as Significant Hazards and the remaining two (2) dams are Low Hazard. The remaining three (3) dams in town are under private ownership. All three (3) are classified as Significant Hazard dams. The dam safety information provided by DCR indicates that four (4) of the dams in town have not been inspected according to the required schedule.

Responsibility for dam inspections resides with the owner of the dam, which will likely create a significant financial hardship, both for towns and individuals who own dams, and result in fewer dams being inspected according to the required schedule.

### ***Zoning***

While no specific mention is made regarding the construction of new dams in either the Floodplain District (Section 200-4.13) or the Wetlands Protection section (Section 195-1), the language regarding encroachment and the erection of structures in both ordinances would indicate that a Special Permit would be required from the Zoning Board of Appeals and an Order of Conditions would be required from the Conservation Commission.

### ***Restrictions on Development***

There are no Town restrictions on dam locations. The DCR issues permits for new dams and does have the authority to deny a permit if it is determined that the design and/or location of the dam is not acceptable.

**Table 4-6: Existing Earthquake Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
<b>Permits required for new dam construction</b>	State law requires a permit for the construction of any dam.	Entire Town.	Effective. Ensures dams are adequately designed.	None.	N/A
<b>Dam Inspections</b>	DCR has an inspection schedule that is based on the hazard rating of the dam (low, significant, high hazard).	Entire Town.	Very Low. The state passed a law in 2002 to shift responsibility for inspections from the state to the dam owner. The regulations have not been issued so DCR continues to inspect only the High Hazard dams. It is highly likely that the remaining dams are not being inspected according to the required schedule.	Repeal the state law requiring dam owners pay for inspections. Adequate staff and resources should be given to DCR to ensure the inspection schedules are maintained.	Still relevant.
				Map dams and Inundation Areas.	Still relevant.
				Evaluate the Need for Dam Inspections by the Town.	Still relevant.
				Incorporate Dam Safety into Development Review process.	Still relevant.
<b>Zoning</b>	Special Permit and/or Order of Conditions required for dams in Floodplain district or wetlands.	Floodplain areas and those under the jurisdiction of the Conservation Commission.	Effective.	None.	N/A

See also Table 4-1: Existing Flood Hazard Mitigation Measures.

## Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernable pattern of previous earthquakes along these faults nor is there a reliable way to predict future earthquakes along these faults or in any other areas of the state. Consequently, earthquakes are arguably the most difficult natural hazard to plan for.

### *Management Plans*

The Greenfield CEM Plan lists five generic earthquake mitigation measures, including:

- Community leaders in cooperation with Emergency Management Personnel should obtain local geological information and identify and assess structures and land areas that are especially vulnerable to earthquake impact and define methods to minimize the risk.
- Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
- Periodic evaluation, repair, and/or improvement should be made to older public structures.
- Emergency earthquake public information and instructions should be developed and disseminated.
- Earthquake drills should be held in schools, businesses, special care facilities, and other public gathering places.

The Greenfield CEM Plan lists the following generic preparedness and response measures for earthquakes:

- Earthquake response plans should be maintained and ready for immediate use.
- All equipment, supplies and facilities that would be needed for management of an earthquake occurrence should be maintained for readiness.
- Emergency Management personnel should receive periodic training in earthquake response.
- If the designated Emergency Operations Center (EOC) is in a building that would probably not withstand earthquake impact, another building should be chosen for an earthquake EOC.
- Mass Care shelters for earthquake victims should be pre-designated in structures that would be most likely to withstand earthquake impact.
- It is assumed that all special needs facilities could be affected to some extent by earthquake effects therefore preparedness measures should be in place to address the needs of all facilities listed in the Resource Manual.
- Most likely the entire population of the community will be affected by a seismic event. Estimate the maximum peak population affected, considering peak tourism, special event populations, and work hours.
- EOC will be activated and response will immediately be engaged to address any and all earthquake effects.

- Emergency warning/notification information and instructions will be broadcast to the public.
- Search and rescue teams will be dispatched.
- Emergency medical teams will be dispatched.
- Firefighters will address fires/explosions, and HAZMAT incidents.
- Law enforcement personnel will coordinate evacuation and traffic control.
- Reception centers and shelters will be opened and staffed.
- Animal control measures will be taken.
- Law enforcement personnel will protect critical facilities and conduct surveillance against criminal activities.
- Immediate life-threatening hazards will be addressed such as broken gas lines or downed utility wires.
- Emergency food, water, and fuel will be acquired.
- Activate mutual aid.
- Measures will be taken relating to identification and disposition of remains of deceased by the Chief Medical Examiner.

### ***Evacuation Options***

The Greenfield CEM lists shelters for victims of earthquakes.

### ***State Building Code***

The first edition of the Massachusetts State Building Code was issued on January 1, 1975 and included specific earthquake resistant design standards. These seismic requirements for new construction have been revised and updated over the years and are part of the current, 8th Edition of the Massachusetts State Building Code (780 CMR 120.AA). Given that many structures in the state and in Greenfield were built before 1975 (nearly 78% were built prior to 1970); it may be assumed that these structures were built without earthquake resistant design features. It is also important to note that the earthquake resistant design standards are the minimum standards for the structure to pass the State Building Code. This does not ensure that the structure will be perfectly safe during an earthquake. Built areas underlain by artificial fill, sandy or clay soils are particularly vulnerable to damage during an earthquake.

### ***Restrictions on Development***

There are no seismic-related restrictions on development.

**Table 4-7: Existing Earthquake Hazard Mitigation Measures**

Type of Existing Protection	Description	Area Covered	Effectiveness	2011 Potential Changes	Accomplished/ Still Relevant?
<b>Zoning Bylaws</b>					
<b>State Building Code</b>	The Town of Greenfield has adopted the Massachusetts State Building Code.	Entire Town	Effective	No Changes	N/A



## **Landslides**

Regulating land use and development to avoid construction on steep slopes and ensuring that construction does not reduce slope stability is one way to mitigate the hazard potential of landslides. The mitigation measures for landslides were found to be the same as for Floods.

Please see Table 4-1: Existing Flood Hazard Mitigation Measures for summary of the above Land Use Regulations and Appendix A detailed Land Use Regulations.

## **Ice Jams**

The most common hazard associated with ice jams is flooding upstream of the ice jam. Therefore strategies to mitigate flooding are also appropriate for mitigating the impacts of ice jams. Please see Current Mitigation Strategies for Flooding section and refer to Table 4-1: Existing Flood Hazard Mitigation Measures as well as Appendix A for complete language for same measures.

## **Manmade Hazards**

Timely, informative and accurate notification of a hazardous material emergency is critical for an effective emergency response and for the safety and protection of Greenfield's citizens. With the frequency of transportation of hazardous materials via Route 2 and railroad, the possibility exists of a catastrophic accident or spill. Strategies to plan for the evacuation of residents and for the cleanup of any chemical spill are key to hazard mitigation.

### ***Management Plans and Regulatory Measures***

The following are generic preparedness and response measures for manmade hazards listed in the Town CEM Plan, specifically hazardous materials emergencies:

- The immediate notification of the community emergency coordinator and the State is required when a release of an extremely hazardous substance or hazardous chemical in an amount above the Reportable Quantity (RQ) occurs. Specific information is required by the notification such as chemical name, method of release, health effects, medical attention and protective actions.
- The Hazardous Materials Release Report Form must be used in the event of the release of a hazardous substance
- Both local and State response personnel, including the DEP must be notified immediately of a release. The local point of contact is the local fire department through the 911 dispatch Center.

### ***Evacuation Options***

Evacuation of an incident site could be required upon the recommendation of the on-scene commander. The routes of evacuation and staging areas for the evacuees will be determined by the Incident Commander. Once the incident site has been evacuated, law enforcement officials will support expanded evacuation if required. The necessity for additional evacuation will be determined by the Incident Commander.

## **Future Mitigation Strategies**

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As part of the natural hazards mitigation planning process undertaken by the Greenfield Natural Hazards Planning Committee, existing gaps in protection and possible deficiencies were identified and discussed. The Committee then developed general goal statements and action items that, when implemented, will help to reduce risks and future damages from natural hazards. The goal statements, action items, town department(s) responsible for implementation, and the proposed timeframe for implementation for each category of natural hazard are described below. There are also several general action items that were developed.

In addition, when identifying and analyzing its comprehensive range of specific mitigation actions and projects, Greenfield's NH Planning Committee was particularly attentive to reducing the effects of each hazard on new and existing structures and infrastructure.

Several of the action items have multiple benefits because, if implemented, these action items will mitigate or prevent damages from more than one type of natural hazards. For example, updating the Subdivision Regulations to require new utility lines be placed underground will prevent property damage and loss of service in the event of high winds (tornado or hurricane), severe snow and ice storms, and mitigate the impacts of flooding and wildfires/brushfires.

### **Hazard Mitigation Goal Statements and Action Plan**

As part of the natural hazards mitigation planning process undertaken by the Greenfield Natural Hazards Mitigation Planning Committee, existing gaps in protection and possible deficiencies were identified and discussed. The committee then developed general goal statements and action items that, when implemented, will help to reduce risks and future damages from natural hazards. The goal statements, action items, Town department(s) responsible for implementation, and the proposed timeframe for implementation for each category of natural hazard are described below. There are also several general action items that were developed.

Action items from the previous plan were carried over where they were still applicable and/or where the item had not yet been completed.

## 2011 Action Plan

### Prioritization of Goals and Action Items

As part of the natural hazards mitigation planning process undertaken by the Committee, existing gaps in protection and possible deficiencies were identified and discussed. The committee then developed general goal statements and action items that, when implemented, will help to reduce risks and future damages from natural hazards. The goal statements, action items, Town department(s) responsible for implementation, and the proposed timeframe for implementation for each category of natural hazard is located in Table 4-8: 2011 Greenfield Local Natural Hazards Mitigation Prioritized Action Plan.

The Committee prioritized Mitigation Action Items by examining the results of the All Hazards Risk Assessment completed by the Committee. The All Hazards Risk Assessment is an interactive table that the Committee completed with the FRCOG staff to evaluate all the natural hazards that can impact the town based on frequency of occurrence, severity of impacts, area of occurrence and preparedness. The completed table gives the town an overall understanding of the natural hazards, provides guidance on which hazards the Town may want to focus mitigation efforts on, reaffirms that Greenfield’s planning and preparedness is on track, and shows residents that town departments and agencies are organized in case of a natural disaster. Those hazards receiving the highest Weighted Hazard Index number were assigned the highest priority as shown in Tables 4-8 and 4-9.

**Table 4-8: Weighted Hazard Index Priority Level**

Weighted Hazard Index	Priority Level
> 5	High
4.0 – 5.0	Medium
< 4.0	Low

**Table 4-9: Hazard Priority Level Rating**

Natural Hazard	Weighted Hazard Index	Priority Level
Microbursts (Includes Thunderstorms and Wind Related Events)	<b>6.8</b>	<b>High</b>
Hurricanes	<b>6.1</b>	<b>High</b>
Severe Winter Storms	<b>5.2</b>	<b>High</b>
Floods	<b>4.7</b>	<b>Medium</b>
Tornados	<b>4.4</b>	<b>Medium</b>
Earthquakes	<b>4.1</b>	<b>Medium</b>
Wildfires and Brush Fires	<b>4.0</b>	<b>Medium</b>
Landslides	<b>3.8</b>	<b>Low</b>
Ice Jams	<b>3.2</b>	<b>Low</b>
Dam Failures	<b>3.2</b>	<b>Low</b>

Because the ranking of priorities was based on the results of the All Hazards Risk Assessment, factors such as local knowledge of the frequency of occurrence of hazard events, the severity of impacts to the population, infrastructure, and the built and natural environments, the location and extent of impacts of the hazard events, and the town's preparedness to respond to hazard events were included in the prioritization process. The Committee's process also considered the anticipated benefits from the implementation of each Action Item to the population, the town's infrastructure, and to the built and natural environment. For most of the Action Items, project costs are not specifically known but there was consideration of whether or not the town currently had the technical and administrative capability to carry out the mitigation measures. Even when the political will exists to implement the Action Items, the fact remains that Greenfield is a town that relies heavily on a relatively small number of paid staff, many of whom have multiple responsibilities, and a dedicated group of volunteers who serve on town boards. The town does not have money to hire consultants and engineers to assist them with implementation of Action Items. Limited technical assistance is available from the Franklin Regional Council of Governments. However, the availability of FRCOG staff can be constrained by the availability of grant funding.

The final 2011 Greenfield Natural Local Hazards Mitigation Prioritized Action Plan is shown in Table 4-10. Potential funding sources to assist the town with implementation of the Action Item were listed. Finally, each Action Item was given an estimated completion date and assigned a responsible department or board.

With respect to Manmade Hazards, the potential for fixed facility and transportation hazardous materials accidents could be high – particularly transportation related accidents, given the proximity of Route 2 and the railroad tracks to rivers and to more densely populated areas of Town. However, no formal vulnerability assessment was done for manmade hazards due to the lack of available data to use in an appropriate assessment model. The potential for these types of manmade hazards to occur, the unknown impact of such accidents on the town's population, infrastructure, and the natural and built environment, and the lack of available and well-analyzed data make this hazard and the implementation of associated Action Items a high priority.

**Table 4-10: 2011 Greenfield Local Natural Hazards Mitigation Prioritized Action Plan**

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
HIGH PRIORITY (> 5.0 Weighted Hazard Index)							
MULTIPLE HAZARDS							
<i>To provide adequate shelter, water, food and basic first aid to displaced residents in the event of a natural disaster.</i>							
		Identify existing shelters that are equipped with an auxiliary power supply and/or are earthquake resistant. Disseminate this information to appropriate town departments.	Emergency Management Director, Building Inspector, Public Works	P	Town	January 2005	
		Identify potential locations for new shelters, in particular, buildings that are equipped with an auxiliary power supply and/or are earthquake resistant. Disseminate this information to appropriate town departments.	Emergency Management Director, Building Inspector, Public Works	P	Town	January 2005	
		Inventory supplies at existing shelters. Establish arrangements with local or neighboring vendors for supplying shelters with potable water, food and first aid supplies in the event of a natural disaster.	Emergency Management Director, Public Works, Planning Department, Fire Department, Police Department	P	Town	January 2006	
		Purchase generators for the DPW and emergency back-up generators for all emergency facilities.	Planning Department, Department of Public Works	P, I	MEMA, FEMA		
<i>To ensure adequate communication and coordination among all emergency personnel in the event of a natural disaster.</i>							
		The Natural Hazards Mitigation Planning Committee will	Emergency Management Director, Greenfield Natural Hazards	B, N, P, I	Town	June 2005	

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		collaborate with appropriate state and local partners to integrate relevant Action Items from this plan into the Greenfield Comprehensive Emergency Management Plan.	Mitigation Planning Committee				
		Purchase equipment to assist with tree removal and debris associated with a hazard or disaster.	Department of Public Works	B, I			
		Identify sites for city-wide or regional debris disposal and processing.	Planning Department, Department of Public Works	B, I			
		Review strategies for animal control and sheltering during and after a disaster or hazard.	Planning Department, Department of Public Works	P, I	MEMA, FEMA		
<i>To provide adequate notification and information regarding evacuation procedures, etc., to residents in the event of a natural disaster.</i>							
		Investigate the feasibility of a Reverse 911 system for the Town of Greenfield. Develop a preliminary project proposal and cost estimate.	Police Department, Fire Department, Public Works	P	Town	June 2005	
		Collect, periodically update, and disseminate information on local radio stations and Greenfield Cable Television regarding fire safety, 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	Police Department, Fire Department, Public Works	P	Town	This action has been implemented and will continue over the next 5 years.	This action has been implemented and will continue over the next 5 years.

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		during a natural disaster.					
<b>MICROBURSTS (INCLUDES THUNDERSTORMS AND WIND-RELATED EVENTS) – These action items could also apply to thunderstorms, hurricanes and tornados</b>							
	<i>To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to microbursts.</i>						
		Review and update Section 200-7.14 of the Greenfield Zoning Ordinance that regulates wireless communication facilities. Consider adding “safety” and “the prevention of wind-related damage” as one of the purposes of the Ordinance.	Planning Department	B, P	Town	December 2011	Still relevant
		Enforce the State Building Code to ensure new buildings are designed to withstand high winds.	Building Inspector	B, P	Town	This action has been implemented and will continue over the next 5 years.	Yes, still relevant
		Encourage the construction of new homes with basements or crawl spaces to provide shelter during a tornado, hurricane or other storm event with high winds.	Building Inspector	B, P	Town	This action has been implemented and will continue over the next 5 years.	Yes, still relevant
		Review and update the Subdivision Regulations. Special consideration should be given to requiring that new utilities be placed underground.	Planning Department	I	Town	Complete	Revised Subdivision Regulations were adopted by the Planning Board on 11/21/08.
Since the town rated microbursts as the highest hazard, what are some current or future action items the town is or should be undertaking?							

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
<b>HURRICANES</b>							
	<i>To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to hurricanes and tropical storms.</i>						
		See action items related to microbursts (above)	N/A	N/A	N/A	N/A	N/A
<b>SEVERE WINTER STORMS</b>							
	<i>To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to severe winter storms.</i>						
		Review and update the Subdivision Regulations. Special consideration should be given to requiring that new utilities be placed underground.	Planning Department	P, I	Town	Complete	Revised Subdivision Regulations were adopted by the Planning Board on 11/21/08.
Any new Action Items related to Severe Winter Storms?							
<b>MANMADE HAZARDS</b>							
		Research appropriate vulnerability assessment models for fixed facility and transportation hazardous materials accidents, collect relevant data, and populate model to further prioritize manmade hazard action items.	Emergency Management Director, FRCOG	B, N, P, I	FEMA		New Action Item.
		Develop an evacuation plan and notification system in the event of a chemical spill in a fixed structure or in a transportation setting such as Route 2 or the railroad.	Emergency Management Director	P	FEMA		New Action Item.

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		Seek technical assistance to ensure annual update of Town of Greenfield CEM Plan.	Emergency Management Director, Planning Department	B, N, P, I	FEMA		New Action Item.
<b>MEDIUM PRIORITY (4.0 – 5.0 Weighted Hazard Index)</b>							
<b>FLOODS</b>							
<i>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 flooding.</i>							
		Replacement and rehabilitation of the existing Maple Brook Culvert in North and Maple Streets.	Department of Public Works	I			
		Review and update the Floodplain District Overlay Zoning Ordinance. Special consideration should be given to further restricting or eliminating new development within the 100-year floodplain.	Planning Department	B, N		2011	Not yet started. Still relevant.
		Using Assessors' data and other available information expand and update the Vulnerability Assessment for properties located within the 100-year floodplain.	Planning Department, Greenfield Natural Hazards Mitigation Planning Committee	B, P		2011	Not yet started. Still relevant.
		As appropriate, consider adding flood prevention and mitigation to the Purpose Section of the Land Use regulations reviewed in Section 4 and noted in Table 4-1 of this report.	Planning Department	B, P		2011	Not yet started. Still relevant.
		Review evacuation procedures for the flood prone areas in town (identified on the map)	Police Department, Fire Department	P		June 2005	

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		and mapped dam failure Inundation Areas, and update, if necessary.					
		Coordinate with state and regional agencies to identify a location(s) for the temporary storage of contaminated and/or hazardous flood debris.	Department of Public Works, Planning Department, Franklin County LEPC	N		2012	Not yet started. Still relevant.
		Support local and regional, watershed-wide open space protection efforts, particularly in floodplain areas.	Planning Department, Town Council	N		This action has been implemented and will continue over the next 5 years.	This action has been implemented and will continue over the next 5 years.
<b>TORNADOS</b>							
	<i>To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to tornados.</i>						
		See microburst-related Action Items above	N/A	N/A	N/A	N/A	N/A
<b>WILDFIRES /BRUSH FIRES</b>							
	<i>To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to wildfires/brushfires.</i>						
		Encourage forest stewardship practices that produce more stable, successional forested landscapes and which reduce the risk of fire hazards (such as the removal of slash).	Conservation Commission, Planning Department, Fire Department	N, P		This action has been implemented and will continue over the next 5 years.	This action has been implemented and will continue over the next 5 years.
		Educate homeowners about general fire safety when issuing burn permits.	Fire Department	N, P		This action has been implemented and will continue over the next 5 years.	This action has been implemented and will continue over the next 5 years.

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		West Side Water Distribution Tank and 20-inch Main. This project would construct a 3.5 million gallon water storage tank on the west side of town off of Gorge Road and a 20-inch water transmission main to Main Street to address poor pressures and flows (especially critical for firefighting) as well as provide a backup for the Rocky Mountain Storage tank. This project has been identified as an infrastructure need in Master Plans written for the town since the 1970's.	Department of Public Works	I		Date?	
<b>EARTHQUAKES</b>							
	<i>To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to earthquakes.</i>						
		Town Departmental Review of Critical Facilities: The Town should review its municipal buildings and structures to determine if they are particularly vulnerable to earthquake damage and determine if any retrofitting measures could mitigate this vulnerability.	Building Inspector, Department of Public Works, Planning Department	B		June 2007	
		Ensure Compliance with the Massachusetts State Building Code: The Building Inspector should ensure that all new construction complies with the appropriate	Building Inspector	B		This action has been implemented and will continue over the next 5 years.	This action has been implemented and will continue over the next 5 years.

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		seismic requirements of the State Building Code.					
LOW PRIORITY (< 4.0 Weighted Hazard Index)							
LANDSLIDES							
	<i>To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to landslides.</i>						
		Town Departmental Review of Local Roads, State Highways and Interstates: The Town should review its roadway system to determine if they are particularly vulnerable to landslide damage and determine if any retrofitting measures of rock cuts could mitigate this vulnerability.	Department of Public Works, Planning Department	I		August 2010	
		Town Departmental Review of River and Stream Embankments: The Conservation Commission should identify and report on unstable embankments.	Conservation Commission, Planning	N		In last plan but no completion date listed	
Any new action items related to landslides, especially in light of recent Green River Cemetery issue?							
ICE JAMS							
	<i>To minimize the loss of life, damage to property, infrastructure and natural resources, and the disruption of governmental services and general business activities due to ice jams and associated flooding.</i>						
		See Floods section for related Action Items	N/A	N/A	N/A	N/A	N/A

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
<b>DAM FAILURES</b>							
	<i>To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to dam failures.</i>						
		The Mill and Meridian Street Dams were identified by the Committee as possibly being in poor condition. Both should be inspected as soon as possible.	Department of Public Works, Planning Department, Town Engineer	P, I		December 2005	
		The Town Engineer, the Department of Public Works and other relevant Town officials should review the dams, their inundation areas, and recent (if available) inspection reports to determine if any dams should be inspected or re-inspected.	Department of Public Works, Planning Department, Town Engineer	P, I		December 2005	
		Map Dams and Inundation Areas. The Town of Greenfield should prepare a GIS map that shows the location of all dams in the town and immediately upstream of the town's borders and the areas that are likely to be flooded in the event of a dam failure. This map should include the Inundation Areas for the US GEN High Hazard dams on the Deerfield River. All public safety officials in the Town should be made aware of the map.	Emergency Management Director, Department of Public Works, Planning Department	P, I		December 2012	Not started – still relevant.
		Incorporate Dam Safety into Development	Department of Public Works, Planning	B, N, P, I		December 2012	Not started – still relevant.

Hazard	Goal	Action Item	Responsible Department / Board	Benefits What Areas Primarily? Built (B), Natural (N), Population (P), Infrastructure (I)	Potential Funding Source	Estimated Completion Date	Status
		Review. The Planning Department, Planning Board, and Zoning Board of Appeals should consult the Dam and Inundation Areas map during their review of major development proposals, especially subdivisions. If there is a dam upstream of a proposed development, the dam should be inspected prior to the start of construction to ensure that the dam is safe. Consider incorporating this requirement into the zoning Ordinance as a Dam Safety Overlay district.	Department, Planning Board, Zoning Board of Appeals				
		Identify locations for emergency shelters and evacuation routes for people who live in an inundation area.	Police Department, Fire Department, Planning Department	P		December 2012	Not started – still relevant.
		See Floods section for additional Action Items	N/A	N/A	N/A	N/A	N/A

## **National Flood Insurance Program Compliance**

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The U.S. Congress established the National Flood Insurance Program (NFIP) in 1968, with the passage of the National Flood Insurance Act of 1968. “For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, seawalls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses, nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

“In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.”<sup>40</sup>

The State of Massachusetts, through its local communities,<sup>41</sup> complies with the NFIP in part by enforcing the Wetlands Protection Act (WPA), which helps restrict development in flood-prone areas, enforcing the State Building Code, which regulates building specifications and additional related zoning bylaws, such as a floodplain overlay district. At the local level, Greenfield’s compliance with the NFIP is enforced through the building inspector and building code, the Conservation Commission and wetland and floodplain regulations, and the zoning bylaws and subdivision regulations related to flooding. While the local building code cannot be more restrictive than the state building code, the local Conservation Commission can restrict development above and beyond the requirements in the WPA. The ability of the Conservation Commission to further regulate development in flood prone areas could be a crucial tool in flood mitigation. In addition, the ability of the Select Board to adopt further bylaws such as a floodplain overlay district could also mitigate flooding.

The Town of Greenfield participates in the National Flood Insurance Program. As of 2010, there were 48 policies in effect in Greenfield for a total of \$10,284,700 worth of insurance. FEMA has not identified any repetitive flood loss structures in the Town of Greenfield. The Town is not a member of the Community Rating System, which entitles policyholders to a discount on flood insurance premiums. The CRS ranking is based on the steps the town has taken to control flood losses. See pages 122-124 for more information on NFIP.

### ***NFIP Community Rating System (CRS)***<sup>42</sup>

The town is not a member of the NFIP Community Rating System, which entitles policyholders to a discount on flood insurance premiums. The Community Rating System is a part of NFIP and provides incentives and tools to further these goals. The goals of the CRS are to recognize, encourage, and reward, by the use of flood insurance premium adjustments, community and state activities beyond the minimum required by the NFIP that:

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<sup>40</sup> <http://www.fema.gov/library/viewRecord.do?id=1404>

<sup>41</sup> Massachusetts is a Home Rule state, the local communities have significant power and authority to implement state regulations and many towns adopt their own wetland and floodplain regulations that are more stringent than state requirements.

<sup>42</sup> <http://training.fema.gov/EMIWeb/CRS/>

- Reduce flood damage to insurable property,
- Strengthen and support the insurance aspects of the NFIP, and
- Encourage a comprehensive approach to floodplain management.

The Community Rating System reduces flood insurance premiums to reflect what a community does above and beyond the National Flood Insurance Program's (NFIP) minimum standards for floodplain regulation. The objective of the CRS is to reward communities for what they are doing, as well as to provide an incentive for new flood protection activities. It provides lower insurance premiums under the National Flood Insurance Program. The premium reduction is in the form of a CRS Class, similar to the classifications used for fire insurance. For example, a Class 1 provides a 45% premium reduction while a Class 10 provides no reduction. The CRS Class is based on the floodplain management activities a community implements. In many cases, these are activities already implemented by the community, the state, or a regional agency. The more activities implemented, the better the CRS class.

Benefits of participating in the Community Rating System:

- Money stays in the community instead of being spent on insurance premiums.
- Every time residents pay their insurance premiums, they are reminded that the community is working to protect them from flood losses, even during dry years.
- The activities credited by the CRS provide direct benefits to the community, including:
  - Enhanced public safety,
  - Reduction in damage to property and public infrastructure,
  - Avoidance of economic disruption and losses,
  - Reduction of human suffering, and
  - Protection of the environment.
- Local flood programs will be better organized and more formal.
- The community can evaluate the effectiveness of its flood program against a nationally recognized benchmark.
- Technical assistance in designing and implementing some activities is available at no charge.
- The community will have an added incentive to maintain its flood programs over the years.
- The public information activities will build a knowledgeable constituency interested in supporting and improving flood protection measures.

Costs to the local government to participate in the Community Rating System:

- The community must designate a CRS Coordinator who prepares the application papers and works with FEMA and the Insurance Services Office (ISO) during the verification visit.
- Each year the community must recertify that it is continuing to implement its activities. It must provide copies of relevant materials (e.g., permit records).
- The community must maintain elevation certificates, permit records, and old Flood Insurance Rate Maps forever.
- The community must maintain other records of its activities for five years, or until the next ISO verification visit, whichever comes sooner.

### ***Community Rating System Process***

One of the actions that Greenfield can take to improve their CRS rating (and subsequently lower their premiums) is to develop a CRS plan. The CRS 10-step planning process provides additional points for activities that communities can take during their planning process that go above the minimum described below, thus possibly lowering insurance rates. At a minimum, an *approved* multi-hazard mitigation plan that addresses floods could qualify for CRS credit. Although communities are not required to participate in CRS in order to receive approval of a Local Natural Hazards Mitigation Plan, FEMA encourages jurisdictions to integrate the CRS planning steps into their multi-hazard mitigation plans.

Credit is provided for preparing, adopting, implementing, evaluating, and updating a comprehensive floodplain management plan or repetitive loss area analyses. The Community Rating System does not specify what must be in a plan, but it only credits plans that have been prepared and kept updated according to CRS standard planning process. Credit is also provided for implementing a habitat conservation plan.

### ***Community Rating System Credit Points***<sup>43</sup>

A total of up to 359 points are provided for three elements. Up to 294 points are provided for adopting and implementing a floodplain management plan (FMP) that was developed using the following standard planning process. There must be some credit for each of the 10 planning steps (Table 4-11).

**Table 4-11: CRSC Standard Planning Process Steps**

<b>Step</b>	<b>Maximum Points</b>
1. Organize to prepare the plan	10
2. Involve the public	85
3. Coordinate with other agencies	25
4. Assess the hazard	20
5. Assess the problem	35
6. Set goals	2
7. Review possible activities	30
8. Draft an action plan	70
9. Adopt the plan	2
10. Implement, evaluate, and revise	15

Up to 50 additional points are provided for conducting repetitive loss area analyses (RLAA) and up to additional 15 points are provided for adopting and implementing a Habitat Conservation Plan (HCP).

More information is available at <http://www.fema.gov/business/nfip/crs.shtm>. A copy of the “Local Official’s Guide to Saving Lives, Preventing Property Damage, and Reducing the Cost of Flood Insurance” is including in the Appendix of this plan or can be downloaded at <http://www.fema.gov/library>.

<sup>43</sup> FEMA Local Multi-Hazard Mitigation Planning Guidance, July 1, 2008.

## 5 – PLAN ADOPTION AND MAINTENANCE

### **Plan Adoption**

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The Franklin Regional Council of Governments (FRCOG) provided support to the Greenfield Local Natural Hazards Mitigation Planning Committee as they underwent the planning process. Town officials such as the Planning Department Director and Emergency Management Director were invaluable resources to the FRCOG and provided background and policy information and municipal documents, which were crucial to facilitating completion of the plan.

When the preliminary draft of the Local Natural Hazards Mitigation Plan was completed, copies were disseminated to the Greenfield Local Natural Hazards Mitigation Planning Committee for comment and approval. The Committee was comprised of representatives of Town boards and departments who bear the responsibility for implementing the action items and recommendations of the completed plan.

Copies of the Final Draft Local Natural Hazards Mitigation Plan for the Town of Greenfield were distributed to the Town boards and to Northfield Mountain Facility for their review and comment. A copy of the plan was also posted on the town website for public review. Once reviewed and approved by MEMA, the plan was sent to the Federal Emergency Management Agency (FEMA) for their approval. On \_\_\_\_\_, the Select Board voted to adopt the plan.

The implementation of the Greenfield Local Natural Hazards Mitigation Plan will begin following its approval by MEMA and FEMA and formal adoption by the Greenfield Select Board. Specific Town departments and boards will be responsible for ensuring the development of policies, bylaw revisions, and programs as described in Table 4-9: 2011 Greenfield Local Natural Hazards Mitigation Prioritized Action Plan. The Greenfield Natural Hazards Mitigation Planning Committee will oversee the implementation of the plan.

### **Monitoring, Evaluating, and Updating the Plan**

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The measure of success of the Greenfield Local Natural Hazards 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 the general public.

The Greenfield Natural Hazards Planning 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 may decide to reassign the roles and responsibilities for implementing mitigation strategies to different Town departments 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 2014. The meetings of the committee will be organized and facilitated by the staff of the Greenfield Town Administrator. Increasing committee membership to include entities such as

the Planning Board and the Conservation Commission could help improve the completion rate of action items.

As is the case with many Franklin County towns, Greenfield’s government relies on few public servants filling many roles, upon citizen volunteers and upon limited budgets. As such, implementation of the recommendations of this plan could be a challenge to the Committee. As the Committee meets regularly to assess progress, it should strive to identify shortfalls in staffing and funding and other issues which may hinder Plan implementation. The Committee should seek technical assistance from the Franklin Regional Council of Governments to help alleviate some of the staffing shortfalls. The Committee could also seek assistance and funding from such sources as are listed in Table 5-1.

**Table 5-1: Potential Funding Sources for Hazard Mitigation Plan Implementation**

<b>Funding Source</b>	<b>Description</b>	<b>Estimated Annual Funding</b>
Hazard Mitigation Grant Program	Provides post-disaster funds to communities to help implement long-term hazard mitigation strategies.	\$15M (from three past Presidential disaster declarations)
Flood Mitigation Assistance Program	Provides pre-disaster funds. There are three types of grants: planning grants, project grants, and technical assistance grants. Requires a 25% non-Federal match and is based on the total number of NFIP policies in the State.	\$500,000
Community Development Block Grant	Although this funding comes from HUD, it is made available to communities through the State Economic and Community Development Administration. The grants are used to expand affordable housing and economic opportunities, and to revitalize communities by improving community facilities and services.	\$2M
SBA Small Business Administration	Post-disaster low interest, long-term loans given to homeowners, renters, businesses, or private non-profit organizations. Up to 20% of the loan amount can be used for hazard mitigation actions.	\$500,000 (based on past disasters)
State Office for Mitigation Funding	This newly created State Office was authorized by a recent act of the State Legislature. This Office will make funds available to local communities for hazard mitigation planning through an increase in the State’s gasoline tax.	\$5M
Manufactured Homebuilders Association	The State is interested in forming an agreement with this association to develop an earthquake-resistant homes campaign.	In-kind services
National Association of Homebuilders	The State is pursuing a relationship with this association and is discussing how the association can assist the State in promoting construction of safe rooms.	In-kind services

**Incorporating the Plan into Existing Planning Mechanisms**

Upon approval of the Greenfield Local Hazards Mitigation Plan by FEMA, the Committee will provide all interested parties and implementing departments with a copy of the plan, with emphasis on Table 4-9: 2011 Greenfield Local Natural Hazards Mitigation Prioritized Action Plan. The committee should also consider initiating a discussion with each department on how the plan can be integrated into that department’s ongoing work. At a minimum, the plan should be distributed to and reviewed with the following entities:

- a. Fire Department
- b. Emergency Management Director

- c. Police Department
- d. Public Works / Highway Department
- e. Planning Board
- f. Zoning Board of Appeals
- g. Conservation Commission
- h. Franklin County Regional Emergency Planning Committee
- i. Building Inspector
- j. Select Board

Incorporating the Greenfield Local Natural Hazards Mitigation Plan into existing and future planning mechanisms could help ensure its success and implementation. Some possible planning mechanisms could include:

- Incorporation of relevant Hazards Mitigation information into the Open Space and Recreation Plan. There are opportunities to discuss findings of the hazard mitigation plan and incorporate them into Environmental Inventory and Analysis section of the OSRP and to include appropriate action items from the hazard mitigation plan in the OSRP Action Plan.
- When the Final Draft Local Natural Hazards Mitigation Plan for the Town of Greenfield is distributed to the Town boards for their review, a letter asking each board to endorse any action item that lists that board as a responsible party would help to encourage completion of action items.
- The Planning Board could include discussions of the Hazards Mitigation Plan Action Items in one meeting annually and assess progress.

## 6 – APPENDIX

### Appendix A: Zoning Bylaws and Subdivision Regulations

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#### Zoning Bylaws (Excerpts)

##### Floodplain Zoning Ordinance: Section 200-4.1:

Floodplain Overlay district. Greenfield's Zoning Ordinance, last amended October 20, 2010 establishes a Floodplain Overlay District (Section 200-4.13) for "the purposes of protecting the public health, safety, and general welfare, to protect human life and property from the hazards of periodic flooding, to reduce the public costs resulting from flood damage, to preserve the natural flood control characteristics and the flood storage capacity of the floodplain, and to preserve and maintain the groundwater table and ground water recharge areas within the floodplain." Specifically, the Ordinance requires that:

Permitted Uses (Section 200-4.13.E) in the Floodplain Overlay District include the following uses with low flood damage potential and causing no obstructions to flood flows shall be allowed in the 100-year floodplain provided they are permitted in the underlying district and they do not require structures, fill, or storage of materials or equipment:

1. Agricultural uses such as farming, grazing, truck farming, horticulture, etc;
2. Forestry and nursery uses;
3. Outdoor recreational uses, including fishing, boating, play areas, etc;
4. Conservation of water, plants, wildlife;
5. Wildlife management areas, foot, bicycle, and horse paths;
6. Temporary nonresidential structures used in connection with fishing, growing, harvesting, storage, or sale of crops raised on the premises;
7. Buildings lawfully existing prior to the adoption of these provisions;
8. Installation of utility, sewer or septic systems, water supplies and production, and water lines provided the Department of Public Works is satisfied that there is adequate protection against breaking, leaking, short-circuiting, grounding, igniting, or floating during flooding;
9. The portion of any lot within the Floodplain District may be used to meet the lot area or yard requirements for the district in which the remainder of the lot is located.

The following are uses in the Floodplain Overlay District requiring Special Permits (Section 200-4.13.F). No encroachment shall be permitted within the 100-year floodplain as shown on the FIRM Maps unless a special permit is granted by the Zoning Board of Appeals. Encroachment shall include:

1. Structures or buildings erected, constructed, or otherwise created or moved;
2. Reconstruction or repair due to flood damage and improvement or expansion of any building or structure lawfully existing prior to the adoption of these provisions;
3. Storage, dumping, filling, excavation, disposal or transfer of earth or other material;

4. Installation of driveways or roads to serve areas outside the floodplain district where other access is not feasible.

The following are uses in the Floodplain Overlay District that are Prohibited (Section 200-4.13.I). No encroachment shall be permitted in the floodway as shown on the FBFM Maps, and the following uses are prohibited in the 100-year floodplain:

Solid waste landfills, junkyards, dumps;

1. The manufacture, storage, or disposal of hazardous, toxic, or radioactive wastes;
2. The temporary or permanent storage or disposal of materials used in snow and ice control including sand, salt or other deicing chemicals;
3. The outdoor storage or placement of storage tanks, above or below ground, for petroleum products or other hazardous material;
4. The storage, dumping, filling, dredging, excavation, disposal, transfer, or removal of earth or other material except as permitted by special permit under this provision.

#### Performance Standards Section 6.8

The purpose of the Zoning Ordinance Performance Standards, amended in July of 2009, is “to ensure that any use allowed by right or special permit in any district is conducted in a manner which does not adversely affect the surrounding natural or human environment by creating a dangerous, injurious or objectionable condition.” One of the standards (6.8.8 A) directly addresses the impacts of uncontrolled surface water runoff and sedimentation as follows:

- Whenever the existing contours of the land are altered; grading, site design, and construction shall be designed to prevent soil erosion, sedimentation, uncontrolled surface water runoff or alteration of runoff to or from abutting properties. The primary reasons for having erosion and sedimentation control measures in place are to:
  - Prevent topsoil from migrating off a construction site,
  - Protect the Town’s streets and storm water systems,
  - Protect adjacent property from siltation, and
  - Protect fish and other wildlife from siltation of ponds, lakes, streams and rivers.
- Procedure:
  - These standards shall pertain to all building sites under new construction or redevelopment. The applicant shall submit an erosion and sedimentation control plan to the Inspector of Buildings for approval. If Site Plan Review and Approval is required under the Greenfield Zoning Ordinance, an erosion and sedimentation control plan shall be submitted to the reviewing authority along with all other submittal requirements.
  - The Inspector of Buildings or any of his designees shall conduct a site visit to ensure that all temporary erosion and sedimentation control measures required under this policy are properly installed prior to and maintained throughout construction. Failure to comply with these standards may result in a stop work order or the revocation of permits.
  - Erosion of soil and sedimentation shall be minimized by using the following erosion control standards, which are in addition to any erosion control measures required by the Greenfield Conservation Commission as part of the issuance of a

wetland related permit (Negative Determination of Applicability with Conditions or an Order of Conditions).

- Temporary erosion control measures shall be installed for the following:
  - All construction areas that slope toward the road or an abutting property shall require a properly installed siltation fence and/or baled hay barrier to prevent siltation of the roadway or neighboring property.
  - All wetland areas shall be protected by a properly installed siltation barrier. Work that occurs in or within 100 feet of a wetland resource area or within 200 feet of a perennial river or stream requires filing with the Greenfield Conservation Commission. In areas outside the jurisdiction of the Conservation Commission but where the ground slopes toward a wetland area, a properly installed siltation fence and/or baled hay barrier shall be required.
  - Stockpiles of loam shall be protected by a siltation fence and/or baled hay barrier. Stockpiles that remain on site for longer than 30 days shall also be seeded to prevent erosion. These measures shall remain until all material has been placed or disposed off site.
  - The smallest practical area of land shall be disturbed at any one time.
  - The duration of exposure of disturbed areas due to stripping of vegetation, soil removal, and regarding shall be kept to a minimum.
  - Baled hay barriers and siltation fencing are to be maintained and cleaned until all slopes have a healthy stand of grass or other approved vegetation.
  - Baled hay and mulch shall be mowings of acceptable herbaceous growth, free from noxious weeds or woody stems. No salt hay shall be used.
  - All disturbed areas shall be loamed and seeded with grass or other approved vegetation.
  - After all disturbed areas have been stabilized, the temporary erosion control measures are to be removed. Disturbed areas resulting from removal of the temporary erosion control measures shall be repaired and seeded.
  - A temporary mud tracking bed (construction entrance) shall be put in place at each site entrance where necessary. This tracking bed shall consist of a four (4) inch minimum layer of 1 ¾ inch crushed stone and shall be a minimum of twenty (20) feet in length and fifteen (15) feet in width. This bed shall be maintained during construction to prevent tracking or flowing of sediment onto the public right-of-way and shall be removed prior to the placement of a gravel base and pavement.
  - It shall be the responsibility of the contractor to control blowing dust and soil. Dust control shall be used during grading operations if the grading is to occur within five hundred (500) feet of an occupied residence or place of business and may consist of grading fine soils on calm days only or dampening the ground with water.
  - Permanent erosion control and vegetative measures shall be in accordance with the Erosion and Sediment Control and Vegetative Practices in Site Development Guides published by the U.S. Department of Agriculture, Natural Resources Conservation Service.

- The construction of roads or structures on slopes of fifteen (15) percent or greater shall require a special permit from the Planning Board. Such permit shall only be granted if the Board finds that adequate provisions have been made to protect against soil erosion and sedimentation, soil instability and uncontrolled surface water runoff.

#### Open Space/Cluster Developments Section 200-7.1

The Zoning Ordinance Open Space/Cluster Developments Part A, amended in May of 2007 lists as its purpose in part the following:

- Promotes a more efficient use of land in harmony with its natural features
- Encourages a less sprawling form of development that consumes less open land
- Encourages the permanent preservation of open space, agricultural lands and other natural resources

This type of residential development can preserve larger areas of undeveloped land which in turn could reduce the impacts of stormwater runoff. The Common Open Space Requirements (Section 200-7.1 H) require that preserved open space shall be at least twenty-five (25) percent of the total land area of the tract not including wetlands, floodplains and slopes in excess of twenty-five (25) percent. In addition, “[a]t least one-half (1/2) of the open space shall be shaped for land uses such as recreation and agriculture.”

#### Earth Removal, Section 200-7.4

Any removal of earth products shall be undertaken only in accordance with the Soil Removal regulations (Chapter 154 of the Town of Greenfield Code) require that a license be issued by the Greenfield Selectmen prior to the removal of soil, loam, sand or gravel from land not in public use except in conjunction with construction of a building, landscaping activities, or the continued operation of an existing sand and gravel pit. The Soil Removal regulations do not mention flood prevention or mitigation.

#### Major Development Review, Section 200-7.12

According to this section, amended in May 2006, the purpose of this ordinance is to identify and attempt to mitigate potential negative impacts to the City of Greenfield, such as to Town services, traffic patterns, the environment, abutting properties, or the public health and safety, caused directly or indirectly by major development.

#### Site Plan Review and Approval (Section 200-8.4)

The Site Plan Review and Approval section of the Greenfield Zoning Ordinance specifically mentions flooding and requires mitigating potential impacts from flooding. The purpose of the Site Plan Review and Approval section of the Greenfield Zoning Ordinance is to ensure that new development reasonably protects the visual, environmental and aesthetic qualities of the neighborhood and the Town. Site plan review and approval is required for all uses that require a Special Permit, any business, commercial, industrial or institutional use (except certain home occupations) and any site containing more than one (1) principal use. The applicant must submit information regarding the measures to:

- Prevent pollution of surface and groundwater, increased runoff, changes in groundwater levels, and flooding.
- Control measures to prevent erosion and sedimentation during and after construction and the sequence of grading and construction activities, location of temporary control measures, and final stabilization of the site.

Approval guidelines that the Planning Board uses include:

- Provision for integrating the project into the existing terrain and surrounding landscape by minimizing use of wetlands, steep slopes, and hilltops; protecting visual amenities and scenic views; preserving unique natural or historical features; minimizing tree, vegetation and soil removal; and minimizing grade changes;
- Provisions for surface runoff and drainage which protects the site and adjacent properties from erosion, maximizes groundwater recharge, and prevents the collection of surface runoff on paved surfaces which may obstruct pedestrian or vehicular flow;
- Measures to prevent pollution of surface or groundwater, and to prevent increased flooding;

Section 200-7.14 of the Greenfield Zoning Ordinance regulates wireless communications facilities. The Ordinance does not mention safety as one of the purposes of the Ordinance. However, the Ordinance does require a special permit from the Zoning Board of Appeals and a building permit from the Inspector of Buildings before a facility can be erected and the applicant must provide plans for anchoring and supporting the structure. The Ordinance also establishes a “fall zone” for the structure in relation to property lines and road right-of-ways. The Ordinance does not prohibit the construction of wireless communications facilities within flood-prone areas.

### **Subdivision Rules and Regulations (Excerpts)**

Greenfield’s Subdivision Rules and Regulations (Chapter 880) were adopted on May 29, 1984 – and subsequently amended on November 21, 2008 – for the purpose of “protecting the safety, convenience and welfare of the inhabitants of Greenfield by regulating the laying out and construction of ways in subdivisions providing access to the several lots therein, but which have not become public ways, and ensuring sanitary conditions in the subdivisions and, in proper cases, parks and open areas.” The Planning Board and Board of Appeals shall exercise their powers to secure the safety of residents in the case of fire, flood, panic and other emergencies and to ensure adequate drainage for the subdivision.

The Subdivision Rules and Regulations contain several provisions that mitigate the potential for flooding, including:

- Section 880-9.B Definitive Plan Submission Requirements requires the proponent to:
  - Proposed layout (including cross sections and profiles) of sewerage, storm drainage and water supply, including invert elevations, slopes, capacity, and velocity.
  - Indication of all areas believed to be subject to control under the Wetlands Protection Act, MGL c. 131, § 40, under procedures outlined at 310 CMR 10.00.

- Stormwater management plan in compliance with the provisions of Chapter 695 of the Greenfield Code
- An erosion control plan, indicating the erosion control measures to be employed, including description of locations of temporary stockpiles, spoil areas, temporary drainage systems, slope stabilization techniques, sediment basins, etc., and narrative description of how erosion from individual lots onto streets and into drainage systems is proposed to be controlled. Review comments on the plan by the Conservation Commission and by the Soil Conservation Service or by others acceptable to the Board as expert in soil erosion. Any site disturbing more than one (1) acre must have a detailed Storm Water Pollution Prevention Plan (SWPPP) and an Erosion Control Plan submitted to and approved by the EPA or its designee in accordance with EPA's NPDES Phase II regulations.
- Section 880-9.E Wetlands Protection Act.
  - (1) In accordance with MGL c. 131, § 40, no person shall remove, fill, dredge or alter any bank, beach, dune, flat, marsh, meadow or swamp bordering on any existing creek, river, stream, pond, lake or any land under said waters or subject to flooding without filing a written notice of intention to perform said work with the local Conservation Commission and the Department of Environmental Protection.
  - (2) In order to determine if the proposed subdivision, or parts thereof, are subject to the provisions of the Wetlands Protection Act, the Planning Board will, where it deems necessary, submit a copy of the definitive plan to the Conservation Commission. The Conservation Commission shall, to the extent practicable, file a report with the Planning Board not later than forty-five (45) days after receipt of the plan stating that the proposed plans are not subject to the provisions of the Wetlands Protection Act, or the Wetlands Protection Act applies to certain designated areas. In the event the plan shall be governed by said Act, the Planning Board shall include in its decision for approval a condition that the applicant shall obtain approval from the Conservation Commission prior to any construction activity in the affected areas.
- Section 880-10. Design Requirements states, in part, that all subdivisions shall be designed to reduce, to the extent reasonably possible:
  - Volume of cut and fill;
  - Area over which existing vegetation will be disturbed, especially if within 200 feet of a river, pond, or stream, or having a slope of more than 15%;
  - Number of mature trees removed;
  - Extent of waterway altered or relocated;
  - Erosion and siltation; and
  - Flood damage.
- Section 880-11. Open Space, Section 880-12. Protection of Natural Features, and Section 880.13. Easements contain design requirements that can reduce the potential for flooding. However, the prevention of flooding is not explicitly stated as a purpose for these requirements.

- Section 880-14. Environmental Assessment. A comparative environmental assessment may be required for any subdivision creating frontage of ten (10) or more dwelling units within one thousand (1,000) feet of a perennial river or stream as defined by the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00). The scope of such assessment, including development alternatives to be compared and consequences to be studied, shall be as agreed to by the Planning Board and may be required to include up to two (2) major alternatives to the plan proposed including a cluster version, with as much of the following information as determined by the Planning Board to be necessary for plan evaluation; and shall be prepared by an interdisciplinary team to include a land surveyor, civil engineer, and an architect or landscape architect, unless otherwise agreed to by the Planning Board.
  - Narrative discussion of differences among alternatives regarding, in part, the following:
    - Impact upon surface water quality and level;
    - Impact upon ground water quality and level;
    - Material effects upon important wildlife habitats, outstanding botanical features, and scenic or historic environs;
    - Capability of soils, vegetative cover, and proposed erosion control efforts to support proposed development without danger of erosion, silting, or other instability;
    - Relationship to the requirements of MGL c. 131, §§ 40 and 40A (the Wetlands Protection Act).
    - Estimated phosphate and nitrate loading on ground water and surface water from septic tanks, lawn fertilizer, and other activities within the development.
  - Discussion of impact on a waterway of a subdivision with topographical features of more than thirty (30) feet above said waterway.
- Section 880-16. Flood Hazard Areas. Any portion of a proposed subdivision which is located within the 100-year floodplain as shown on the Town of Greenfield Flood Insurance Rate Maps (FIRM) together with the Flood Boundary and Floodway Maps contained in the Flood Insurance Study shall meet the following requirements:
  - All requirements of § 200-4.13 Floodplain District (F) of the Greenfield Zoning Ordinance.
  - The subdivision, including utilities and drainage, shall be designed to be consistent with the needs to minimize flood damage and provide adequate drainage.
  - Subdivisions shall include base flood elevation data.

Section 3.1.2 Design Standards of the Town of Greenfield Subdivision Rules and Regulations set grade limits on streets, which, although not specified as weather hazard mitigation, can serve to minimize the potential for motor vehicle accidents during severe winter storms (i.e., reduce road icing).

- Vertical grades should not exceed six (6) percent for primary roads and ten (10) percent for secondary roads; and

- Horizontal alignment must provide minimum safe stopping sight distances for motor vehicle traffic. This is specified as 300 feet for primary roads and 200 feet for secondary roads.

The Town also requires a permit from the Department of Public Works for a curb cut on town-owned roads and a permit for a curb cut on state-owned roads must be obtained from Mass Highway. These permits help to ensure proper driveway and roadway drainage and help minimize icing during winter storms. Large residential developments and commercial developments are required to manage stormwater (discussed above in the flooding section) which also helps to reduce icing from melting snow.

## **Town of Greenfield Code (Excerpts)**

### Wetlands Protection, Chapter 195

Chapter 195 of the Town of Greenfield Code, adopted by the Town Council of the Town of Greenfield in 2001, addresses the protection of wetland resources within the town and includes provisions to address issues particular to Greenfield. The Ordinance includes a brief explanation of the intended purpose and intent of each of the provisions. The prevention of flooding events or the mitigation of impacts from flooding are addressed directly and indirectly in this Ordinance, as indicated below. The italicized sections are the town's intended purpose for each provision.

- A minimum of a 25-foot naturally vegetated “No Disturb Zone” shall be maintained or provided between resource areas and all altered areas. A wider “No Disturb Zone” may be required within the 100-foot buffer zone. *This provision serves to ensure protection from negative impacts during construction activities and the long-term viability of a resource area.* It also serves to preserve, intact, a portion of the floodplain associated with some resource areas.
- A list of prohibited new uses within the 100-year floodplain. *These restrictions serve to protect areas within the floodplain from potential sources of contamination from pollutants. Vehicles and their accessories (road salt, sand, oil, gas) stored in the floodplain will pollute surface water during flooding events. Vehicles and their accessories can also become dangerous debris during a flooding event.*
- 100% compensatory storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within the 100-year floodplain. *This provision clarifies that the Commission considers all incremental reductions in flood storage capacity to be significant over time, and therefore requires replacement at a 1:1 ratio.*
- The Commission shall not consider the replication of wetlands adequate mitigation for the destruction of resource areas. Alteration of wetlands requiring replication shall be permitted only where the landowner will be deprived of substantially all

economic use of the property, there are no reasonable alternatives, and the wetland area to be lost is minimized to the greatest extent possible. *The purpose of this provision is to provide clarification that the destruction of natural wetlands shall only be considered as a last resort. In general, the Commission shall not permit replication of wetlands because replication does not in fact substitute for many wetlands values. Proposed wetlands replications are at the discretion of the Commission based upon solid scientific reasoning and shall not be permitted simply based upon a proposed 1:1 replication ratio or the “highest and best use” of a property based upon development potential.*

#### Stormwater System Regulations, Chapter 695

Chapter 695 of the Town of Greenfield Code, dated June 2003, contains regulations governing the use of the town’s stormwater system. The regulations specifically address flood prevention. The stated purpose of the regulations is to “...ensure high water quality standards and address any potential water quantity problems associated with development and to:

- Preserve hydrologic conditions that closely resemble pre-development conditions;
- Prevent *flooding* by managing the peak discharge and volume of runoff; and
- Reduce the amount of suspended solids and other pollutants in order to maintain water quality.”

The Stormwater System Regulations establish a permitting process that governs any new discharge or increase in the volume of discharge of stormwater to a public way or stormwater sewer. There are two (2) classes of stormwater permit applications: Residential (single and two-family dwelling units) and Nonresidential (multi-family dwellings, subdivisions, commercial, industrial and institutional uses). For Nonresidential stormwater connection permits, an applicant must submit a Stormwater Management Plan to the Department of Public Works. The Stormwater Management Plan must be coordinated with requirements of the Wetlands Protection Act and the Greenfield Conservation Commission. The Stormwater System Regulations establish Stormwater Management Standards (section 695-11) that mitigate the potential for flooding, including:

- The stormwater management system shall be designed so that the post-development peak discharge rates do not exceed the pre-development discharge rates for a 10-year 24-hour storm.
- Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions based on soil types.

The regulations also include Design Criteria that address flood prevention and mitigation. Section 695-12 states:

- Stormwater management systems are encouraged to be designed to incorporate the use of natural topography and land cover. The use of such features as natural swales

- and depressions as they exist prior to development to the degree that they can accommodate the additional flow of water are recommended.
- All stormwater management systems shall be designed to provide an emergency overflow system, and incorporate measures to provide a non-erosive velocity of flow along its length and at any outfall.

Inspection and maintenance agreements are also required for stormwater management systems located on private land.

## Appendix B: Massachusetts Cultural Resource Information System

Inv. No.	Property Name	Street	Year
GRE.A	Main Street Historic District		
GRE.B	East Main - High Street Historic District		
GRE.C	Central Main Street Area		
GRE.D	Crescent Street - Highland Avenue Area		
GRE.E	Factory Hollow Road Area		
GRE.F	Fort Square		
GRE.G	Grinnell - Congress - Prospect Streets Area		
GRE.H	Hope Street Area		
GRE.I	Lampblack Road Area		
GRE.J	Leonard Street Area		
GRE.K	Meridian Street - Petty Plain Road Area		
GRE.L	Mill Street Area		
GRE.M	Pierce - Garfield Streets Area		
GRE.N	Nash's Mill		
GRE.O	North Meadows		
GRE.P	Riddell - Hastings - Haywood Streets Area		
GRE.Q	Washington Streetscape		
GRE.R	Sanderson Street Area		
GRE.S	Franklin County Fairgrounds		
GRE.T	Green River Cemetery		
GRE.U	Highland Park - Temple Woods - Rocky Mountain Park		
GRE.W	Riverside Archaeological District		
GRE.X	Greenfield Tap and Die Plant #1		
GRE.Y	Lower Federal Street Area		
GRE.186	Keefe, Jeremiah House	17 Abbott St	1902
GRE.187	Davenport, William A. House	21 Abbott St	1900
GRE.188	Rosen, David House	22 Abbott St	1905
GRE.189		37 Abbott St	1900
GRE.218	Adams, Andrew House	127 Adams Rd	1815
GRE.136	Conway Street Elementary School	Allen St	1909
GRE.927	B & M Railroad Connecticut River Main Line Bridge	Allen St	1934
GRE.407	The C. Bau Photography Studio	4 Ames St	1990
GRE.145	Threadwell Tap and Die Company	Arch St	1882
GRE.919	Arch Street Overpass	Arch St	1848
GRE.29	Prospect Hill School for Girls	4 Armory St	1856
GRE.920	Bank Row Underpass	Bank Row	1846
GRE.87	First National Bank and Trust of Greenfield	9 Bank Row	1929

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.88	First Franklin County Courthouse	15 Bank Row	1813
GRE.89	Pond, Frank A. Block	19-21 Bank Row	1874
GRE.90	Siano Block	25-27 Bank Row	1921
GRE.91	Coleman, William - Hollister, J. H. House	36 Bank Row	1797
GRE.92	Chevalier Block	38-46 Bank Row	1916
GRE.270	Ambercrombie Building	56 Bank Row	1892
GRE.271	King's Appliance Store	60 Bank Row	
GRE.245	Phillips, McHard House	205 Barton Rd	1782
GRE.246	Barton, Isaac House	283 Barton Rd	1837
GRE.247	Allen, J. S. House	335 Barton Rd	1797
GRE.379	Sawyer - Tyler House and Farm	1 Bascom Rd	1870
GRE.201	Beacon Street School	Beacon St	1929
GRE.932	Beacon Field	Beacon St	1912
GRE.204	Wells, F. E. Tool Manufacturing Company	39 Beacon St	1910
GRE.250	Sprague, Avery - Newton, Hervey C. House	Bernardston Rd	1845
GRE.251	Stoneleigh - Prospect Hill School for Girls	Bernardston Rd	1930
GRE.255	Fay, Damon L. Farm	Bernardston Rd	1852
GRE.249	Sprague, Asa House	560 Bernardston Rd	1840
GRE.252	Davis, George House	611 Bernardston Rd	1937
GRE.253	Stevens, R. E. House	629 Bernardston Rd	1940
GRE.254	Winer, Benjamin Home	633 Bernardston Rd	1930
GRE.256	Bullard, Silas House	804 Bernardston Rd	1865
GRE.257	Bullard, Mark House	878 Bernardston Rd	1881
GRE.258	Spaulding, Varney House	890 Bernardston Rd	1835
GRE.259	Pickett, Samuel House	908 Bernardston Rd	1820
GRE.262	Strickland, Russell F. House	1012 Bernardston Rd	1830
GRE.807	Log Plain Cemetery	1037 Bernardston Rd	1802
GRE.190		3 Bowker St	1900
GRE.191		22 Bowker St	1830
GRE.214	Canada Hill Elementary School	40 Canada Hill Rd	1920
GRE.272	Victoria Theater	13-25 Chapman St	1913
GRE.275	Outlet Store	14-18 Chapman St	1890
GRE.274	Rist Building	26 Chapman St	1920
GRE.273	Deland Building	27-31 Chapman St	1911
GRE.108	Mohawk Engraving Company Building	52 Chapman St	1900
GRE.109	Chapman, Henry House	58 Chapman St	1850
GRE.151	Wiley and Russell Box Company	330 Chapman St	1912
GRE.152	Guiding Star Grange	401 Chapman St	1932
GRE.45	Comstock, Samuel W. House	Chestnut Hill	1890

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.77	Saint James Protestant Episcopal Church	8 Church St	1847
GRE.422	Saint James Protestant Episcopal Church Rectory	8 Church St	
GRE.336	Stevens House	18 Church St	1900
GRE.334	Prentice House	19 Church St	1870
GRE.333	Eldrich House	20 Church St	1860
GRE.78	Potter, Waymes N. House	24 Church St	1885
GRE.79	First Methodist Episcopal Church	25 Church St	1885
GRE.329	Wise House	40 Church St	1864
GRE.80	Greenfield Historic Society Building	43 Church St	1851
GRE.328		44 Church St	1920
GRE.327		46-48 Church St	1920
GRE.81	Fay, Charles F. - Griswold, Whiting House	51 Church St	1854
GRE.392	Long, Alanson House and Farm	175 Cleveland St	1838
GRE.922	Colrain Road Bridge over Allen Brook	Colrain Rd	1905
GRE.810	Lower Meadows Cemetery	213 Colrain Rd	1793
GRE.219	Arms, Moses Farmhouse	248 Colrain Rd	1777
GRE.221	Belgrade, David House	350 Colrain Rd	1939
GRE.222	Nims, Thomas Barn	370 Colrain Rd	1810
GRE.223	Nims, Thomas Homestead	465 Colrain Rd	1826
GRE.224	Nims, Prudence House	479 Colrain Rd	1847
GRE.225	Brook, Allen Farmhouse	620 Colrain Rd	1766
GRE.226	Coleman, Capt. Thadeus House	637 Colrain Rd	1813
GRE.227	Wells, Capt. Ebenezer House	638 Colrain Rd	1747
GRE.811	Upper Meadows Cemetery	711 Colrain Rd	1821
GRE.228	Smead, Asaph House	729 Colrain Rd	1810
GRE.229	Wells Tavern	758 Colrain Rd	1780
GRE.230	Parmenter, Dea. Elias A. - Spear, George House	789 Colrain Rd	1851
GRE.232	Old Tavern Farm	817 Colrain Rd	1740
GRE.30	Washburn, William B. House	35 Congress St	1859
GRE.31	Wiley, Solon L. House	60 Congress St	1877
GRE.141	North Parish School	Conway St	1920
GRE.137	Emerson, Professor L. O. House	70 Conway St	1840
GRE.138	Severance, Charles D. House	93 Conway St	1910
GRE.139	Newton, James House	117-119 Conway St	1850
GRE.140	Smart, Albert J. House	136 Conway St	1870
GRE.917	Country Club Road Overpass	Country Club Rd	1848
GRE.83	Second Franklin County Courthouse	Court Sq	1848
GRE.310	Second Congregational Church	Court Sq	1868
GRE.903	Civil War Monument	Court Sq	1870

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.46	Snow, Walter N. House	50 Crescent St	1895
GRE.178	Grammar School	Davis St	1902
GRE.175		63-65 Davis St	1845
GRE.16	Harugari Hall	Deerfield St	1886
GRE.908	Cheapside Railroad Bridge	Deerfield St	1912
GRE.17	Potter, Mary Pratt - Ward Elizabeth House	50 Deerfield St	1850
GRE.18		98 Deerfield St	1850
GRE.99		11 Deven St	1850
GRE.135	Franklin County Jail and House of Correction	Elm St	1886
GRE.134	Mitchell, J. E. House	34 Elm St	1875
GRE.244	Green River Pumping Station	Eunice Williams Dr	1896
GRE.901	Pumping Station Bridge	Eunice Williams Dr	1972
GRE.916	Williams, Eunice Monument	Eunice Williams Dr	1884
GRE.215	Little Brick House	7 Factory Hollow Rd	1830
GRE.905	Factory Hollow Mill Bell Tower	12 Factory Hollow Rd	1830
GRE.217	Hastings, Obed House	17 Factory Hollow Rd	1700
GRE.216	Wood, Seth House and Store	24 Factory Hollow Rd	1835
GRE.373		30 Factory Hollow Rd	1900
GRE.374		39 Factory Hollow Rd	1933
GRE.375		53 Factory Hollow Rd	1900
GRE.910	First Meeting House Marker and Watering Trough	Federal St	1894
GRE.911	Revolutionary War Memorial	Federal St	1916
GRE.154	Pioneer National Bank and Trust Company	1 Federal St	1970
GRE.938	Untitled Sculpture	1 Federal St	1975
GRE.153	Corsiglia Block	8 Federal St	1898
GRE.428	Rosge Garden Building - Donovan Block	18 Federal St	1926
GRE.155	Levy Block	26-28 Federal St	1915
GRE.409	Famous Bill's Restaurant	30-44 Federal St	1900
GRE.156	Odd Fellows Block	31 Federal St	1922
GRE.157	Schick, Jacob Block	41 Federal St	1912
GRE.410	Greenfield Electric Light and Power Company Office	45 Federal St	1930
GRE.159	Graves Bakery	54 Federal St	1910
GRE.158	Greenfield Power and Light Company Service Station	55R Federal St	1918
GRE.160	Mansion House Hotel Garage	62 Federal St	1915
GRE.411	Greenfield Co-Operative Bank	63 Federal St	1950
GRE.161	Knights of Columbus Block	70 Federal St	1926
GRE.162	Brown's Toy Company Store	78-80 Federal St	1922
GRE.163	Weldon Hotel Garage	90 Federal St	1909
GRE.164	Wilcox, George Auto Dealership	100 Federal St	1930

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.165	Wiley - O'Brien, Dr. John C. House	111 Federal St	1845
GRE.168	Leonard, Theodore House	116 Federal St	1850
GRE.183	Greenfield First Baptist Church	116 Federal St	1912
GRE.166	Federal Street Elementary School	125 Federal St	1911
GRE.167	Third Greenfield High School	125 Federal St	1904
GRE.412	Hull, A. N. House	128 Federal St	1880
GRE.413	Lamb, J. H. House	132 Federal St	1880
GRE.419	Krohne's Automotive Service Garage	151 Federal St	1912
GRE.420		155-157 Federal St	1900
GRE.421		159-161 Federal St	1900
GRE.414	Bardwell, Oscar House	162 Federal St	1885
GRE.417	Scobey, C. House	166 Federal St	1880
GRE.418	Stratton, O. House	168-170 Federal St	1890
GRE.415	Ingell and Shepard Funeral Home	180 Federal St	1923
GRE.801	Federal Street Cemetery	187 Federal St	1803
GRE.802	Pierce, John J. Burial Lot	187 Federal St	
GRE.425		189 Federal St	
GRE.180	Fourth Greenfield Senior High School	195 Federal St	1924
GRE.198	Pierce, John D. House	196 Federal St	1887
GRE.199	Woodleigh Villa	220 Federal St	1888
GRE.416		224 Federal St	1900
GRE.200	First National Stores	226-230 Federal St	1927
GRE.367	Severance, Asa House	234 Federal St	1896
GRE.368	Parker, George W. House	240 Federal St	1903
GRE.369	Allen, Dr. Porter C. House	244 Federal St	1906
GRE.370	Corbin, Charles G. House	246 Federal St	1910
GRE.212	Lunt Silversmith Factory	298 Federal St	1890
GRE.371	Braff's Royal Cleaners	430 Federal St	1950
GRE.106	Greenfield Storage	1 Fiske Ave	1915
GRE.267	Avenue Lighting	10 Fiske Ave	1920
GRE.68	Greenfield Library Association Building	7 Franklin St	1878
GRE.351	Washburn House	15 Franklin St	1882
GRE.350	Fiske, O. H. House	23 Franklin St	1890
GRE.349	Reed Apartments	24 Franklin St	1915
GRE.69	Russell, Isabella House	29 Franklin St	1890
GRE.348	Howland House	34 Franklin St	1860
GRE.347		37 Franklin St	1960
GRE.346	Ward House	42 Franklin St	1880
GRE.345	Smead House	43 Franklin St	1880

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.344	Crafts, Fannie E. House	68 Franklin St	1880
GRE.343	Newcomb House	69 Franklin St	1865
GRE.331		81 Franklin St	1880
GRE.332	Burrage House	87 Franklin St	1924
GRE.243	Greenfield Town Farm	34 Glenbrook Dr	1847
GRE.396	Greenfield Town Farm Barn	34 Glenbrook Dr	1909
GRE.924	Gerrett Bridge	Green River Rd	1907
GRE.233	Smead, Capt. Thomas House	11 Green River Rd	1794
GRE.234	Ewers, Henry A. Blacksmith Shop	18 Green River Rd	1840
GRE.235	Smead, Jonathan House	200 Green River Rd	1739
GRE.236	Smead, Lemuel House	276 Green River Rd	1766
GRE.32	Conant, Samuel D. House	3 Grinnell St	1880
GRE.33	Wells, F. O. House	9 Grinnell St	1880
GRE.34	Reed, Frank H. House	16 Grinnell St	1880
GRE.35	Hardison, F. S. House	26 Grinnell St	1882
GRE.36	Day, Charles J. House	29 Grinnell St	1880
GRE.37	Allen, Sylvester House	41 Grinnell St	1836
GRE.38		55 Grinnell St	1880
GRE.210	Akey, Clifford House	11 Haywood St	1900
GRE.211	Greenfield Machine Company	38 Haywood St	1900
GRE.812	Country Farms Cemetery	Health Camp Rd	1794
GRE.276	Hoyt House	11-15 High St	1883
GRE.277	Walker Funeral Home	14 High St	1893
GRE.278	Lamb House	17 High St	1851
GRE.70	Beals, Dr. Joseph House	21 High St	1845
GRE.71	Simons, H. K. House	22 High St	1875
GRE.320	Arms, George House	23-25 High St	1850
GRE.72	Kellog, Dwight B. - Conant, Chester C. House	28 High St	1854
GRE.321	Forbes House	29 High St	1850
GRE.322	Packard House	32 High St	1855
GRE.323	Moors - Comstock House	35 High St	1850
GRE.324		36-38 High St	1855
GRE.73	Taylor, Rinaldo Rinaldine - Russell, Nathaniel Hse	40 High St	1855
GRE.74	Field, Charles R. House	43 High St	1870
GRE.326	Fletcher House	51 High St	1870
GRE.75	Weldon Hotel, The	54 High St	1905
GRE.76	Bolter, Cyprian - Jones, Orra Martin Cottage	77 High St	1852
GRE.205	Hastings, Lemuel - Riddell, John Wesley House	186 High St	1790
GRE.206		193 High St	1915

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.209	Taylor, Lewis House	210 High St	1930
GRE.41	Lupinwood	Highland Ave	1890
GRE.42	Cutler, Nahum Sawin House	35 Highland Ave	1886
GRE.43	Field, David C. G. - Esleek, Augustine W. House	58 Highland Ave	1895
GRE.44	Rogers, George E. House	93 Highland Ave	1903
GRE.22	Cutler, Lyons and Field Shoe Factory	Hope St	1891
GRE.27		Hope St	1890
GRE.403	Mohawk Cadillac Company Repair Garage	36 Hope St	1920
GRE.404	Father Mathew Temperance Society Hall	44 Hope St	1920
GRE.21	Greenfield Armory	71 Hope St	1910
GRE.23	Saint Paul's Lutheran Church	88 Hope St	1883
GRE.24	Noyes, B. B. Foundry	106 Hope St	1893
GRE.25		123 Hope St	1870
GRE.26	Toiletine Building	143 Hope St	1910
GRE.264	Childs, Timothy - Bascom, Moses House	509 Lampblack Rd	1774
GRE.380	Griswold Farmhouse	588 Lampblack Rd	1873
GRE.376	Griswold Farmstead	599 Lampblack Rd	1920
GRE.377	Philips - Bascom House	672 Lampblack Rd	1830
GRE.378	Chapin, C. House	692 Lampblack Rd	1820
GRE.100	Main Street Primary School	7 Legion Ave	1877
GRE.169	Mosa, G. W. House	8-10 Leonard St	1880
GRE.170	Whitney, E. House	11 Leonard St	1885
GRE.171		12 Leonard St	1895
GRE.386		15 Leonard St	1900
GRE.381		16 Leonard St	1895
GRE.172	Smith, C. House	17 Leonard St	1900
GRE.382		18 Leonard St	1895
GRE.385		21 Leonard St	1900
GRE.173	Partenheimer, Philip House	22 Leonard St	1883
GRE.384		23 Leonard St	1900
GRE.383		27 Leonard St	1880
GRE.394	Green River Booster Pumping Station - North Bldg	Leyden Rd	1922
GRE.395	Green River Booster Pumping Station - South Bldg	Leyden Rd	1923
GRE.237	Wilder, Samuel House	21 Leyden Rd	1835
GRE.238	Parsonage, The	31 Leyden Rd	1845
GRE.265	Nash, Daniel House	36 Leyden Rd	1820
GRE.239	Newcomb, Allyn S. House	46 Leyden Rd	1885
GRE.240	Martindale, Uriah and Theodore House	127 Leyden Rd	1835
GRE.241	Smead, Charles Dea. House	219 Leyden Rd	1840

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.242	Smead, Jonathan Jr. House	274 Leyden Rd	1765
GRE.808	Hebrew Cemetery	Log Plain Rd	1924
GRE.925	Log Plain Road Bridge over Mill - Barton Brook	Log Plain Rd	1939
GRE.260	Adams, George House	136 Lover's Ln	1870
GRE.915	Spanish War Memorial	Main St	1928
GRE.918	Main Street Arch	Main St	1848
GRE.939	Peace Symbol - Greenfield Civil War Memorial	Main St	1965
GRE.940	Serpentine Wall - Greenfield War Memorial	Main St	1965
GRE.127	Goodell Manufacturing Company	1 Main St	1897
GRE.124	Coombs, Joseph House	6 Main St	1854
GRE.123	Noyes, Baxter B. House	8 Main St	1895
GRE.126	Simons House	30 Main St	1865
GRE.399	Benson Block	94 Main St	1915
GRE.398	Sears Building	102 Main St	1929
GRE.397	Abrahamson Furniture and Appliance Building	122 Main St	1918
GRE.94		130 Main St	1913
GRE.95	Holy Trinity Roman Catholic Church	133 Main St	1871
GRE.426	Holy Trinity Roman Catholic Church Rectory	133 Main St	1901
GRE.96		138 Main St	1916
GRE.400	McLellan Women's Clothing Store	142 Main St	1940
GRE.402	Penny, J. C. Department Store	144 Main St	1940
GRE.97	Potter, W. N. Grain Store	155 Main St	1910
GRE.401	Cohn, Simon L. Block	156 Main St	1928
GRE.408	Miles, Isaac House	173 Main St	1855
GRE.101	Blake Block	201 Main St	1909
GRE.102	Kennedy - Maniatty Block	204-206 Main St	1904
GRE.103	Ragovin Block	205-209 Main St	1924
GRE.104	Pond - Coughlin Block	217-219 Main St	1902
GRE.311	National Shoe Service	221-223 Main St	1915
GRE.105	Pillar Building	226-228 Main St	1845
GRE.110	Botsford Block	231 Main St	1873
GRE.111	Union - Taylor Block	232-240 Main St	1854
GRE.112	Sullivan Building	233 Main St	1873
GRE.268	Borofsky Block	239 Main St	1947
GRE.113	American House	242-258 Main St	1876
GRE.269	Greenfield Police Station	253 Main St	1936
GRE.115	Wiley - Cohn Block	269 Main St	1845
GRE.116	Heritage NIS Bank	270 Main St	1976
GRE.118	Pond's Block	276-294 Main St	1874

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.117	Sheldon Block	277 Main St	1912
GRE.119	Arms, George A. Block	285-291 Main St	1876
GRE.120	Hollister Block	298-302 Main St	1874
GRE.121	Bird - Hovey Block	310 Main St	1812
GRE.122	Franklin County Trust Company Building	324 Main St	1972
GRE.84	Franklin Savings Bank	332 Main St	1911
GRE.85	Allen Corner Block	351 Main St	1827
GRE.86	Garden Theater Block	353-367 Main St	1928
GRE.48	Greenfield Masonic Block	375 Main St	1896
GRE.49	Lyons - Nims Building	377-379 Main St	1871
GRE.50	Unitarian Church Hall	397 Main St	1837
GRE.51	All Souls Unitarian Church	399 Main St	1894
GRE.52	Greenfield Savings and Loan Bank	400 Main St	1963
GRE.53	Leavitt - Hovey House	402 Main St	1797
GRE.54	Second Greenfield Fire Station	412 Main St	1936
GRE.55	Franklin County Court House	425 Main St	1931
GRE.56	U. S. Post Office - Greenfield Main Branch	442 Main St	1916
GRE.57	Greenfield YMCA	451 Main St	1949
GRE.58	Coldbrook Springs Baptist Church	463 Main St	1842
GRE.59	Snow, Newell House - Greenfield Club	466 Main St	1881
GRE.60	Elliott, William House	473 Main St	1836
GRE.61	Wright, Aaron H. - Sanderson, John H. House	474 Main St	1881
GRE.62	Ripley, Franklin - Root, Rebecca L. House	479 Main St	1834
GRE.63	Gould, Elijah Addison - Clapp, Henry Wells House	486 Main St	1827
GRE.64	Bird, George - Fessenden, Franklin Goodrich House	488 Main St	1845
GRE.65	Morgan, Alexander - Allen, Franklin R. House	491 Main St	1816
GRE.66	Smith, Martin House	497 Main St	1824
GRE.67	Grinnell, George - Tufts, Nathan House	500 Main St	1846
GRE.179	Day, Nina L. House	23 Maple St	1900
GRE.15	Snow, Newell Factory	Mead St	1879
GRE.5	Greenfield Tap and Die Plant #1 - Boiler Building	Meridian St	1860
GRE.7	Green River Elementary School	Meridian St	1949
GRE.352	Greenfield Tap and Die Plant #1 - Pump House	Meridian St	1860
GRE.353	Greenfield Tap and Die Plant #1 - Machine Shop	Meridian St	1890
GRE.354	Greenfield Tap and Die Plant #1 - Hardening Shop	Meridian St	1887
GRE.355	Greenfield Tap and Die Plant #1 - Machine Shop	Meridian St	1889
GRE.356	Greenfield Tap and Die Plant #1 - Hardening Shop	Meridian St	1888
GRE.357	Greenfield Tap and Die Plant #1 - Storehouse	Meridian St	1896
GRE.358	Greenfield Tap and Die Plant #1 - Meter House	Meridian St	1896

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.359	Greenfield Tap and Die Plant #1 - Machine Shop	Meridian St	1891
GRE.360	Greenfield Tap and Die Plant #1 - Restaurant	Meridian St	1945
GRE.361	Greenfield Tap and Die Plant #1 - Machine Shop	Meridian St	1887
GRE.362	Greenfield Tap and Die Plant #1 - Squaring Shop	Meridian St	1912
GRE.363	Greenfield Tap and Die Plant #1 - Auto Shop	Meridian St	1912
GRE.364	Greenfield Tap and Die Plant #1 - Machine Shop	Meridian St	1920
GRE.365	Greenfield Tap and Die Plant #1 - Oil Filter Bldg.	Meridian St	1970
GRE.907	Meridian Marker	Meridian St	1870
GRE.921	Wiley and Russell Bridge	Meridian St	1917
GRE.934	Greenfield Tap and Die Plant #1 - Smokestack	Meridian St	1930
GRE.935	Greenfield Tap and Die Plant #1 - Canal	Meridian St	
GRE.936	Greenfield Tap and Die Plant #1 - Wood Crib Dam	Meridian St	
GRE.937	Greenfield Tap and Die Plant #1 - Flood Walls	Meridian St	1938
GRE.6		98 Meridian St	1860
GRE.107	Miles Hotel	10 Miles St	1900
GRE.406	B&M Railroad - Fitchburgh Line Divisional Offices	59 Miles St	1914
GRE.923	Mill Street Bridge over Green River	Mill St	1910
GRE.11	Greenfield Monumental Works Shop	9 Mill St	1911
GRE.372	Jones, Levi House	15 Mill St	1845
GRE.12		38 Mill St	1900
GRE.388	Green River Mill Company Worker Housing	51 Mill St	1838
GRE.914	Three State Long View Tower	Mohawk Trail	1952
GRE.10	Abercrombie Elementary School	Montague City Rd	1920
GRE.926	Pierce, Gen. Frederick E. Bridge	Montague City Rd	1947
GRE.8	Cheapside District Schoolhouse	21 Montague City Rd	1800
GRE.9		151 Montague City Rd	1890
GRE.40	Eager, Noah - Temple, Philo Farm	230 Mountain Rd	1815
GRE.1	Westside Chapel	59 Munson St	1909
GRE.2	Newton, Alpheus House	176 Munson St	1826
GRE.913	Turner, Capt. William Monument	Nash's Mill Rd	1905
GRE.931	Nash's Mills Bridge over Green River	Nash's Mill Rd	1933
GRE.335		1-3 Newell Ct	1909
GRE.82	Potter, Aaron D. and Sons Garage	13 Newell Ct	1896
GRE.261	McHard Red Salt Box House	Newell Pond Pl	1750
GRE.902	Langstroth Memorial	Newton Pl	1948
GRE.128	Rugg Manufacturing Company	105 Newton St	1855
GRE.203	Sisters of Saint Joseph Convent	North St	1929
GRE.405	Olive Street Garage	11 Olive St	1922
GRE.93	Pierce, E. Lumber Company Planing Mill	30 Olive St	1860

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.427	Mohawk Cadillac Company Repair Shop	33 Olive St	1922
GRE.47	Gun House Hill	30 Orchard St	1895
GRE.429	Phelps, Col. Ansel House	13 Osgood St	
GRE.342	McClellan House	3 Park St	1850
GRE.330		5 Park St	1970
GRE.341	Thayer House	7-9 Park St	1870
GRE.340	Field House	10 Park St	1883
GRE.339	Sheldon House	11 Park St	1865
GRE.338	Scotts House	14 Park St	1900
GRE.337		15 Park St	1920
GRE.366	Nichols, Louise J. House	7 Peirce St	1895
GRE.195	Pierce Street Primary School	Pierce St	1894
GRE.194	Second Baptist Church	27 Pierce St	1898
GRE.196	Chauncey Wing and Sons Mailing Machine Factory	78 Pierce St	1892
GRE.197	Diamond Electric Soap Company	85 Pierce St	1900
GRE.220	Bass, Nathaniel House	318 Plain Rd	1820
GRE.174	Inkwell House	61 Pleasant St	1850
GRE.184		12-14 Pond St	1900
GRE.185	Houston, Hayden House	27 Pond St	1900
GRE.13	Field, Charles A. Baby Carriage Manufacturing Co.	Power Sq	1860
GRE.14	Greenfield Electric Light and Power Company	Power Sq	1900
GRE.28	Thompson, John Webber House	34 Prospect St	1840
GRE.207		21 Riddell St	1894
GRE.208		23 Riddell St	1890
GRE.912	Green River Railroad Bridge	River Rd	1918
GRE.900	Poet Seat Tower	Rocky Mountain	1912
GRE.928	Route 2 Eastbound Ramp over I-91 Northbound	Rt 2	1964
GRE.929	Route 2 Eastbound Ramp over I-91 Southbound	Rt 2	1964
GRE.930	Route 2 Westbound Ramp over I-91 Northbound	Rt 2	1964
GRE.933	Cheapside Bridge	Rt 5	1931
GRE.39		Russell St	1850
GRE.424		8 Sanderson St	
GRE.181	Otterson, James P. S. - Spencer, Archer J. House	10 Sanderson St	1890
GRE.423		14 Sanderson St	
GRE.182	Greenfield Tap and Die Factory #2	34 Sanderson St	1889
GRE.177	Richardson, John B. House	25-27 School St	1840
GRE.114	New England Telephone and Telegraph Company Bldg	53 School St	1912
GRE.176	Brown, Frank H. House	162 School St	1898
GRE.248	Greenfield District #7 Schoolhouse	Severance St	1873

<b>Inv. No.</b>	<b>Property Name</b>	<b>Street</b>	<b>Year</b>
GRE.909	Commemorative Watering Trough	Shattuck Park	1903
GRE.132	Newton Street School	Shelburne Rd	1915
GRE.129	Potter, J. Warren House	107 Shelburne Rd	1800
GRE.390	Edgemere Inn, The	140 Shelburne Rd	1920
GRE.389	Turnbull's Green Mountain Ice Cream Company	184 Shelburne Rd	1926
GRE.133	Falcon Knight Motors Showroom and Service Station	189 Shelburne Rd	1927
GRE.809	High Street Cemetery	11 Silver St	1768
GRE.387	Newton, Samuel House	287 Silver St	1812
GRE.142	North Meeting House District School	384 Silver St	1839
GRE.143	Graves, John J. House	399 Silver St	1824
GRE.130	Arms, Ebenezer Farm	54 Thayer Rd	1800
GRE.213		Turners Falls Rd	1880
GRE.263	Snow, Barnabus House	Upper Bernardston Rd	1795
GRE.20	Green River Primary School	Washington St	1857
GRE.19		57 Washington St	1840
GRE.98	Millers Falls Tool Company	Wells St	1892
GRE.144	Hunt, Wilfred E. Feeds Store	121 1/2 Wells St	1922
GRE.146	Pray, Frank G. House	143 Wells St	1880
GRE.147	Pray, Robert E. House	149 Wells St	1900
GRE.148	Pray, Frank G. House	153 Wells St	1900
GRE.393	Knight, Theodore R. House	189 Wells St	1870
GRE.149		238 Wells St	1905
GRE.150	Bickford Machine Company	309 Wells St	1908
GRE.125	Woffenden, Judson House	61 West Fort Sq	1915
GRE.4	Green River Cemetery Mortuary Chapel	Wisdom Way	1921
GRE.803	Our Lady of Sorrows Cemetery	Wisdom Way	1923
GRE.906	Russell Family Memorial Tombstone	Wisdom Way	1926
GRE.806	Green River Cemetery	56 Wisdom Way	1851
GRE.904	Franklin County Fairground Gates	85 Wisdom Way	1917
GRE.3	Franklin County Fairgrounds Roundhouse Barn	89 Wisdom Way	1899
GRE.805	Catholic Cemetery, Old	171 Wisdom Way	1804
GRE.804	Calvary Catholic Cemetery	202 Wisdom Way	1877
GRE.131	Woodard, H. G. House	Woodard St	1835
GRE.192		7 Woodleigh St	1900
GRE.193		11 Woodleigh St	1900

**Appendix C: Plan Approval and Adoption**

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**The Town of Greenfield Planning Board formally adopted this  
Local Natural Hazards Mitigation Plan by  
vote at their xxxxxxxx xx, 2011 meeting.**

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**Roxann Wedegartner, Chair**

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**Linda Smith, Vice Chair**

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**Mary Newton, Clerk**

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**James Allen**

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**Clayton Sibley**

**Following approval by the Greenfield Planning Board, this Local Natural  
Hazards Mitigation Plan was accepted by the Mayor of Greenfield**

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**William Martin**

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**Date**