

# **TOWN OF SHERMAN NATURAL HAZARD PRE-DISASTER MITIGATION PLAN**

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***Prepared for the:***

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## EXECUTIVE SUMMARY

### *Town of Sherman Natural Hazard Pre-Disaster Mitigation Plan*

The primary purpose of a Natural Hazard Pre-Disaster Hazard Mitigation Plan is to identify natural hazards and risks, existing capabilities, and activities that can be undertaken by a community to prevent loss of life and reduce property damages associated with identified hazards. The Disaster Mitigation Act of 2000 requires local communities to have a FEMA-approved mitigation plan in order to be eligible to receive Pre-Disaster Mitigation program grants and post-disaster Hazard Mitigation Grant Program funds under the Hazard Mitigation Assistance program.

The variety of terrain in Sherman makes it particularly vulnerable to an array of natural hazards, including small areas of inland flooding; high winds associated with hurricanes, summer storms, tornadoes, and winter storms; hail and lightning during summer storms; ice and snow during winter storms; earthquakes; dam failure; and wildfires. The Town of Sherman Natural Hazard Pre-Disaster Mitigation Plan (the Plan) discusses each of these natural hazards in detail with the understanding that a particular hazard effect (e.g., high winds) can be caused by a variety of hazard events (e.g., hurricanes and winter storms).

The Town of Sherman (the Town or Sherman) considers its police, fire, governmental, and major transportation arteries to be its critical facilities as well as its churches and educational institutions which can be used as shelters. None of these critical facilities are regularly impacted by flooding. The Emergency Operations Facility will be Sherman's primary shelter once construction is completed. Sherman Consolidated School is currently the primary shelter with fire department volunteers serving as staff. Route 37 and Route 39 southwest of the Town Center has flooded during extreme events, and such flooding effectively isolates the northern and southern sections of Sherman.

The town's emergency communications systems have dead zones that should be addressed through upgrades and a new communications tower. Sherman is pursuing a location for a new cellular tower to reduce the number of dead zones and increase overall signal strength.

Sherman lies within seven major watersheds. Approximately 89% of the town eventually drains to the Housatonic River. There are also a number of water bodies in town including Candlewood Lake, Lake Mauweehoo, and Spring Lake. The majority of these areas have 100-year floodplains defined.

The town has a number of measures in place to prevent flood damage including regulations, codes, and ordinances preventing encroachments and development near floodplains and floodways. 1,583 acres of land are located within the 100-year flood boundary, and additional indirect and nuisance flooding occurs near streams and rivers throughout town due to inadequate drainage and other factors. There are no repetitive loss properties in Sherman, and flood damage to structures is limited. The majority of flooding damage in Sherman occurs to town-owned infrastructure such as culverts and bridges.

Minor wind damage occurs as a result of summer storms and winter storms each year. Most of this damage is secondary damage caused by falling tree limbs as opposed to wind shear. Hurricanes and tornadoes are less frequent but represent more extreme wind events. HAZUS-MH simulations predict that minimal wind damage will occur in Sherman for events with top wind speeds less than 70 miles per hour (approximately a 50-year event). Major winter nor'easters have the potential to occur every few years which produce extreme snowfall and moderate wind damage.

No active faults lie within Sherman, and earthquake damage is practically nonexistent. While Sherman is unlikely to experience a damaging earthquake in any given year, areas underlain with sand and gravel are at increased risk due to amplification of energy and collapse if one should occur.

No high hazard dams lie within or upstream of Sherman. Sherman has three Class B (significant) hazard dams. These dams are privately owned and are not believed to have Emergency Operations Plans. Rogers Pond dam, a minor hazard dam, fully breached during the heavy rainfall in April 2007.

Sherman is at a low risk for wildfires. Those areas at the highest risk are limited access forests and other areas away from water sources where tanker trucks must be relied on to fight a fire. Agricultural fields and pastures are also considered to be higher risk areas as they could burn quickly during a drought.

A variety of recommendations are included in this Plan for each natural hazard type. Recommendations are summarized in Section 10.1 and 10.2. Section 10.4 summarizes the highest-ranked recommendations on the basis of a STAPLEE analysis, which were primarily associated with continued or improved public communication and outreach. For example, one highly ranked recommendation is to add pages to the Town website dedicated to citizen education and preparedness for natural hazard events.

Section 10.4 also presents the highest ranked capital improvement projects. The top three recommendations are to (1) upgrade emergency communications as necessary to ensure adequate communication with all areas of town and each of Sherman's neighbors, (2) re-evaluate the drainage computations for culverts on public dead-end roads and resize if necessary, and (3) pursue additional sources of fire-fighting water where adequate supplies do not currently exist. The town has been pursuing these recommendations prior to the development of this Plan. Section 9 of this Plan was designed, in part, to assist the town with locating new sources of fire-fighting water.

The Plan concludes with a discussion of implementing and updating the Plan. A listing of potential grant sources as well as federal, regional, state, and other resources is provided to assist the Town of Sherman in implementing the Plan. This Plan will need to be updated within five years from the date of approval by FEMA in order to be considered current.

## 1.0 INTRODUCTION

### 1.1 Background and Purpose

The term hazard refers to an extreme natural event that poses a risk to people, infrastructure, or resources. In the context of natural disasters, pre-disaster hazard mitigation is commonly defined as any sustained action that permanently reduces or eliminates long-term risk to people, property, and resources from natural hazards and their effects.

The primary purpose of a pre-disaster hazard mitigation plan (HMP) is to identify natural hazards and risks, existing capabilities, and activities that can be undertaken by a community or group of communities to prevent loss of life and reduce property damages associated with the identified hazards. This HMP is prepared specifically to identify hazards in the town of Sherman, Connecticut. The HMP is relevant not only in emergency management situations but also should be used within the town's land use, environmental, and capital improvement frameworks.

The Disaster Mitigation Act of 2000 (DMA), commonly known as the 2000 Stafford Act amendments, was approved by Congress and signed into law in October 2000, creating Public Law 106-390. The purposes of the DMA are to establish a national program for pre-disaster mitigation and streamline administration of disaster relief.

The DMA requires local communities to have a Federal Emergency Management Agency (FEMA)-approved mitigation plan in order to be eligible to apply for and receive Hazard Mitigation Assistance (HMA) grants. The HMA "umbrella" contains five competitive grant programs designed to mitigate



the impacts of natural hazards. This natural hazard pre-disaster hazard mitigation plan was developed to be consistent with the general requirements of the HMA program as well as the specific requirements of the Hazard Mitigation Grant Program (HMGP) for post-disaster mitigation activities, as well as the Pre-Disaster Mitigation (PDM), Flood Management Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL) programs. These programs are briefly described below.

### ***Mitigation Funding***

***Applications for hazard mitigation grant funding are administered under the Unified Hazard Mitigation Assistance (HMA) program. More information on this and the following programs can be found at FEMA's website, <http://www.fema.gov/>***

### **Pre-Disaster Mitigation (PDM) Program**

The Pre-Disaster Mitigation Program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through



pre-disaster mitigation planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. PDM funds should be used primarily to support mitigation activities that address natural hazards. In addition to providing a vehicle for funding, the PDM program provides an opportunity to raise risk awareness within communities. The grant to prepare the subject plan came through the PDM program.

### Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. A key purpose of the HMGP is to ensure that any opportunities to take critical mitigation measures to protect life and property from future disasters are not "lost" during the recovery and reconstruction process following a disaster.



### Flood Mitigation Assistance (FMA) Program

The FMA program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. Three types of grants are available under FMA. These are Planning, Project, and Technical Assistance grants.



### Repetitive Flood Claims (RFC) Program

The RFC grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act (NFIA) of 1968. Up to \$10 million is available annually for FEMA to provide RFC funds to assist states and communities reduce flood damages to insured properties that have had one or more damage claims under the National Flood Insurance Program (NFIP). FEMA may contribute up to 100% of the total amount approved under the RFC grant award to implement approved activities, if the applicant has demonstrated that the proposed activities can not be funded under the Flood Mitigation Assistance (FMA) Program.



### Severe Repetitive Loss (SRL) Program

The SRL grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to SRL structures insured under the NFIP. The program is meant to reduce or eliminate claims under NFIP through project activities that will result in the greatest savings to the NFIP.



A severe repetitive loss property is defined as a residential property that is covered under an NFIP flood insurance policy and (a) has at least four NFIP claim payments (including building and contents) over \$5,000 each, with the cumulative amount of such claims payments exceeding \$20,000, or (b) for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both (a) and (b), at least two of the claims must have occurred within any 10-year period and must be greater than 10 days apart.

## 1.2 **Hazard Mitigation Goals**

The primary goal of this hazard mitigation plan is to ***reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters***. This includes the reduction of public and private damage costs. Limiting losses of and damage to life and property will also reduce the social, emotional, and economic disruption associated with a natural disaster.

Developing, adopting, and implementing this hazard mitigation plan is expected to:

- ❑ ***Increase access to and awareness of funding sources for hazard mitigation projects.*** Certain funding sources, such as the PDM and HMGP, may be available if the hazard mitigation plan is in place and approved.
- ❑ ***Identify mitigation initiatives to be implemented if and when funding becomes available.*** This HMP will identify a number of mitigation recommendations, which can then be prioritized and acted upon as funding allows.
- ❑ ***Connect hazard mitigation planning to other community planning efforts.*** This HMP can be used to guide Sherman's development through interdepartmental and intermunicipal coordination.
- ❑ ***Improve the mechanisms for pre- and post-disaster decision making efforts.*** This plan emphasizes actions that can be taken now to reduce or prevent future disaster damages. If the actions identified in this plan are implemented, damage from future hazard events can be minimized, thereby easing recovery and reducing the cost of repairs and reconstruction.

- ❑ ***Improve the ability to implement postdisaster recovery projects*** through development of a list of mitigation alternatives ready to be implemented.
- ❑ ***Enhance and preserve natural resource systems.*** Natural resources, such as wetlands and floodplains, provide protection against disasters such as floods and hurricanes. Proper planning and protection of natural resources can provide hazard mitigation at substantially reduced costs.
- ❑ ***Educate residents and policy makers about natural hazard risk and vulnerability.*** Education is an important tool to ensure that people make informed decisions that complement the Town's ability to implement and maintain mitigation strategies.
- ❑ ***Complement future Community Rating System (CRS) efforts.*** Implementation of certain mitigation measures may increase a community's rating within the NFIP and thus the benefits that it derives from FEMA. The Town has consistently participated in the NFIP since June 18, 1987 but has yet to participate in the CRS.

### **1.3 Identification of Hazards and Document Overview**

As stated in Section 1.1, the term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. Based on a review of the Connecticut Natural Hazard Mitigation Plan, the New York State Hazard Mitigation Plan, and correspondence with local officials, the following have been identified as natural hazards that can potentially affect the town of Sherman:

- ❑ Inland Flooding
- ❑ Hurricanes and Tropical Storms
- ❑ Summer Storms (including lightning, hail, and heavy winds) and Tornadoes
- ❑ Winter Storms
- ❑ Earthquakes

- ❑ Dam Failure
- ❑ Wildfires

This document has been prepared with the understanding that a single *hazard effect* may be caused by multiple *hazard events*. For example, flooding may occur as a result of frequent heavy rains, a hurricane, or a winter storm. Thus, appended Tables 1 and 2 provide summaries of the hazard events and hazard effects that impact the town of Sherman and include criteria for characterizing the locations impacted by the hazard, the frequency of occurrence of the hazards, and the magnitude or severity of the hazards.

Despite the causes, the effects of several hazards are persistent and demand high expenditures from the town. In order to better identify current vulnerabilities and potential mitigation strategies associated with other hazards, each hazard has been individually discussed in a separate chapter.

This document begins with a general discussion of Sherman's community profile, including the physical setting, demographics, development trends, governmental structure, and sheltering capacity. Next, each chapter of this Plan that is dedicated to a particular hazard event is broken down into six or seven different parts. These are *Setting*; *Hazard Assessment*; *Historic Record*; *Existing Programs, Policies, and Mitigation Measures*; *Vulnerabilities and Risk Assessment*; and *Potential Mitigation Measures, Strategies, and Alternatives*, and for chapters with several recommendations, a *Summary of Recommendations*. These are described below.

- ❑ ***Setting*** addresses the general areas that are at risk from the hazard. General land uses are identified.
- ❑ ***Hazard Assessment*** describes the specifics of a given hazard, including general characteristics and associated effects. Also defined are associated return intervals, probability and risk, and relative magnitude.

- ❑ ***Historic Record*** is a discussion of past occurrences of the hazard and associated damages when available.
- ❑ ***Existing Programs, Policies, and Mitigation Measures*** gives an overview of the measures that the Town of Sherman is currently undertaking to mitigate the given hazard. These may take the form of ordinances and codes, structural measures such as dams, or public outreach initiatives.
- ❑ ***Vulnerabilities and Risk Assessment*** focuses on the specific areas at risk to the hazard. Specific land uses in the given areas are identified. Critical buildings and infrastructure that would be affected by the hazard are identified.
- ❑ ***Potential Mitigation Measures, Strategies, and Alternatives*** identifies mitigation alternatives, including those that may be the least cost effective or inappropriate for Sherman.
- ❑ ***Summary of Recommended Mitigation Measures, Strategies, and Alternatives*** provides a summary of the recommended courses of action for Sherman, which is included in the STAPLEE analysis described below.

This document concludes with a strategy for implementation of the Hazard Mitigation Plan, including a schedule, a program for monitoring and updating the plan, and a discussion of technical and financial resources.

#### **1.4 Discussion of STAPLEE Ranking Method**

To prioritize recommended mitigation measures, it is necessary to determine how effective each measure will be in reducing or preventing damage. A set of criteria commonly used by public administration officials and planners was applied to each

proposed strategy. The method, called STAPLEE, is outlined in FEMA planning documents such as *Developing the Mitigation Plan* (FEMA 386-3) and *Using Benefit-Cost Review in Mitigation Planning* (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic and Environmental" criteria for making planning decisions.

Benefit-cost review was emphasized in the prioritization process. Criteria were divided into potential benefits (pros) and potential costs (cons) for each mitigation strategy. The following questions were asked about the proposed mitigation strategies:

❑ **Social:**

- Benefits: Is the proposed strategy socially acceptable to Sherman?
- Costs: Is there any equity issues involved that would mean that one segment of Sherman could be treated unfairly? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower-income people? Is the action compatible with present and future community values?

❑ **Technical:**

- Benefits: Will the proposed strategy work? Will it reduce losses in the long term with minimal secondary impacts?
- Costs: Is the action technically feasible? Will it create more problems than it will solve? Does it solve the problem or only a symptom?

❑ **Administrative:**

- Benefits: Does the project make it easier for the community to administrate future mitigation or emergency response actions?
- Costs: Does Sherman have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can Sherman perform the necessary maintenance? Can the project be accomplished in a timely manner?

❑ **Political:**

- Benefits: Is the strategy politically beneficial? Is there public support both to implement and maintain the project? Is there a local champion willing to see the project to completion? Can the mitigation objectives be accomplished at the lowest cost to the community (grants, etc.)?
- Costs: Have political leaders participated in the planning process? Do project stakeholders support the project enough to ensure success? Have the stakeholders been offered the opportunity to participate in the planning process?

❑ **Legal:**

- Benefits: Is there a technical, scientific, or legal basis for the mitigation action? Are the proper laws, ordinances, and resolutions in place to implement the action?
- Costs: Does Sherman have the authority to implement the proposed action? Are there any potential legal consequences? Will the community be liable for the actions or support of actions, or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

❑ **Economic:**

- Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals, such as capital improvements or economic development?
- Costs: Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? What proposed actions should be considered but be tables for implementation until outside sources of funding are available?

❑ **Environmental:**

- Benefits: Will this action beneficially affect the environment (land, water, endangered species)?

- Costs: Will this action comply with local, state, and federal environmental laws and regulations? Is the action consistent with community environmental goals?

Each proposed mitigation strategy presented in this plan was evaluated and quantitatively assigned a "benefit" score and a "cost" score for each of the seven STAPLEE criteria, as outlined below:

- ❑ For potential benefits, a score of "1" was assigned if the project will have a beneficial effect for that particular criterion, or a "0" if the project would have a negligible effect or if the questions were not applicable to the strategy.
- ❑ For potential costs, a score of "-1" was assigned if the project would have an unfavorable impact for that particular criterion, or a "0" if the project would have a negligible impact or if the questions were not applicable to the strategy.
- ❑ Technical and Economic criteria were double-weighted (x2) in the final sum of scores.
- ❑ The total benefit score and cost score for each mitigation strategy was summed to determine each strategy's final STAPLEE score.

An evaluation matrix with the total scores from each strategy can be found in Appendix A. Strategies are prioritized according to final score in Section 10. The highest scoring is determined to be of more importance, economically, socially, environmentally, and politically and, hence, prioritized over those with lower scoring.

In addition, structural projects were also evaluated qualitatively. The results of the qualitative assessment are included in Appendix A.

## **1.5 Discussion of Benefit-Cost Ratio**

Although a community may implement recommendations as prioritized by the STAPLEE method, an additional consideration is important for those recommendations that may be

funded under the FEMA mitigation grant programs. To receive federal funding, the mitigation action must have a benefit-cost ratio (BCR) that exceeds one. Calculation of the BCR is conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation may be complex, varying with the mitigation action of interest, and dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

Although it is beyond the scope of this plan to develop precise BCRs for each recommendation, the likelihood of receiving funding is estimated for each recommendation as presented in Appendix A. When pursuing grants for selected projects, this information can be used to help select the projects that have the greatest chance of successfully navigating through the application review process.

## **1.6 Documentation of the Planning Process**

The Town of Sherman is a member of the Housatonic Valley Council of Elected Officials (HVCEO), the regional planning body responsible for Sherman and nine other member municipalities: Bethel, Bridgewater, Brookfield, Danbury, New Fairfield, New Milford, Newtown, Redding, and Ridgefield. Natural hazard pre-disaster mitigation plans are being concurrently developed for the City of Danbury and Town of New Fairfield. The remaining seven municipalities do not have hazard mitigation plans developed in accordance with the DMA.

Mr. David Hannon of the HVCEO coordinated the development of this Hazard Mitigation Plan. The HVCEO applied for the planning grant from FEMA through the Connecticut Department of Environmental Protection (DEP) and has administered the grant. The adoption of this Plan in the town of Sherman will be coordinated by the Town of Sherman with the assistance of HVCEO. In addition, the HVCEO provided Geographic Information System (GIS) base mapping to support the creation of the figures presented in this document.

Milone & MacBroom, Inc. (MMI) compiled the subject plan. The following individuals from the Town of Sherman provided information, data, studies, reports, and observations and were involved in the development of the Plan:

- ❑ Ms. Andrea O'Connor, First Selectwoman
- ❑ Mr. Ron Cooper, Land Use Enforcement Officer
- ❑ Mr. Don Borkowski, Supervisor, Department of Public Works
- ❑ Mr. Dave Raines, Director, Office of Emergency Management
- ❑ Ms. Christine Walsh, Sherman Volunteer Fire Department

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the town, as well as to identify areas that should be prioritized for hazard mitigation. Appendix B contains copies of meeting minutes, field notes and observations, the public information meeting presentation, and other records that document the development of this Natural Hazard Pre-Disaster Mitigation Plan. The following is a list of meetings that were held as well as other efforts to develop this Hazard Mitigation Plan:

- ❑ ***Field inspections were performed on May 20, 2010.*** Observations were made of problem areas within the Town by MMI based on preliminary correspondence with local officials.
- ❑ ***A project meeting with Town officials was held on May 20, 2010.*** Necessary documentation was collected, and problem areas within the town were discussed.
- ❑ ***A public information meeting was held June 11, 2010 at 7:00 p.m.*** Preliminary findings were presented and public comments solicited.

- ❑ ***Field inspections were performed on June 29, 2010.*** Observations were made by MMI of problem areas within the town with the assistance of Mr. Cooper and by the president of the Candlewood Lake Estates Association.
- ❑ ***Field inspections were performed on October 1, 2010.*** Observations were made of potential problem areas within the town by MMI following heavy rainfall associated with Tropical Storm Nicole.
- ❑ ***A public information meeting was held \_\_\_\_, 2011 at \_\_\_\_ P.M.*** The final report conditionally approved by FEMA was presented and public comments solicited prior to approval by the Sherman Board of Selectmen.

#### Public Comment

Residents, business owners, and other stakeholders of Sherman, neighboring communities, and local and regional agencies were invited to the public information meeting via the two local newspapers: the Citizen News (weekly) and the Sentinel (biweekly). Ms. O'Connor described the planning process in her personal column in both newspapers. Copies of these announcements and the column are included in Appendix B.

In addition, 13 private community organizations, as well as individuals known to the First Selectwoman to have experienced flood damage within the Town of Sherman, were directly invited via a mailed copy of the press release that announced the public information meeting. Of these organizations, the Candlewood Lake Estates Association and the Candlewood Echos Association spoke at the meeting, and several other residents attended that were not Town personnel or a commission member. As another direct gauge of public interest, a review of Public Works Department complaint files was undertaken to document problems of public concern.

The Candlewood Lake Authority (the Authority) is an organization consisting of appointed officials from the city of Danbury and the towns of Brookfield, New Fairfield, New Milford, and Sherman. The Authority is charged with managing recreation, public safety, and specific environmental initiatives regarding the lake. The Executive Director of the Authority, Mr. Larry Marsicano, was contacted to provide an opportunity for the Authority to participate in the planning process. Because local officials from Sherman were already involved with the planning process, some redundancy exists and any concerns related to the lake had already been raised during the project meetings. Mr. Marsicano recommended that First Light be contacted regarding management of the dams and dikes that impound the lake. Refer to Section 8 for a review of the Emergency Action Plan for the dams and dikes.

Additional opportunities for the public to review the Plan will be implemented in advance of the public hearing to adopt this plan, tentatively scheduled for autumn 2010, contingent on receiving conditional approval from FEMA. The draft that is sent for FEMA review will be posted on the Town website (<http://www.townofshermanct.org/>) and the HVCEO website (<http://www.hvceo.org>) to provide opportunities for public review and comment, and a review draft will be made available in the Sherman Public Library. Such comments will be incorporated into the final draft where applicable. The public and interested parties will be notified of the opportunity to review the Plan via the two websites and in the two local newspapers.

Upon receiving conditional approval from FEMA, the public hearing will be scheduled, at which time any remaining comments can be addressed. If any final Plan modifications result during the comment period leading up to and including the public hearing to adopt the Plan, these will be submitted to FEMA as page revisions with a cover letter explaining the changes. It is not anticipated that any major modifications will occur at this phase of the project.

## **2.0 COMMUNITY PROFILE**

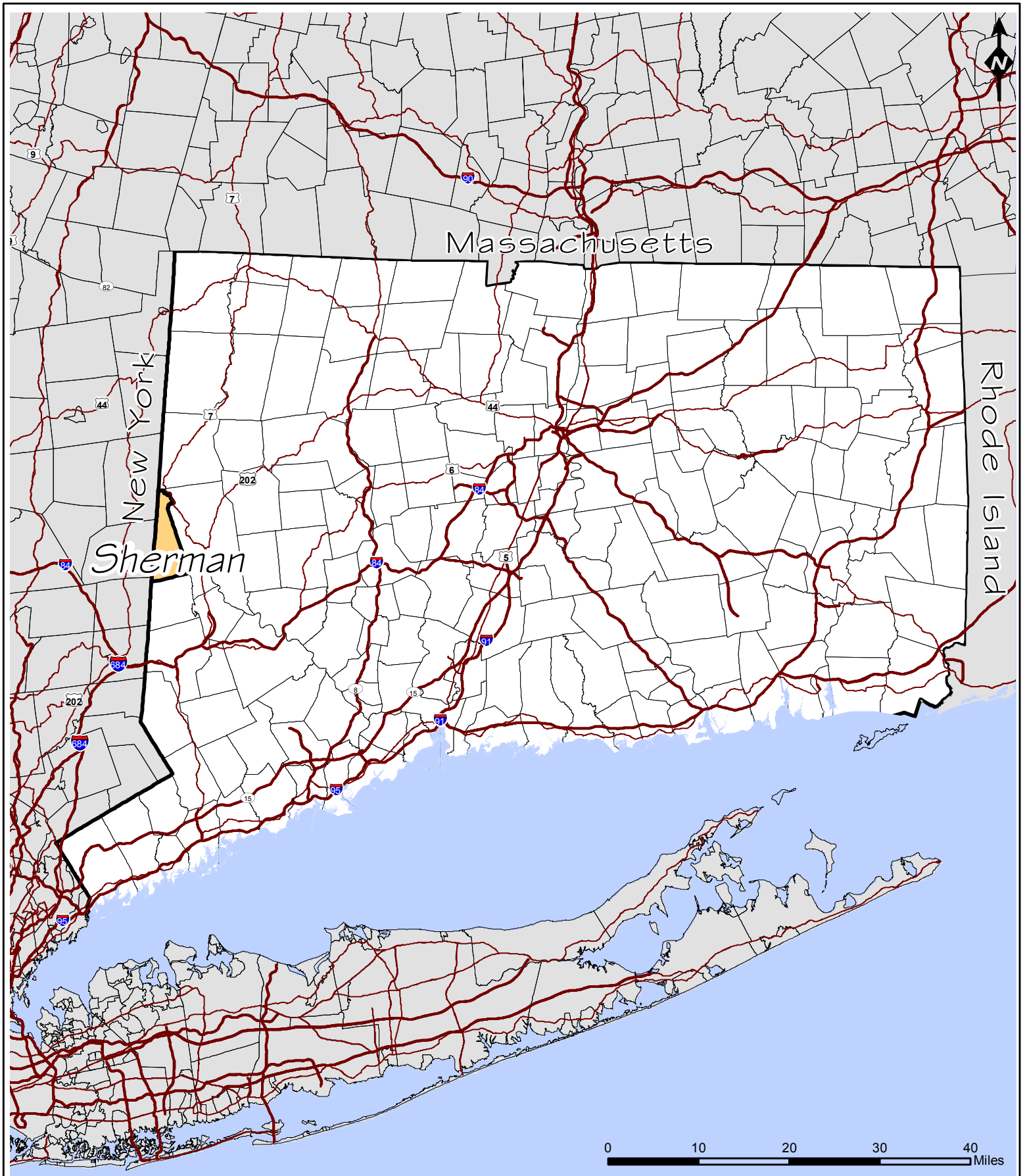
### **2.1 Physical Setting**

The town of Sherman is located in northern Fairfield County along the New York state border. Sherman is bordered by the Connecticut municipalities of Kent to the north, New Milford to the east, and to the south by New Fairfield. It is bordered to the west (from north to south) by the municipalities of Dover, Pawling, and Patterson, New York. Refer to Figures 2-1 and 2-2 for maps showing the regional location of Sherman and within the HVCEO region.

Sherman is located in the Western Highlands of Connecticut. The topography of the Town is characterized by a narrow central valley bounded to the west and east by a series of high hills and mountains broken by narrow stream valleys. Peaks in the southwestern part of town reach elevations nearing 1,300 feet above sea level. An arm of Candlewood Lake extends from the New Fairfield border about three miles into Sherman. The central valley surrounding the lake contains productive agricultural soils. The varying terrain of Sherman makes the town vulnerable to an array of natural hazards.

### **2.2 Existing Land Use**

Sherman is a rural municipality characterized by low population density, active agricultural uses, and very limited commercial development. The need for on-site water supply and septic disposal limits density throughout the community. In general, low-density residential uses are located around Candlewood Lake and low-density residential and agricultural uses are located along the major transportation corridors through Sherman, namely State Routes 37, 39, and 55. A small Town Center with limited commercial, municipal, and institutional land uses is located just north of Candlewood Lake at the junction of Routes 37 and 39.

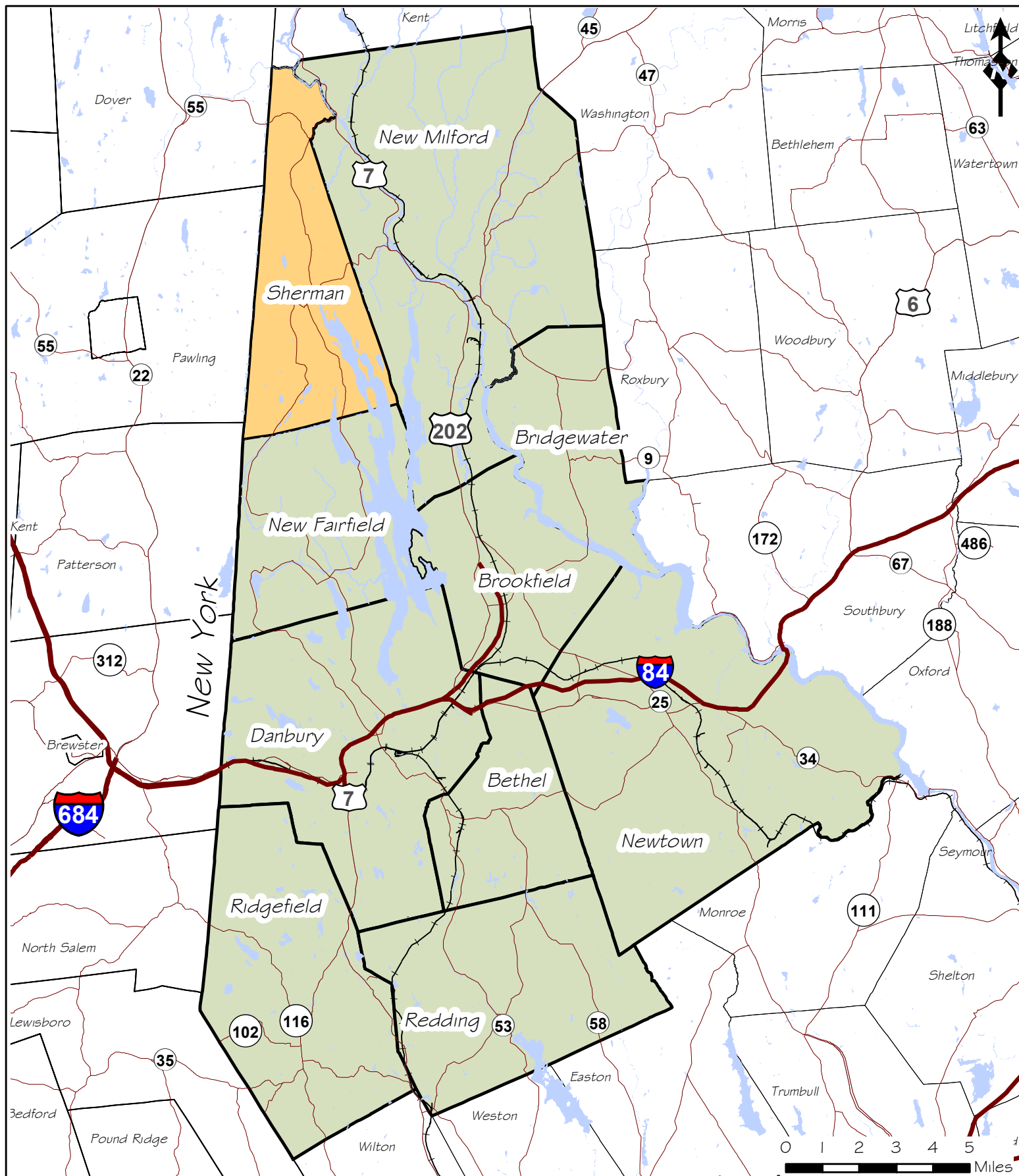


**Figure 2-1:**  
**Location Map**

**Natural Hazard**  
**Pre-Disaster Mitigation Plan**  
**Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 9/1/2010  
**MMI#:** 3101-04

**SOURCE:**  
 Connecticut Department of Environmental  
 Protection Map & Geographic Information  
 Center (2009).  
 Streetmap USA (2009).



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**Figure 2-2:  
HVCEO Regional Map**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT

**DATE:** 9/1/2010

**MMI#:** 3101-04

**SOURCE:**

CTDEP, Map & Geographic Information  
Center (2009).  
Streetmap USA (2009).

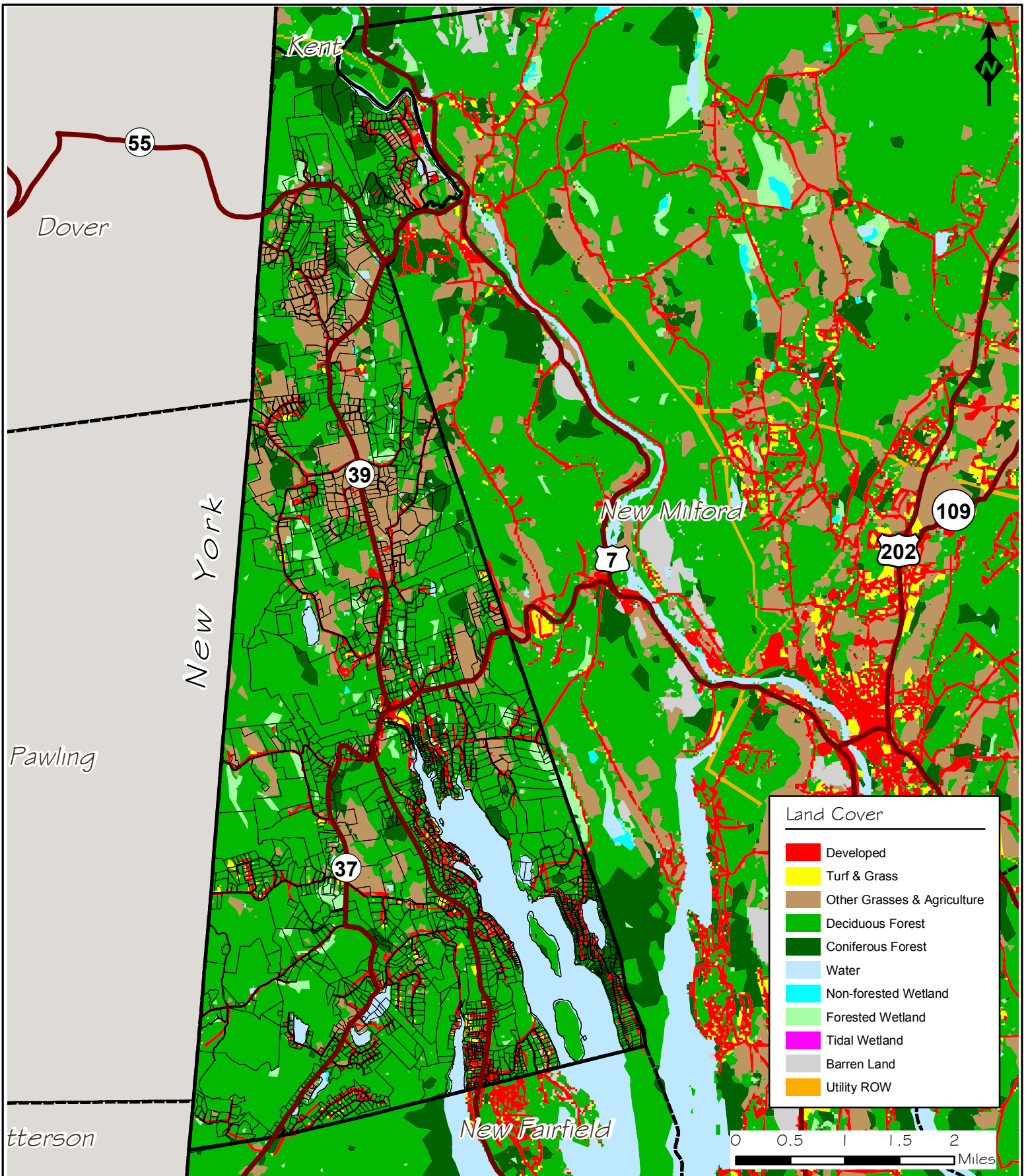
Table 2-1 summarizes 2006 land cover data which was derived from satellite imagery. According to this data, about two-thirds of the Town's approximate 23.4 square miles is forested.

**Table 2-1  
2006 Land Cover by Area**

<b>Land Cover</b>	<b>Area (acres)</b>	<b>Percent of Town</b>
Deciduous Forest	9,117	60.9%
Developed	1,413	9.4%
Agricultural Field	1,265	8.4%
Water	1,164	7.8%
Coniferous Forest	880	5.9%
Turf & Grass	663	4.4%
Forested Wetland	344	2.3%
Undefined	180	0.1%
Other Grasses	112	0.8%
Barren	7	0.0%
Non-Forested Wetland	6	0.0%
Utility (Forest)	1	0.0%
<b>Total</b>	<b>14,972</b>	<b>100%</b>

*Source: UCONN Center for Land Use Education and Research (CLEAR)*

Figure 2-3 presents generalized land uses based on the 2006 land cover data. Areas shown as turf and grass are maintained grasses such as residential and commercial lawns or golf courses. The southwestern and far northern parts of Sherman are predominantly forested. Agricultural and residential uses are interspersed through the central part of the community, with higher density residential uses situated around Candlewood Lake.



**Figure 2-3:  
2002 Land Cover**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT

**DATE:** 8/19/2010

**MMI#:** 3101-04

**SOURCE:**  
UCONN CLEAR, 2010.  
StreetMaps USA, 2010.



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## 2.3 Geology

Geology is important to the occurrence and relative effects of natural hazards such as earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in Sherman. The following discussion highlights Sherman's geology at several regional scales. Geologic information discussed in the following section was acquired in GIS format from the United States Geological Survey and the Connecticut Department of Environmental Protection.

In terms of North American bedrock geology, the Town of Sherman is located in the northeastern part of the Appalachian Orogenic Belt, also known as the Appalachian Highlands. The Appalachian Highlands extend from Maine south into Mississippi and Alabama and were formed during the orogeny that occurred when the super-continent Pangaea assembled during the late Paleozoic era. The region is generally characterized by deformed sedimentary rocks cut through by numerous thrust faults.

### ***Bedrock Geology***

Connecticut bedrock geology is comprised of several "terranes." Terranes are geologic regions that reflect the role of plate tectonics in Connecticut's natural history.

The bedrock beneath the Town of Sherman is part of the Proto-North American (Continental) Terrane, comprised of Early Paleozoic and Proterozoic metamorphosed and sedimentary and igneous rocks. This terrane formed when part of present day South America collided with present day New York. Some of the formations were later modified by collisions with formations related to the Iapetus Ocean (the precursor to the Atlantic Ocean).

In terms of New England bedrock geology, the town of Sherman lies within the Eugeosyncline Sequence and the Grenville Shelf Sequence. Bedrock formations belonging to the Eugeosyncline Sequence are typically deformed, metamorphosed, and intruded by small to large igneous plutons, while bedrock belonging to the Grenville Shelf Sequence consist primarily of metamorphic, pelitic, and carbonate rock.

The town of Sherman's bedrock consists primarily of Early Paleozoic metasedimentary and metaigneous schists of the Taconic Allochthons (displaced Iapetus Terrane) (in the west); metamorphic marble, schist, and quartzite of a Early Paleozoic continental shelf sequence in the north; and granitic gneiss of the "Grenville" basement from Proterozoic Y age (approximately one billion years old). The bedrock alignment trends generally southeast to north through the Town. Table 2-2 and Figure 2-4 present the bedrock geology in the Town of Sherman.

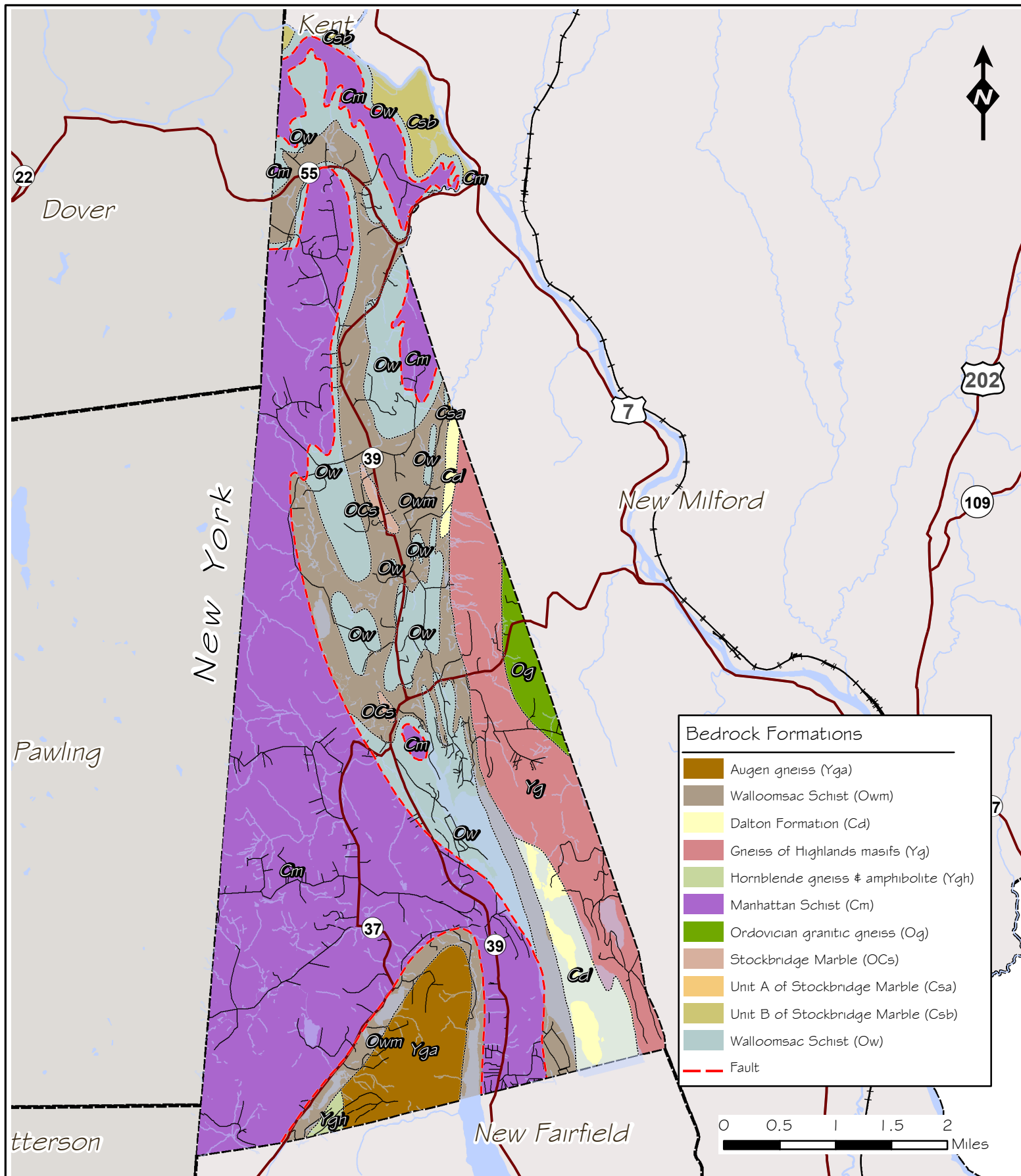
**Table 2-2**  
**Bedrock Geology**

<b>Formation</b>	<b>Area (acres)</b>	<b>Percent of Town</b>
Manhattan Schist	6,758	45.1%
Basal marble member of Walloomsac Schist	2,641	17.6%
Walloomsac Schist	2,223	14.8%
Gneiss of Highlands mastiffs	1,555	10.4%
Augen gneiss	687	4.6%
Dalton Formation	539	3.6%
Unit b of Stockbridge Marble	245	1.6%
Ordovician? granitic gneiss	223	1.5%
Stockbridge Marble	58	0.4%
Hornblende gneiss and amphibolite	39	0.3%
Unit "a" of Stockbridge Marble	4	0.0%
<b>Total</b>	<b>14,972</b>	<b>100%</b>

*Source: Connecticut Department of Environmental Protection GIS Data*

The four primary bedrock formations in the town (from west to east) are Manhattan Schist, Basal marble member of Walloomsac Schist, Walloomsac Schist, and Gneiss of Highlands mastiffs.

- ❑ The Manhattan Schist is a dark-gray to silvery, rusty-weathering, coarse-grained schistose gneiss.
- ❑ The basal marble member of the Walloomsac Schist is a dark- to light-colored schistose marble.



**Figure 2-4:  
Bedrock Geology**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 8/19/2010  
**MMI#:** 3101-04

**SOURCE:**  
Connecticut Department of Environmental  
Protection Map & Geographic Information  
Center (2009).  
Streetmap USA (2009)



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- ❑ The Walloomsac Schist is a dark, fine-grained schist.
- ❑ The Gneiss of Highlands mastiffs consist of granitic gneiss, gneiss, and schist.

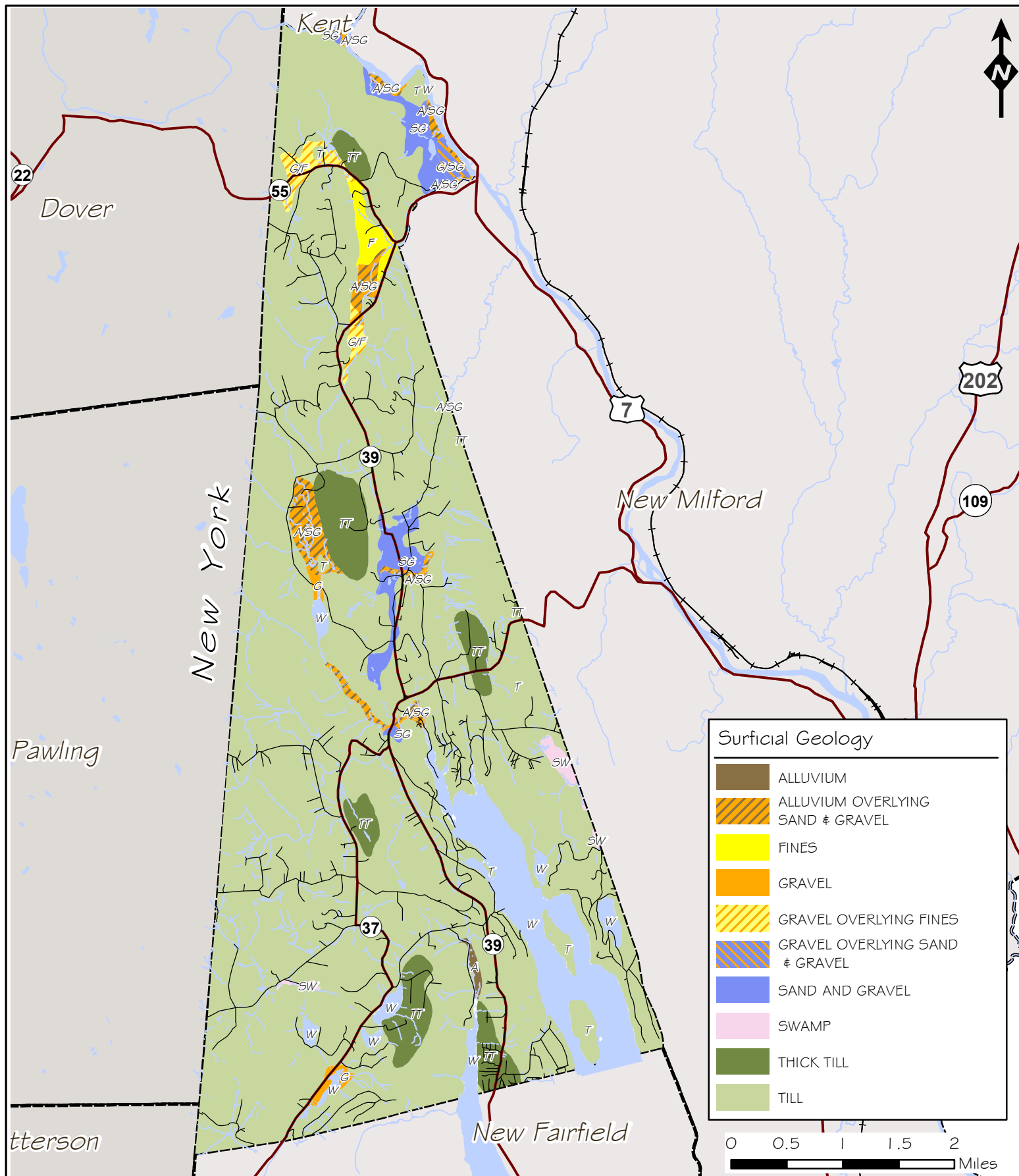
Four faults are mapped in the town of Sherman. Each fault is defined as being a "klippe or outlier of upper plate of thrust fault beneath Taconic Allochthons" in the bedrock geology GIS database based on the 1985 *Bedrock Geologic Map of Connecticut*. A klippe is the remnant portion of a "nappe" (a large, sheet-like body of rock that has slid more than 1.2 miles from its original position) after erosion has removed the remnants of the nappe. These faults occur along the geologic contacts of the Manhattan Schist throughout the Town and are believed to be inactive. Bedrock outcrops are prevalent in Sherman, particularly along higher elevations and on hilltops.

Continental ice sheets moved across Connecticut at least twice in the late Pleistocene. As a result, Sherman's surficial geology is characteristic of the depositional environments that occurred during glacial and postglacial periods. Refer to Table 2-3 and Figure 2-5 for a depiction of surficial geology.

**Table 2-3**  
**Surficial Geology**

<b>Surficial Material</b>	<b>Area (acres)</b>	<b>Percent of Town</b>
Till	12,251	81.8%
Water	1,000	6.7%
Thick Till	732	4.9%
Sand and gravel	323	2.2%
Alluvium overlying sand and gravel	285	1.9%
Gravel overlying fines	122	0.8%
Fines	97	0.6%
Swamp	56	0.4%
Gravel	46	0.3%
Gravel overlying sand and gravel	35	0.2%
Alluvium	25	0.2%
<b>Total</b>	<b>14,972</b>	<b>100%</b>

*Source: Connecticut Department of Environmental Protection GIS Data*



**Figure 2-5:  
Surficial Geology**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 8/19/2010  
**MMI#:** 3101-04

**SOURCE:**  
Connecticut Department of Environmental  
Protection Map & Geographic Information  
Center (2009).  
Streetmap USA (2009).

Sherman is covered primarily by glacial till and water related to the various water bodies in town. Tills contain an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. Till is present throughout Sherman, with stratified drift deposits concentrated near the Housatonic River and its tributaries in northern Sherman, and around the lower parts of Sawmill Brook in the central valley of Sherman.

In terms of soil types, approximately 63% of Sherman contains Charlton-Chatfield complex, Hollis-Chatfield-Rock outcrop complex, Stockbridge loam, and Georgia and Amenia silt loams (Table 2-4). The remainder of the town has soil types of consisting primarily of rocky soils, various sandy loams, silt loams, wetland soils, and urban land. The following soil descriptions are taken in part from the official series descriptions from the United States Department of Agriculture (USDA) website.

*The amount of stratified drift present in the Town is important as areas of stratified materials are generally coincident with inland floodplains. These materials were deposited at lower elevations by glacial streams, and these valleys were later inherited by the larger of our present day streams and rivers. However, the smaller glacial till watercourses throughout Sherman can also cause flooding.*

*The amount of stratified drift also has bearing on the relative intensity of earthquakes and the likelihood of soil subsidence in areas of fill.*

- ❑ The Charlton-Chatfield complex consists of moderately deep to deep, well-drained, and somewhat excessively drained soils formed in glacial till. They are very nearly level to very steep soils on glaciated plains, hills, and ridges. The soil is often stony or very stony. Slope ranges from three to 45%. Crystalline bedrock is at depths of 20 to 40 inches. Saturated hydraulic conductivity is moderately high to high in the mineral soil.

**Table 2-4**  
**Soil Classifications**

<b>Soil Type</b>	<b>Area (acres)</b>	<b>Percentage of Town</b>
Charlton-Chatfield complex	2,903	19.4%
Hollis-Chatfield-Rock outcrop complex	2,494	16.6%
Stockbridge loam	2,435	16.3%
Georgia and Amenia silt loams	1,582	10.5%
Other sandy loams	1,064	7.1%
Water	1,021	6.8%
Ridgebury, Leicester, and Whitman soils	734	4.9%
All other soils	646	4.3%
Rock-outcrop-Hollis complex	593	4.0%
Farmington-Nellis complex, very rocky	547	3.7%
Canton and Charlton soils	509	3.4%
Other silt loams	444	3.0%
<b>Total</b>	<b>14,972</b>	<b>100%</b>

*Source: 2007 Soil Survey Geographic (SSURGO) database for the State of Connecticut*

- ❑ Hollis-Chatfield-Rock outcrop complex soils are characterized as being 35% Hollis soils, 30% Chatfield soils, 15% rock outcrop, and 20% minor components.
  - Hollis soils are well drained or somewhat excessively drained, gently sloping to steep soils that are very shallow or shallow over crystalline bedrock, including schist or gneiss. Their permeability is moderate or moderately rapid.
  - Chatfield soils are moderately deep, well drained, and somewhat excessively drained soils formed in till. They are nearly level through very steep and occur on convex bedrock-controlled glaciated upland landscapes.
  - Rock outcrops are mapped in area where exposed bedrock occupies more than 50% of the surface. Most of the exposed rock is schist, gneiss, and granite. Slopes are gentle to hilly or steep.
  
- ❑ The Stockbridge series consists of well-drained, nearly level to hilly soils that developed in firm or very firm glacial till. Permeability is moderate in the surface layer and subsoil but is slow or very slow in the substratum.

- Georgia and Amenia silt loams include the following:
  - The Georgia series consists of very deep, moderately well-drained soils on glaciated uplands.
  - The Amenia series is made up of very deep, moderately well-drained soils that developed in firm to very firm calcareous glacial till. They occur on drumlins or drumloidal hills, generally downslope from well-drained Stockbridge soils. The soils are moderately permeable in the surface layer and subsoil but are slowly or very slowly permeable in the substratum. Their available moisture capacity is high.

## 2.4 Climate

Sherman has an agreeable climate, characterized by moderate but distinct seasons. The mean annual temperature is approximately 50.6 degrees Fahrenheit based on temperature data collected by the National Climatic Data Center (NCDC) from 2002-2008. Summer temperatures rise in the mid-80s and winter temperatures dip into the upper 20s to mid-30s as measured in Fahrenheit. Extreme conditions raise summer temperatures to near 100 degrees and winter temperatures to below zero. Median snowfall is approximately 52 inches per year. Mean annual precipitation is 44.7 inches, spread evenly over the course of a year.

By comparison, average annual statewide precipitation based on more than 100 years of

*The continued increase in precipitation only heightens the need for hazard mitigation planning as the occurrence of floods may change in accordance with the greater precipitation.*

record is nearly the same, at 45 inches. However, average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19<sup>th</sup> century (Miller et. al., 1997; NCDC, 2005). Likewise, total annual precipitation in the Town has increased over time.

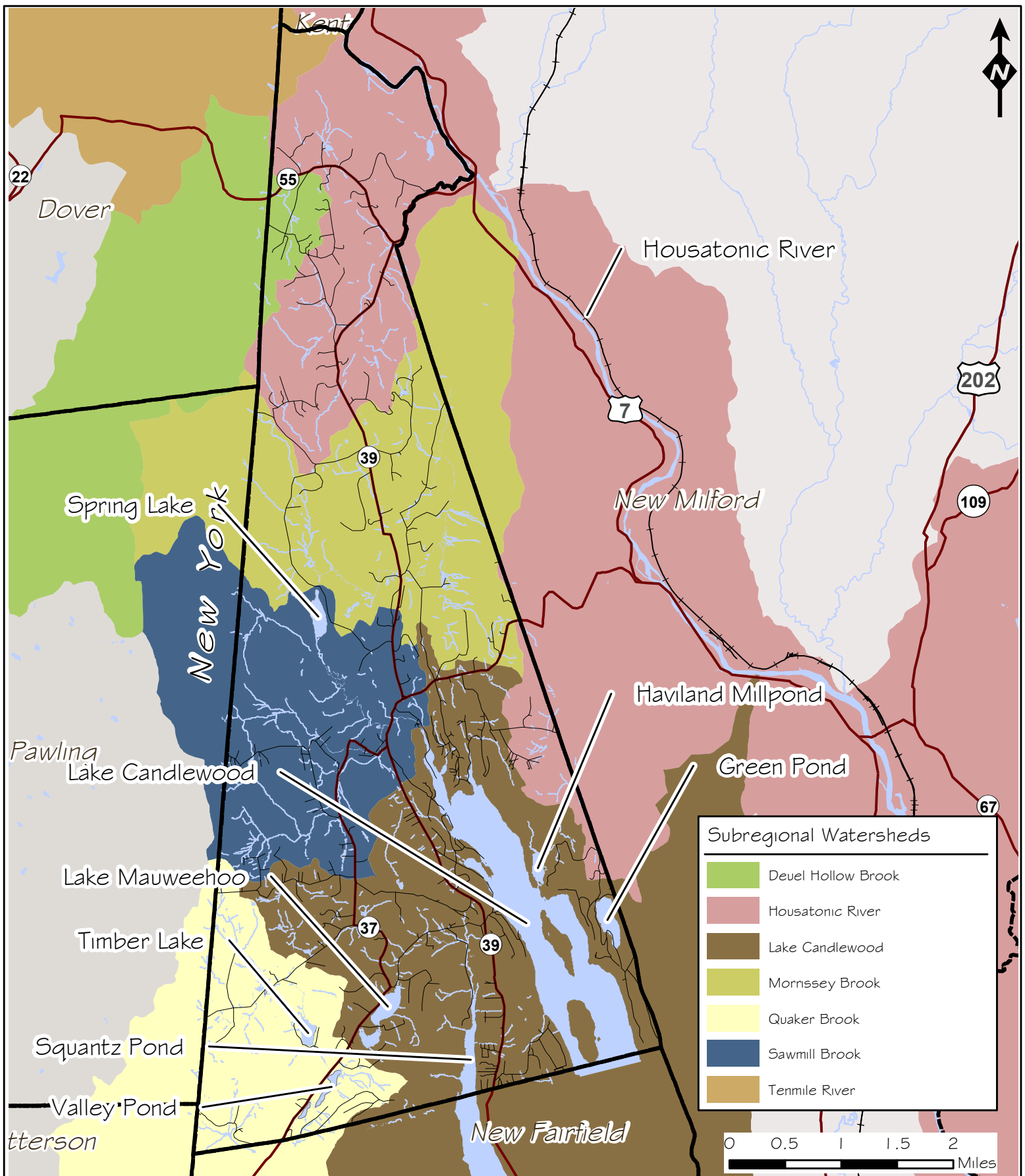
## 2.5 Drainage Basins and Hydrology

Sherman is divided among seven subregional watersheds as shown on Figure 2-6 and in Table 2-5. The majority of the drainage basins drain back to the Housatonic River. Streams in the northern part of town flow into the Housatonic River directly via the Tenmile River and/or its tributary, Deuel Hollow Brook, or via Naromiyocknowhusunkatankshunk Brook (formerly known as Morrissey Brook, abbreviated as "Naromi" for this document). Streams in the central and southern areas of town either drain directly into Candlewood Lake or its tributary Saw Mill Brook. The southwestern corner of town drains to Quaker Brook, which flows eventually to the Hudson River in New York state.

**Table 2-5**  
**Subregional Drainage Basins**

<b>Drainage Basin</b>	<b>Area (sq. mi)</b>	<b>Percent of Town</b>
Candlewood Lake	7.78	33.3%
Housatonic River	4.52	19.3%
Naromi Brook	4.12	17.6%
Sawmill Brook	3.74	16.0%
Quaker Brook	2.54	10.9%
Deuel Hollow Brook	0.47	2.0%
Tenmile River	0.22	0.9%
<b>Total</b>	<b>23.39</b>	<b>100.0%</b>

*Source: Connecticut Department of Environmental Protection GIS Data*



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**Figure 2-6:  
Subregional Watersheds**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT

**DATE:** 9/1/2010

**MMI#:** 3101-04

**SOURCE:**

Connecticut Department of Environmental Protection Map & Geographic Information Center (2009).  
Streetmap USA (2009).

## Housatonic River

The Housatonic River originates in western Massachusetts with its main stem forming at the confluence of the west and southwest branches in Pittsfield. From there, the river flows 132 miles through western Massachusetts and Connecticut to its mouth at Long Island Sound at Milford Point in Connecticut. The Housatonic River watershed covers 1,948 square miles in three states (Connecticut, Massachusetts, and New York). The Housatonic River has several hydroelectric power dams and diversions within the state of Connecticut.

The Housatonic River forms approximately 2.1 linear miles of Sherman's boundary with the town of New Milford. The watershed for the Housatonic River and its tributaries covers 89% of the land area of Sherman. About 19% of Sherman drains directly to the river, with these areas being primarily in the northern and eastern sections of town. The Tenmile River is one of the Housatonic River's major tributaries, and it joins the Housatonic River along Sherman's northern border with the town of Kent. The entire length of the Housatonic River in Sherman has 100-year floodplains defined with elevations.

## Candlewood Lake

Candlewood Lake is the country's first pump-storage reservoir and, at 5,400 acres, is the largest lake in Connecticut. The reservoir was constructed to support power generation at the Rocky River power station in New Milford. Since 1926, water has been diverted from the Housatonic River and pumped uphill into the Lake. During low-flow conditions on the Housatonic River, water is released from Candlewood Lake to run the generation turbines and, hence, this water is returned to the Housatonic River.

The Candlewood Lake watershed comprises one-third of the town's land area. Several small streams such as Glen Brook, Greenwood Brook, and Tollgate Brook drain directly

to Candlewood Lake. In addition, Sawmill Brook and its watershed area drain to the lake within Sherman. There is a delineated 100-year floodplain surrounding the lake without elevations defined.

#### Naromiyocknowhusunkatankshunk Brook

This brook was formerly known as Morrissey Brook until it was officially renamed by the Connecticut General Assembly in 2001. It flows northward through central Sherman to join the Housatonic River in neighboring New Milford. The watershed covers about 17% of the town, primarily in the central area. The headwaters of this stream begin west of Sherman in Pawling, New York. The entire stream has a delineated 100-year floodplain without elevations defined.

#### Sawmill Brook

This brook, which is also locally known as Great Brook, flows into Candlewood Lake after draining a portion of central Sherman and a small area of Pawling, New York. The Saw Mill Brook drainage basin covers about 16% of Sherman's land area. This stream is very flashy, and nearby infrastructure has experienced damage during flooding events, particularly the extreme floods that occurred in 1999 and 2007. The entire stream has a delineated 100-year floodplain without elevations defined.

#### Quaker Brook

Quaker Brook is the only subregional watershed in Sherman that does not drain to the Housatonic River. The headwaters of the brook begin in southeastern Dutchess County, New York. The brook loops through southwestern Sherman, passing through Timber Lake, Squantz Pond, and Valley Pond before passing southwest into New Fairfield. Quaker Brook then flows southwest through New Fairfield and then west into Patterson, New York. It eventually joins the East Branch of the Croton River and then the Croton

Reservoir, which serves New York City as a public water supply source. Approximately 11% of the land area in Sherman drains to this brook in the southwestern portion of town. The entire stream has a delineated 100-year floodplain without elevations defined.

#### Deuel Hollow Brook

Deuel Hollow Brook is a tributary of the Tenmile River. Only a small portion of Sherman's land area (2%) in northwestern Sherman flows west to this brook, the channel of which is located in Pawling and Dover, New York.

#### Tenmile River

The Tenmile River flows south through Dutchess County, New York, joining the Housatonic River at Sherman's northern town boundary. It is a primary tributary to the Housatonic River. A very small portion of its 210 square mile watershed is located in northern Sherman, covering approximately 1% of the town's land area. The Tenmile River has a 100-year floodplain with defined elevations along the northern boundary of Sherman.

## **2.6 Population and Demographic Setting**

Sherman had an estimated population of 4,120 in 2009 according to estimates taken by the U.S. Census, with an overall population density of 189 persons per square mile. Sherman ranks 139 out of 169 municipalities in Connecticut in terms of overall population. As noted in Table 2-6, Sherman is the second least densely populated municipality in the region.

**Table 2-6**  
**Population Density by Municipality, Region, and State, 2009**

<b>Municipality</b>	<b>Total Population</b>	<b>Land Area (square miles)</b>	<b>Population Density per Square Mile</b>
Bethel	18,534	16.94	1,094
Bridgewater	1,889	17.36	109
Brookfield	16,680	20.37	819
Danbury	79,743	43.93	1,815
New Fairfield	14,099	25.16	560
New Milford	28,505	63.88	446
Newtown	25,028	58.90	425
Redding	8,836	32.03	276
Ridgefield	24,228	34.86	695
Sherman	4,120	23.39	176
HVCEO Region	221,662	336.82	658
Connecticut	3,518,288	4844.80	726

*Source: United States Census Bureau, 2009 Population Estimates*

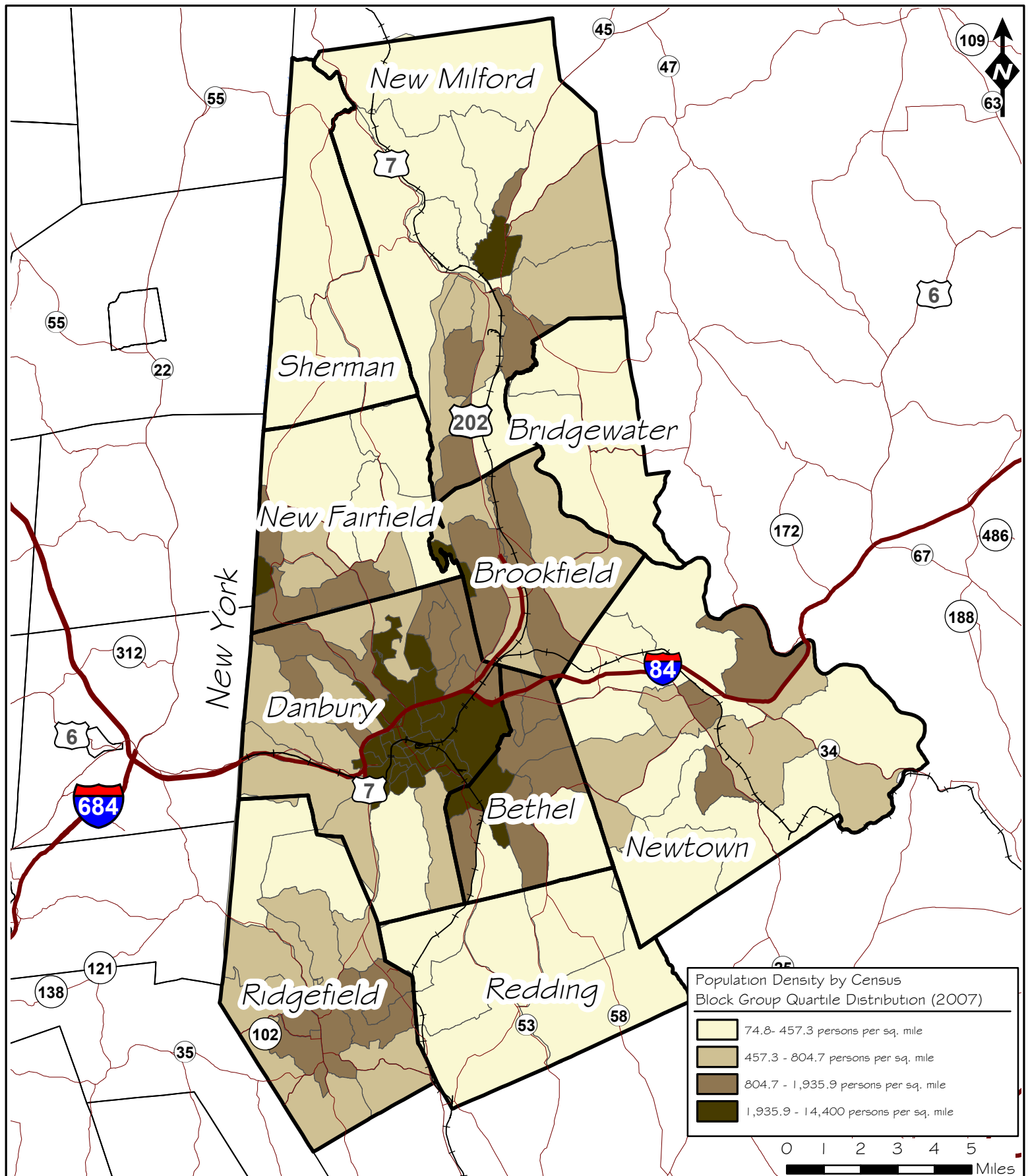
Figure 2-7 presents estimated population density by Census Block Groups for 2007 in the HVCEO region. Figure 2-8 compares 2007 population densities among Sherman's three Census Block Groups. Most residents of Sherman live in the southern half of the town, particularly in the vicinity of Candlewood Lake.

In 1950, Sherman had a population of 549. By 1970, the town's population had increased almost three-fold to 1,459. Continued growth led to a 2000 population of 3,827. The Connecticut State Data Center projects continued population growth in Sherman over the next 20 years and estimates that the 2030 population will be 4,823.

Sherman has small populations of people who are linguistically isolated, elderly, and/or disabled. These are depicted by the three census blocks in Sherman on Figures 2-9, 2-10,

***Elderly, linguistically isolated, and disabled populations have numerous implications for hazard mitigation as they may require special assistance or different means of notification before and during natural hazards.***

and 2-11, respectively. Not surprisingly, the more populated Census Block groups include a higher number of individuals. These needs will be discussed in subsequent sections.



**Figure 2-7:**  
**Population Density by Census Block Groups**  
**for HVCEO Region**

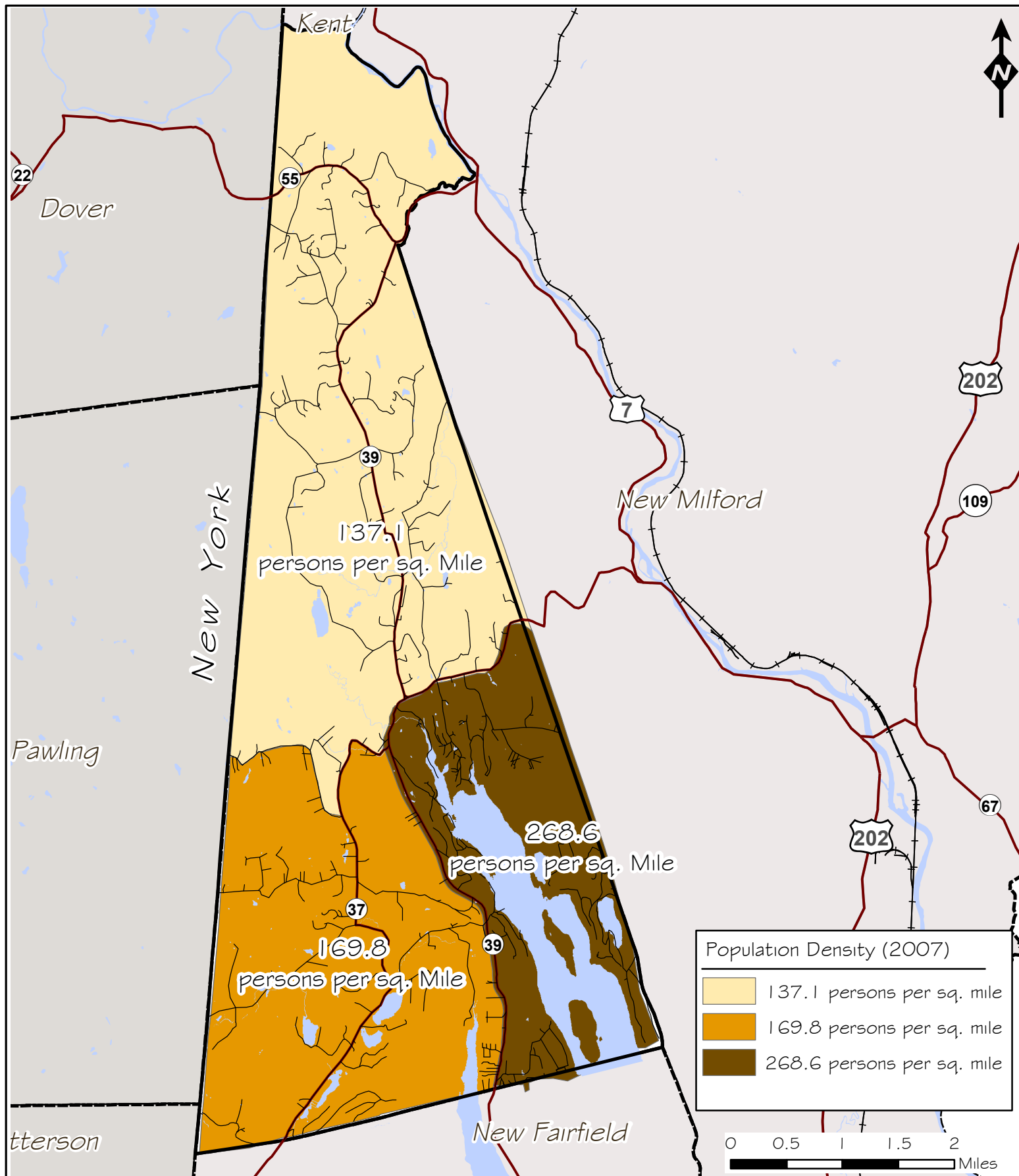
**LOCATION:** Sherman, CT

**DATE:** 8/19/2010

**MMI#:** 3101-04

**Natural Hazard**  
**Pre-Disaster Mitigation Plan**  
**Town of Sherman, Connecticut**

**SOURCE:**  
 US Census, American Community  
 Survey (2010).  
 CTDEP, Map & Geographic Information  
 Center (2009).



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**Figure 2-8:  
Population Density**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

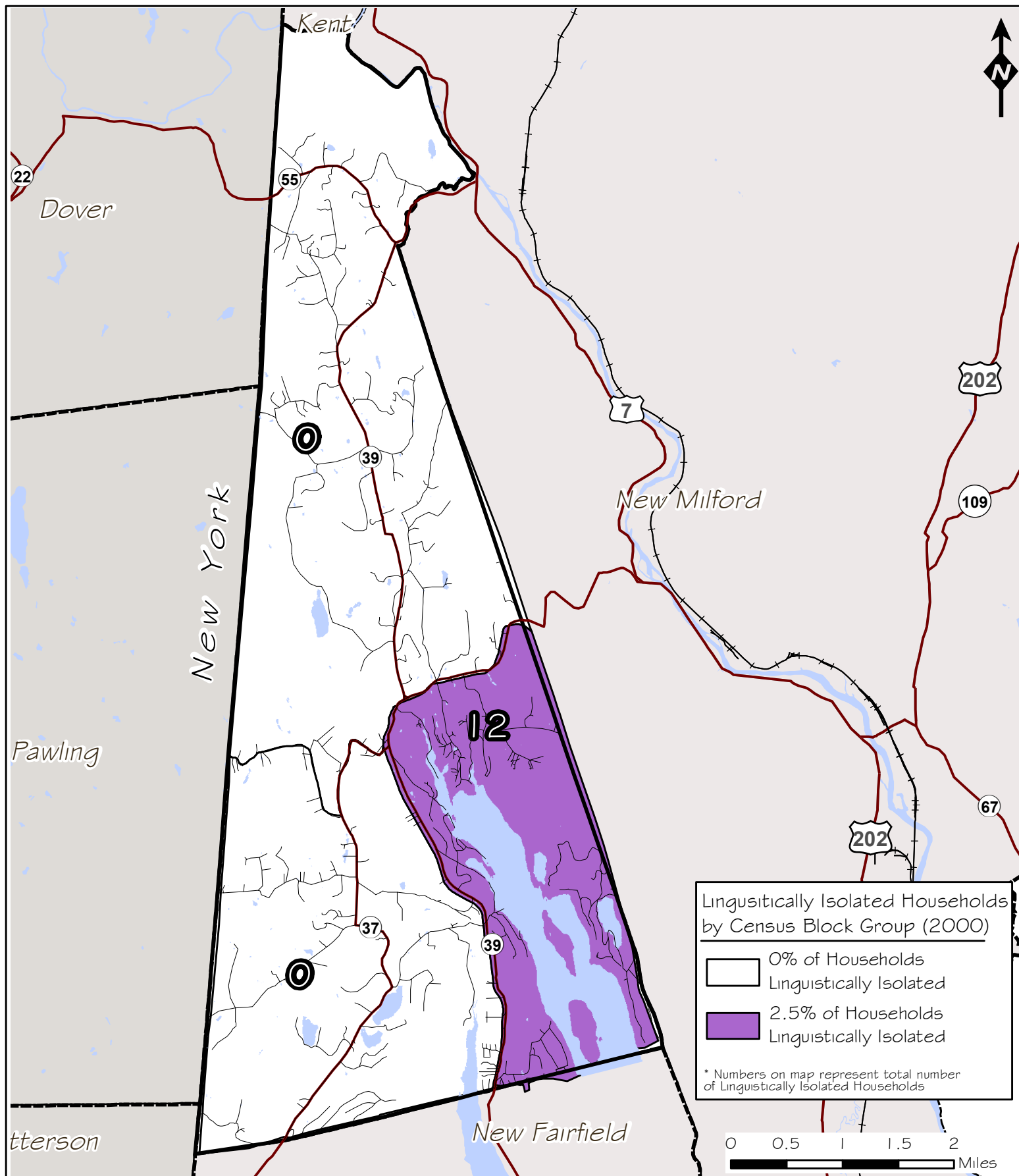
**LOCATION: Sherman, CT**

**DATE: 8/19/2010**

**MMI#: 3101-04**

**SOURCE:**

US Census, American Community Survey (2010).  
CTDEP, Map & Geographic Information Center (2009).

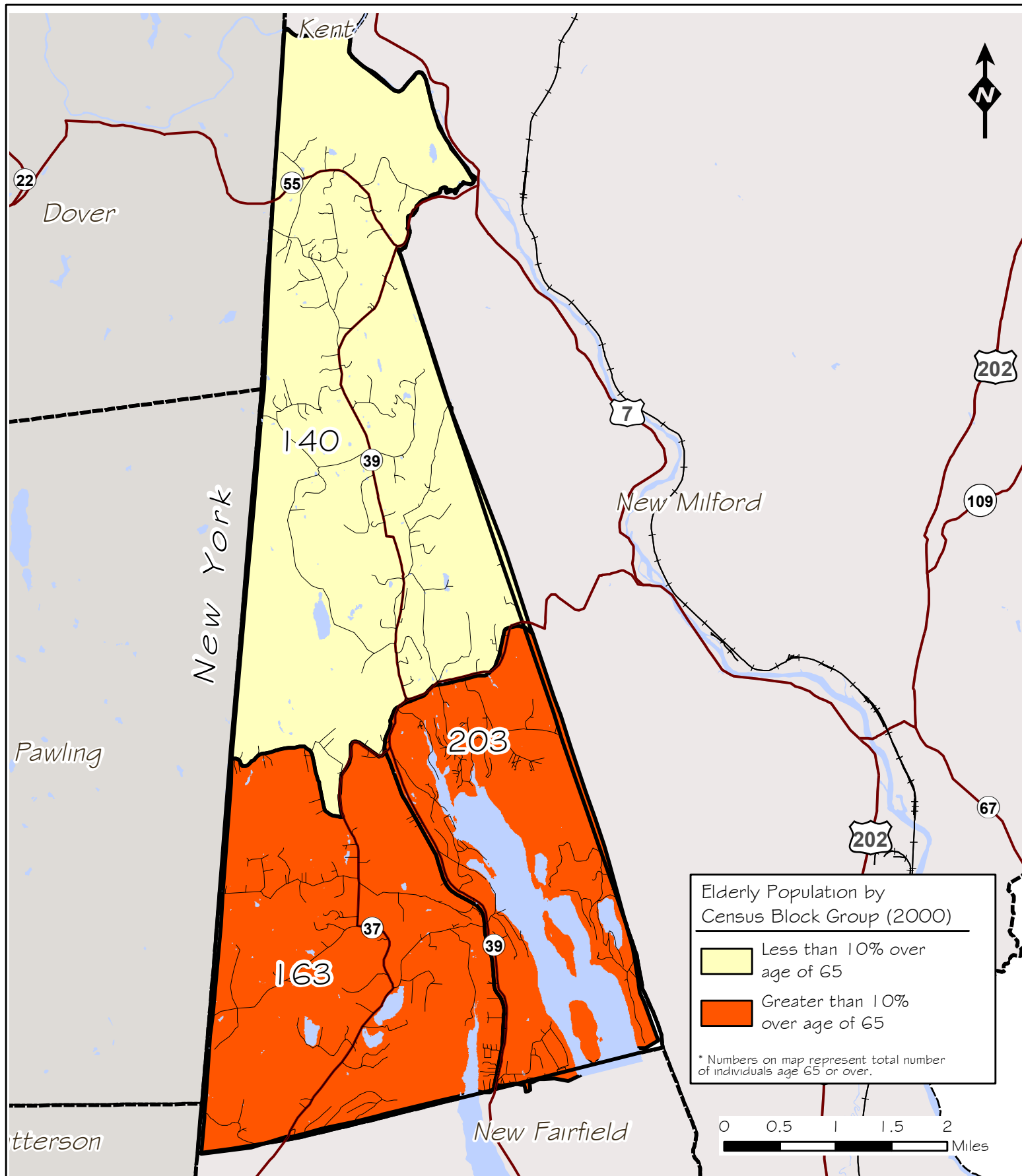


**Figure 2-9:  
Linguistically Isolated Households**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 9/1/2010  
**MMI#:** 3101-04

**SOURCE:**  
US Census, American Community  
Survey (2010).  
CTDEP, Map & Geographic Information  
Center (2009).  
StreetMaps USA, 2010



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**Figure 2-10:  
Elderly Population**

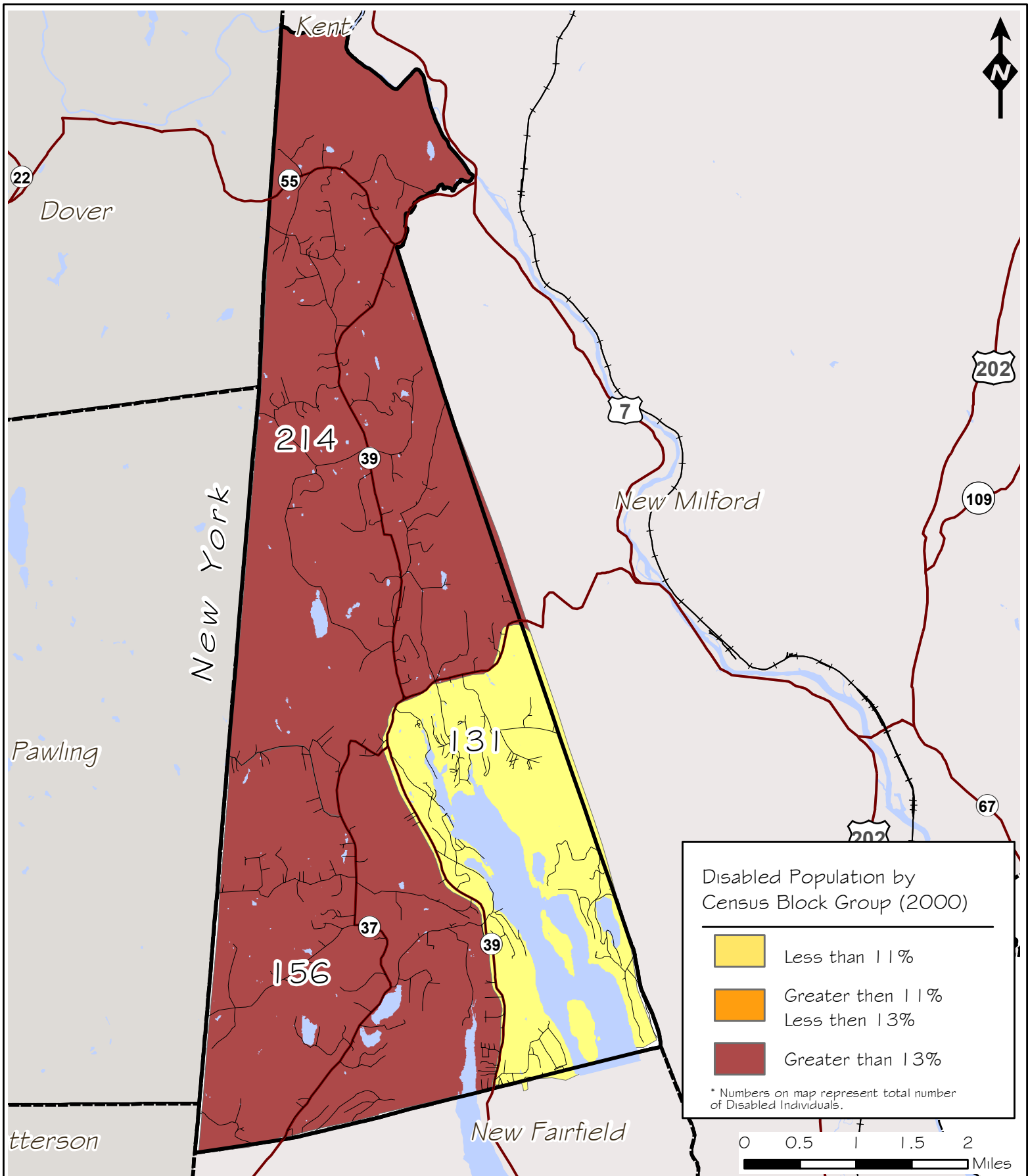
**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION: Sherman, CT**

**DATE: 9/1/2010**

**MMI#: 3101-04**

**SOURCE:**  
US Census, American Community  
Survey, (2010).  
CTDEP, Map & Geographic Information  
Center (2009).  
StreetMaps USA, (2010).



**Figure 2-11:  
Disabled Population**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION: Sherman, CT**

**DATE: 9/1/2010**

**MMI#: 3101-04**

**SOURCE:**  
US Census, American Community  
Survey (2010).  
CTDEP, Map & Geographic Information  
Center (2009).  
StreetMaps USA, (2010).

## **2.7 Governmental Structure**

The Town of Sherman is governed by a Selectman-Town Meeting form of government in which legislative responsibilities are shared by the Board of Selectmen and the Town Meeting. The First Selectman serves as the chief executive.

In addition to the Board of Selectmen and the Town Meeting, there are boards, commissions and committees providing input and direction to Town administrators, while Town departments provide municipal services and day-to-day administration. Many of these commissions and departments play a role in hazard mitigation, including the Planning and Zoning Commission, the Zoning Board of Appeals, the Inland Wetlands and Watercourses Commission, the Sherman Volunteer Fire Department, the Public Works Department, the Building Official, and the Resident State Trooper.

The Public Works Department is the principal municipal department that responds to problems caused by natural hazards. Complaints related to Town maintenance issues are routed to the Public Works Department and are investigated and remediated as necessary.

As the Town has an almost entirely residential tax base, funding of capital projects is challenging. Sherman relies heavily on outside grants for many projects and upgrades, which can be difficult to obtain due to the small size of the town.

## **2.8 Development Trends**

Sherman was first settled in 1736 as part of a parish in New Fairfield. Early settlers were attracted to the fertile central valley between the Sawmill and Wimisink Brooks. A central village developed close to the banks of Sawmill Brook where small industries including a sawmill, tannery, hat shop, and carriage factory were located. This small village was the precursor to today's Town Center. Despite these industries, agriculture was the mainstay of the community throughout most of its history.

Sherman was incorporated in 1802. Throughout the 19<sup>th</sup> century, most of the valley and many areas of upland plateau were under cultivation and pasture. During the first half of the 19<sup>th</sup> century, the town had a stable population of just under 1,000 residents. However, like many small east coast communities, Sherman lost population as residents sought opportunities in the west. Because of this outmigration, many hillsides and upland farms were abandoned and began to revert to woodland, while most of the valley farms continued to thrive. Population had declined to 600 by 1900, and reached a low of 391 in 1930.

Beginning in the 1920s, infrastructure investments in the community started to affect patterns of development. The state completed construction of Route 37 during the 1920s and shortly thereafter completed Route 39 through town. These two roads remain the most significant accessways into and out of Sherman. Electricity was installed in Sherman in 1927 and, from 1927 to 1929, the Connecticut Light & Power Company constructed Candlewood Lake. Sherman lost several good farms with the flooding of Candlewood Lake, but gained a resource that significantly influenced later development. Finally, in 1936, a consolidated school was established in the Town Center.

To some degree, Sherman had already established itself as a bucolic retreat for city residents by the 1920s. In 1906, a group of year-round and summer residents constructed Lake Mauweehoo, a 40-acre lake along Route 37, for recreational purposes. Lake Mauweehoo continues to operate as a private club today. While development along Candlewood Lake frontage was sparse through the 1930s and 1940s, it was during this time that Holiday Point, two camps, and a few seasonal homes were developed around the lake.

As development started to increase along new roads and the lake, and population began to rebound, the Town adopted its first zoning regulations in 1937 and first subdivision regulations in 1947. By 1950, the town's population had reached 549. However, it wasn't

until after 1950 that the pace of development in town increased significantly. After World War II, many weekend and summer residents retired to Sherman. Subdivisions at several locations around Candlewood Lake resulted in many new seasonal and year-round homes. From 1950 to 1970, most new development occurred near the shores of Candlewood Lake or Lake Mauweehoo and off Route 39 east of the Town Center and consisted primarily of residential units.

In response to growth pressure, the Town adopted new zoning regulations in 1977 that designated a small residential and commercial village district at Sherman Center, one-acre residential zoning along lakefronts and in the area of Timber Trails (a resort in the south end of town), and two-acre zoning throughout the remainder of Town. The 1978 Sherman Town Plan recommended a strong antisewer policy, which was subsequently adopted and persists today. In addition, the state's adoption of inland wetlands regulations in 1973 prevented development on the wetlands, which compose 11% of Sherman.

Sherman's Town Center continued to develop in the 1970s and 1980s with the expansion of the Consolidated School and municipal recreation facilities, the construction of a small retail center, a new post office, and a new church. During the same period, several new subdivisions were also built out. Population reached 2,281 in 1980 and was 2,809 by 1990. In 1987, the Town amended its zoning regulations to require two-acre zoning on new developments throughout the Town. The Town subsequently amended the zoning regulations to increase the lot size in Zone A (the farm-residential zone comprising all but the lake communities, Timber Trails, and commercial lands) to four acres with slope and wetlands restrictions on the buildable area.

Conservation measures have set aside a large percentage of the Town as open space. The local Naromi Land Trust, the only agency of the Town specifically chartered for the purpose of owning open space lands, conservation easements, agricultural easements, and similar assets, was formed in 1968. The Town also created the Land Acquisition Fund to

fund purchases of open space using tax dollars and bonds. The first land purchase was four acres in the Town Center called "Manch Meadow."

The trust successfully obtained title to 850 acres and permanent conservation restrictions on an additional 150 acres throughout Sherman by 1990. Protected lands included active farmland, fields, forest, subdivision open space, trail land, and wildlife preserve. In 1980, a group of local residents successfully obtained title to a tract of land in the northern part of Town that was subsequently transferred to the National Park Service as a wilderness preserve for the relocation of the Appalachian Trail. Currently, the Town is working on buying a 100-acre farm on Farm Road to covert to open space.

The Town has many planning documents that guide development. In addition to zoning, subdivision, and wetlands regulations, the Town has a Plan of Conservation and Development, a dry hydrant installation ordinance, and a road ordinance. The Town is beginning the process for updating the Plan of Conservation and Development.

***Despite a relatively high percentage of growth, Sherman remains a rural community with little commercial and industrial development. The lack of public sewer and water services severely limits the potential for dense development anywhere in the community. Approximately 20% of the houses in Sherman are second homes used for vacation and recreation purposes by owners who live, and earn their living, elsewhere.***

Growth remained strong from 1990 to 2000 and development increasingly extended throughout the community at a rate of approximately 40 new homes per year. According to the CT Department of Economic and Community Development, 104 housing units were added to the community's housing stock between 2000 and 2009. Most new development is in the northern end of town, but the most concentrated development remains around Candlewood Lake.

The Town notes that development of large subdivisions stalled in recent years due to the economic downturn. The Town has approved two subdivisions since 2006 that have yet

to be built, namely Far View Farms on the north end of town off Anderson Road (18 two-acre lots) and Chapel Hill Estates (14 lots off Chapel Hill Road). A development surrounding the Club at River Oaks golf course in the north end of town near the Housatonic River has 62 lots approved, but only 14 have been built. Town personnel also note that much of the undeveloped 400 acres within the Timber Trails Association in the southwestern part of town is potentially developable and lies within the Quaker Brook watershed that drains to the New York City water supply reservoirs.

Given the patterns of development associated with Candlewood Lake as well as other areas with Sherman as described above, numerous homeowner and residential associations exist within the town. Many of these associations are charged with paying for projects such as road maintenance within their boundaries. As this Plan will discuss in subsequent sections, the presence of so many small associations presents a unique set of challenges relative to natural hazard mitigation. Table 2-7 presents the list of private communities in Sherman.

**Table 2-7**  
**Private Associations Within the Town of Sherman**

Association Name	Area
Holiday Point Association	Candlewood Lake
Atchinson Cove Tax District	Candlewood Lake
Candlewood Lake Estates	Candlewood Lake
Deer Run Shores	Candlewood Lake
Orchard Rest Association	Candlewood Lake
Deer Hill Association	Candlewood Lake
Pinewood Shores Association	Candlewood Lake
Candlewood Echoes Association	Candlewood Lake
Pleasant View Road Association	Candlewood Lake
Mill Pond Farm	Candlewood Lake
Sail Harbor	Candlewood Lake
Mauweehoo Lake Association	Lake Mauweehoo
Timber Trails Association	Southwestern Sherman

## 2.9 Critical Facilities, Sheltering Capabilities, and Emergency Response

The Town has an Emergency Operations Plan that guides its response to emergencies. To that end, the Town considers its police, fire, governmental, and major transportation arteries to be its most important critical facilities since these are needed to ensure that emergencies are addressed while day-to-day management of Sherman continues. Educational institutions and churches are also included as critical facilities as these can be used as shelters or supply distribution centers.

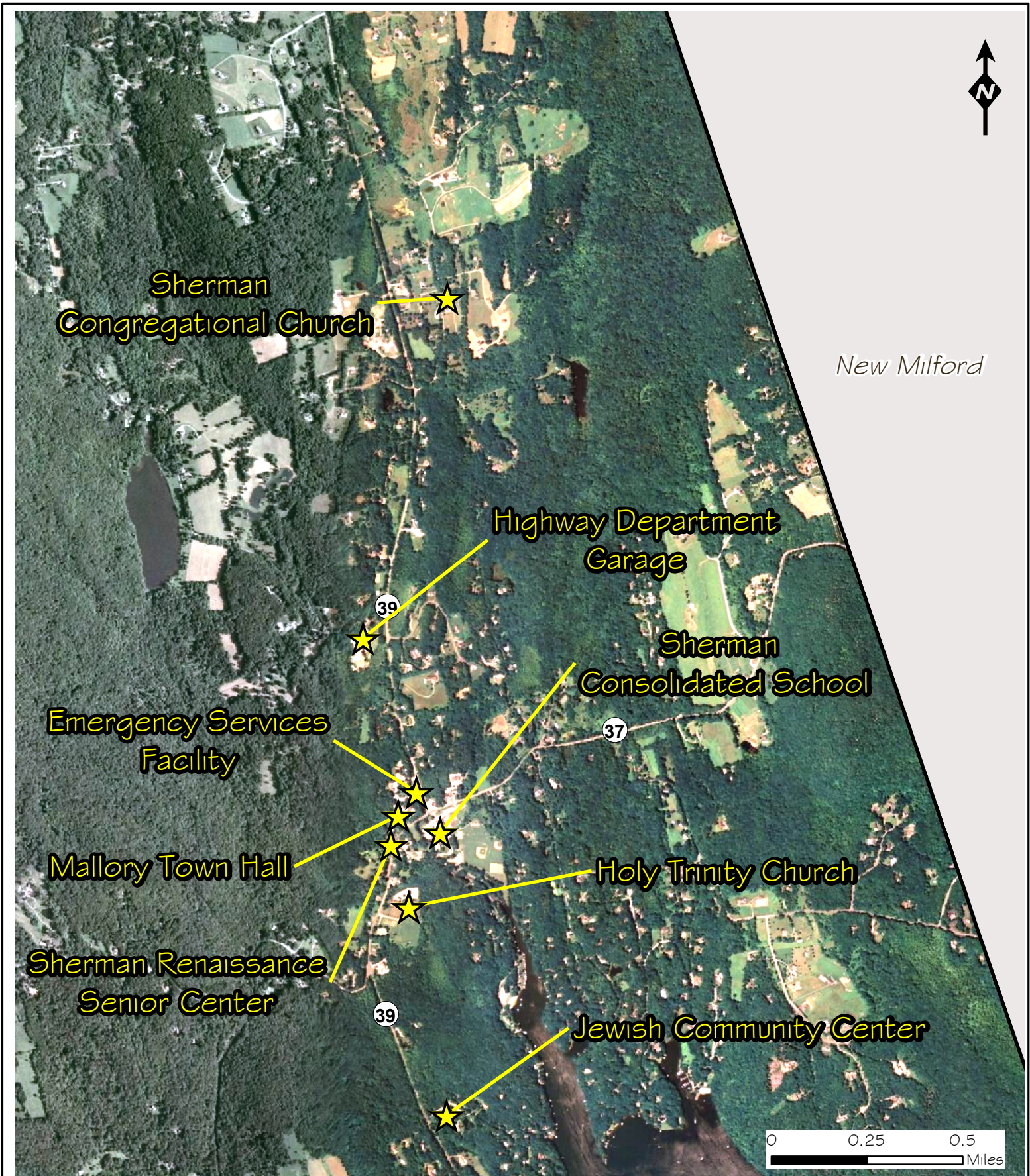
No elderly housing facilities or assisted facilities exist in the town. Populations of individuals that would require special assistance during an emergency are scattered throughout the town.

A map of the critical facilities in Sherman is shown as Figure 2-11, and a list of the critical facilities is provided in Table 2-8. Each critical facility and the Town's emergency response capabilities are described in more detail below, along with a summary of the potential for these facilities to be impacted by natural hazards.

**Table 2-8**  
**Critical Facilities in Sherman**

Type	Name	Address	Building in Floodplain?
Fire / EMT / Shelter	Emergency Services Facility	Route 39 North	No
Police / Town Hall / Emergency Operations Center	Mallory Town Hall	9 Route 39 North	No
Public Works / Fire	Highway Department Garage	43 Route 39 North	No
School / Shelter	Sherman Consolidated School	2 Route 37 East	No
Shelter	Sherman Renaissance Senior Center	8 Route 37 Center	No
Shelter/Distribution	Holy Trinity Church	15 Route 37 Center	No
Shelter/Distribution	Sherman Congregational Church	6 Church Road	No
Shelter/Distribution	Jewish Community Center	9 Route 39 South	No

*Source: HVCEO; Town of Sherman, FEMA*



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**Figure 2-12:  
Critical Facilities**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT

**DATE:** 8/19/2010

**MMI#:** 3101-04

**SOURCE:**

Microsoft Virtual Earth, 2010.  
StreetMaps USA, 2010.  
Critical Facilities, Town of Sherman

## Shelters

Emergency shelters are an important subset of critical facilities as they are needed in most large-scale emergency situations. The Town of Sherman has designated two American Red Cross emergency shelters with additional facilities that can be used as needed. The Sherman Consolidated School is currently the primary shelter facility and has a generator. Once the new Emergency Services Building is completed (an addition to the previous firehouse) in early 2011, it will become the primary shelter facility with a dedicated generator while the Sherman Consolidated School becomes the backup facility. Both buildings also have storage tanks containing fire-fighting water.

These buildings have been designated as public shelter facilities by meeting specific American Red Cross guidelines. The Resident State Trooper and the Sherman Volunteer Fire Department staff the shelters. Amenities and operating costs of the designated shelters including expenses for food, cooking equipment, emergency power services, bedding, etc., are the responsibilities of the community and generally are not paid for by the American Red Cross.

The Town's other municipal critical facilities include the Mallory Town Hall, the Public Works Department Garage, and the Sherman Renaissance Senior Center. The Mallory Town Hall is the current Emergency Operations Center and is equipped with a portable generator. The Public Works Department Garage is currently housing the Town's emergency response vehicles while the Emergency Services Facility is under construction and also houses the Town's public works equipment and vehicles that would be utilized to respond to an emergency. The Sherman Renaissance Senior Center is located in the previous Town Hall building. This building has space available to be used as a shelter, and the Senior Center maintains a list of addresses of elderly and home-bound persons who require special assistance during an evacuation or emergency.

Other potential shelters are included in the list of critical facilities. The Jewish Community Center could potentially be used as a shelter during a large evacuation. The Holy Trinity Church and the Sherman Congregational Church could also be used as shelters, but more likely would be utilized as supply distribution and food preparation facilities in the event of a long-term emergency. The Holy Trinity Church is currently the assigned shelter if students at Sherman Consolidated School are evacuated.

As there is no public transportation in the town of Sherman, these types of vehicles are not available if needed for an evacuation. The Town can utilize the Senior Center van and school buses if emergency transportation is needed during an evacuation.

In case of a power outage, it is anticipated that 10 to 20% of the population would relocate although not all of those relocating would necessarily utilize the shelter facilities. Sherman utilizes its facilities on a temporary basis to provide shelter until hazards such as hurricanes diminish. Regionally located mass care facilities operated and paid for by the American Red Cross may also be available during recovery operations when additional sheltering services are necessary.

#### Emergency Response Capabilities

The Office of Emergency Management coordinates emergency preparedness in the Town of Sherman. The office provides training for emergency response personnel, supports state and local emergency response exercises, and provides technical assistance to state and local emergency response agencies and public officials. Its goal is to provide citizens with the highest level of emergency preparedness before, during, and after disasters or emergencies.

Sherman participates in the Resident State Trooper Program rather than maintaining its own police force. Program benefits include access to all services provided within the Connecticut State Police Department. The Town uses 9-1-1 for emergency notification

and response. The Candlewood Lake Authority has a small seasonal police force that is overseen by the DEP, but they provide security more than emergency services. The Resident State Trooper has a list of contacts for each of the private lake communities if there is a nonemergency issue but, during emergency situations, the Office of Emergency Management and the Fire Department assist the private communities.

The Sherman Volunteer Fire Department provides fire-fighting and ambulance services for the residents of Sherman. The Town also participates in a paramedic intercept program that deploys a paramedic to the scene when warranted by the victim's symptoms. Fire Department apparatus include an ambulance, three fire engines, a tanker truck, brush truck, gator, and portable light tower. A new fire engine arrived in late summer 2010.

The Fire Department had a rescue boat until 2009 when it was retired from use. Currently, the Town is relying on its mutual aid agreements with other municipalities and from the lake communities until it can be replaced. Access to a rescue boat is important because during some emergencies it is easier and faster to access the lake communities by water than by land.

An effective emergency communication system is integral to timely emergency response. Emergency calls go to the Litchfield County Dispatch who relay them to Sherman via radio. Sherman operates on a high band radio system, but there are many "dead zones" in Sherman where radios fail to transmit effectively due to the many hills in Town. The Town is pursuing a location for a cellular tower in Sherman with Litchfield County Dispatch to reduce the number of dead zones in Town and increase overall signal strength.

It is important to note that member communities of the HVCEO ratified a Regional Mutual Aid Agreement for emergency response activities within the Housatonic Valley region on June 10, 2010. This agreement provides a more formalized approach to providing mutual aid during a major regional emergency. The member communities of

HVCEO had previously ratified a Regional Public Health Mutual Aid Agreement for response to bioterrorism and other forms of public health emergencies in 2006. The Town is in Region 5 of the Connecticut Emergency Medical Service regions.

### Transportation

The town of Sherman does not have any hospitals or medical centers. Instead, residents use the nearby facilities in New Milford or Danbury. As a means of accessing these facilities, Sherman residents travel along Route 37 and Route 7 in New Milford or south along Route 37 into Danbury through New Fairfield.

There is no regional emergency/evacuation plan. Route 37 and Route 39 are the two major transportation arteries out of town, with both routes connecting Sherman with New Milford to the northeast and New Fairfield to the south. Route 55 also provides access to Dover, New York to the west in the northern part of town. Sherman residents must use state roads in surrounding towns to access Interstate 84.

Sherman has many dead-end roads and many are relatively long and/or private, with some of these owned and maintained by homeowner associations. Emergency services can be cut off by fallen trees or washed out culverts during emergencies. The Office of Emergency Management has provided education to the private communities about road and tree maintenance to help ensure adequate access, while the Town tree warden maintains trees along public roads.

The most difficult emergency response problem in Sherman is poor access to the private lake communities. These roads are narrow, often one lane, and have steep grades that impede access by modern fire-fighting and rescue equipment. Grades exceed 15% and widening is often impossible. Pavement has deteriorated in many locations, whereas some roads are unpaved. Some roads have deteriorated because there was no association set up to manage them when they were originally built, and private owners very rarely

want to pool money for repairs. The Town utilizes the gator and other all-terrain vehicles to provide emergency response to these areas. New public and private roads are regulated by the Town through the subdivision process, such that emergency access is not an issue moving forward.

### Potential Impacts from Natural Hazards

Critical facilities are rarely impacted by flooding in the town of Sherman as none are located within floodplains. However, a portion of the parking areas at Sherman Consolidated School and Holy Trinity Church lies within the mapped 100-year floodplain, which could limit vehicular space at these facilities. Route 37 and Route 39 in the center of town have experienced flood damage during large storm events. As this road is the only connector between southern and northern Sherman, flooding slows emergency response times to the southern portion of town due to long out-of-town detours. The Town would like to upgrade Jericho Road North (much of which is currently an unpaved, one-lane trail) to provide an additional means of egress north or east around the center of Sherman.

None of the critical facilities in Sherman are any more susceptible to wind, summer storms, winter storms, or earthquakes than structures in the rest of the town. In addition, no critical facilities are believed near enough to a stream to be within a potential dam failure inundation area or within an area at increased risk of wildfires. The following sections will discuss each natural hazard in detail and include a description of populations at risk.

## **3.0 INLAND FLOODING**

### **3.1 Setting**

According to FEMA, most municipalities in the United States have at least one clearly recognizable floodprone area around a river, stream, or large body of water. These areas are outlined as Special Flood Hazard Areas (SFHA) and delineated as part of the National Flood Insurance Program (NFIP). Floodprone areas are addressed through a combination of floodplain management criteria, ordinances, and community assistance programs sponsored by the NFIP and individual municipalities.

Many communities also have localized flooding areas outside the SFHA. These floods tend to be shallower and chronically reoccur in the same area due to a combination of factors. Such factors can include ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed drainageways, sewer backup, or overbank flooding from small streams.

In general, inland flooding affects a small area of Sherman with moderate to frequent regularity. The areas impacted by overflow of river systems are generally limited to river corridors and floodplains. Indirect flooding that occurs outside floodplains and localized nuisance flooding along tributaries is a more common problem in the town. This type of flooding occurs particularly along roadways as a result of inadequate drainage and other factors. The frequency of flooding in Sherman is considered likely for any given year, with flooding damage potentially having significant effects during extreme events (refer to Appended Table 2).

### **3.2 Hazard Assessment**

Flooding represents the most common and costly natural hazard in Connecticut. The state typically experiences floods in the early spring due to snowmelt and in the late

summer/early autumn due to frontal systems and tropical storms, although localized flooding caused by thunderstorm activity can be significant. Flooding can occur as a result of other natural hazards, including hurricanes, summer storms, and winter storms. Flooding can also occur as a result of dam failure, which is discussed in Section 8.0, and may also cause landslides and slumps in affected areas.

Flooding presents several safety hazards to people and property. Floodwaters cause massive damage to the lower levels of buildings, destroying business records, furniture, and other sentimental papers and artifacts. In addition, floodwaters can prevent emergency and commercial egress by blocking streets, deteriorate municipal drainage systems, and divert municipal staff and resources.

Furthermore, damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Snakes and rodents are forced out of their natural habitat and into closer contact with people, and ponded water following a flood presents a breeding ground for mosquitoes. Gasoline, pesticides, and other aqueous pollutants can be carried into areas and buildings by floodwaters and soak into soil, building components, and furniture.

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of floodplain management and

***Floodplains are lands along watercourses that are subject to periodic flooding; floodways are those areas within the floodplains that convey the majority of flood discharge. Floodways are subject to water being conveyed at relatively high velocity and force. The floodway fringe contains those areas of the 100-year floodplain that are outside the floodway and are subject to inundation but do not convey the floodwaters at a high velocity.***

to determine the need for insurance. This flood has a 1% chance of being equaled or exceeded each year. The risk of having a flood of this magnitude or greater increases when periods longer than one year are considered. For example, FEMA notes that a structure located within a 100-year flood zone has a 26% change of suffering flood

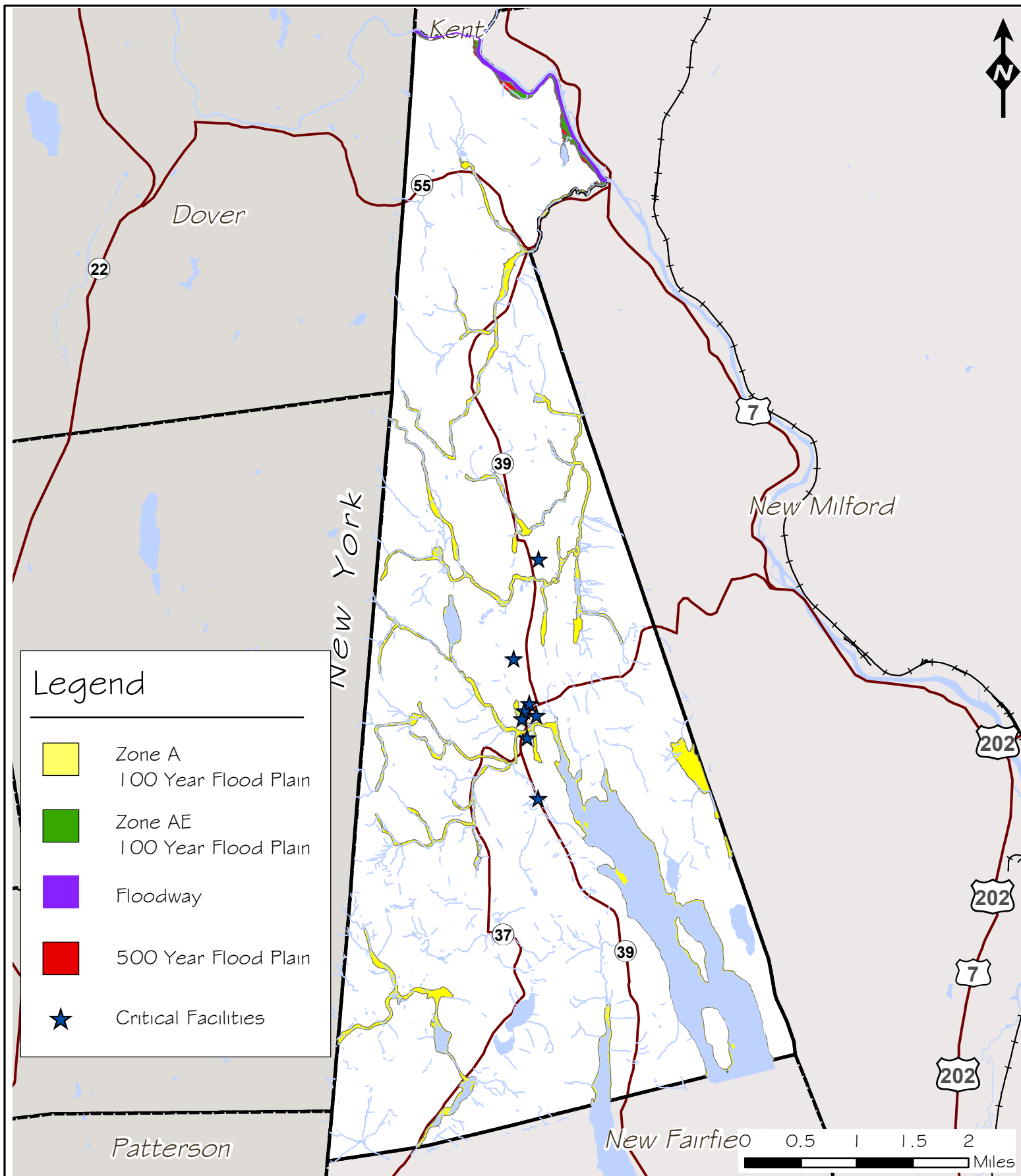
damage during the term of a 30-year mortgage. Similarly, a 500-year flood has a 0.2 percent chance of occurring in a given year. The 500-year floodplain indicates areas of moderate flood hazard.

SFHAs in Sherman are delineated on a Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS). The FIRM delineates areas within Sherman that are vulnerable to flooding and was originally published on June 18, 1987. The Town of Sherman FIS was also originally published on June 18, 1987, and both the FIRM and the FIS were updated as part of the Fairfield County FIS during the countywide Map Mod program. The updates were published on June 18, 2010. The majority of the watercourses in Sherman are mapped as Zone A, while the Tenmile River and the Housatonic River are mapped as Zone AE. Refer to Figure 3-1 for the areas of Sherman susceptible to flooding based on FEMA flood zones. Table 3-1 describes the various zones depicted on the FIRM panel for Sherman.

**Table 3-1**  
**FIRM Zone Descriptions**

<b>Zone</b>	<b>Description</b>
A	An area inundated by 100-year flooding, for which no base flood elevations (BFEs) have been determined.
AE	An area inundated by 100-year flooding, for which BFEs have been determined. This area may include a mapped floodway.
Area Not Included	An area that is located within a community or county that is not mapped on any published FIRM.
X	An area that is determined to be outside the 100- and 500-year floodplains.

Flooding can occur in some areas with a higher frequency than those mapped by FEMA. This nuisance flooding occurs from heavy rains with a much higher frequency than those used to calculate the 100-year flood event and often in different areas than those depicted on the FIRM panels. These frequent flooding events occur in areas with insufficient drainage; where conditions may cause flashy, localized flooding; and where poor maintenance may exacerbate drainage problems (see Sections 3.3 and 3.5).



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**Figure 3-1:  
FEMA Flood Zones**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 8/19/2010  
**MMI#:** 3101-04

**SOURCE:**  
CTDEP, Map & Geographic Information  
Center (2009).  
Flood Zone: FEMA DFIRM Data (2010).

During large storms, the recurrence interval level of a flood discharge on a tributary tends to be greater than the recurrence interval level of the flood discharge on the main channel downstream. In other words, a 100-year flood event on a tributary may only contribute to a 50-year flood event downstream. This is due to the distribution of rainfall and the greater hydraulic capacity of the downstream channel to convey floodwaters. Dams and other flood control structures can also reduce the magnitude of peak flood flows.

The recurrence interval level of a precipitation event also generally differs from the recurrence interval level of the associated flood. An example would be Tropical Storm Floyd in 1999, which caused rainfall on the order of a 250-year event while flood frequencies were slightly greater than a 10-year event on the Naugatuck River in Beacon Falls, Connecticut. Flood events can also be mitigated or exacerbated by in-channel and soil conditions, such as low or high flows, the presence of frozen ground, or a deep or shallow water table, as can be seen in the following historic record.

### **3.3 Historic Record**

The town of Sherman has experienced various degrees of flooding in every season of the year throughout its recorded history. Melting snow combined with early spring rains have caused frequent spring flooding. Numerous flood events have occurred in late summer to early autumn resulting from storms of tropical origin moving northeast along the Atlantic coast. Winter floods result from the occasional thaw, particularly during years of heavy snow, or periods of rainfall on frozen ground. Other flood events have been caused by excessive rainfalls upon saturated soils, yielding greater than normal runoff.

According to the 1987 FEMA FIS, at least 26 major storms occurred in the Housatonic River basin since 1693. The more recent floods occurred in November 1927, March 1936, September 1938, January 1949, August 1955, and October 1955. In terms of damage to the town of Sherman, the most severe of these was damage associated with

Hurricane Diane in August 1955, which had a return period of 100 years. Flood discharge on the Housatonic River at nearby Gaylordsville, Connecticut recorded a peak discharge of 51,800 cubic feet per second. This flood was the result of high intensity rainfall falling on saturated ground.

While flooding from the Housatonic River in northeastern Sherman only affected farmland, infrastructure along smaller streams in Sherman was greatly affected by the 1955 flood. A section of Leachhollow Road fell into Glen Brook, culverts on State Route 37 near Chapel Hill Road washed out, and there was damage to the pipes under the bridge along Saw Mill Road. These pipes were replaced in 1956 by a 10-foot diameter culvert.

In general, there are few flooding problems in Sherman that result in damage to insured structures. This is due to the undeveloped rural nature of the area as well as the local floodplain regulations. The most common damage is to infrastructure and occurs due to flash flooding. The most extreme damage occurs at and near bridges as a result of extreme rainfall events. Appendix C contains a compilation of photos collected by the Town for various flooding events since 1999.

According to the NCDC Storm Events Database, since 1993 there have been 66 flooding events and 24 flash flood events in Litchfield County (the county on the north and east sides of Sherman), 27 flooding and 48 flash flooding events in Fairfield County, and 28 flooding and 19 flash flooding events in Dutchess County, New York (the county on the west side of Sherman). The following are descriptions of more recent examples of floods in and around the town of Sherman as described in the NCDC Storm Events Database, and based on correspondence with municipal officials.

- ❑ August 21, 1994: Flash flooding caused approximately \$5 million in property damage in Litchfield County.

- ❑ October 21, 1995: A flood caused \$20,000 in damage in Dutchess County.
- ❑ January 19, 1996: An intense area of low pressure over the mid-Atlantic region produced unseasonably warm temperatures, resulting in the rapid melting of one to three feet of snow. This melting combined with one to three inches of rainfall to produce flooding across Litchfield County and Dutchess County, particularly along small streams. This flooding caused \$7,000,000 in property damage in Dutchess County, resulting in presidential disaster declaration. Half of the roads in neighboring Pawling, New York and many other roads near small streams throughout the county were washed out. In Litchfield County, the storm caused approximately \$300,000 in property damage.
- ❑ July 13, 1996: The remnants of Hurricane Bertha tracked northeast over Connecticut and eastern New York, producing three to five inches of rain across Litchfield County and Dutchess County. The storm resulted in minimal property damage in Connecticut, but caused flooding in several roads and streams, and the strong winds accompanying the storm caused scattered power outages when water-laden tree branches were downed on wires. Approximately \$60,000 in property damage was reported in Dutchess County.
- ❑ September 16, 1999: Torrential record rainfall preceding the remnants of Tropical Storm Floyd caused widespread urban, small stream, and river flooding. Fairfield County was declared a disaster area, along with Litchfield and Hartford Counties. Initial cost estimates for damages to the public sector was \$1.3 million for Fairfield County, \$204,254 for Hartford County, and \$53,000 for Litchfield County. These estimates do not account for damages to the private sector and are based on information provided by the Connecticut Office of Emergency Management. Total damage was approximated at \$1.1 million for Litchfield County.

Serious widespread flooding of low-lying and poor drainage areas resulted in the closure of many roads and basement flooding across Fairfield, New Haven, and Middlesex Counties. Dutchess County experienced \$900,000 in property damage and one death from significant flooding on smaller tributary streams. Route 7 washed out in several areas in New Milford. See Section 3.3.1 for a description of the flooding damage to Sherman as a result of this storm.

- ❑ December 17, 2000: Unseasonably warm and moist air tracked northward from the Gulf of Mexico, bringing a record-breaking rainstorm to Litchfield County and Dutchess County. The storm produced two to four inches of rain, strong winds, and combined with melting snow to produce flooding conditions. The bulk of the rainfall occurred in a short interval of time, with some localities receiving an inch per hour. \$75,000 dollars in property damage was reported in Litchfield County. At the height of the storm, 50 roads were closed in Dutchess County, and one death was reported due to the flood.
  
- ❑ September 23, 2003: A line of thunderstorms brought high winds and rain as it moved through Litchfield County. Sherman experienced heavy rainfall which swelled Sawmill Brook to the point of almost overtopping Sawmill Road and caused Church Road (inset photo) to flood though no structures were damaged.



- ❑ September 8, 2004: The remnants of Hurricane Frances produced torrential rainfall across western Connecticut, with total rainfall amounts ranging from one to six inches. The rainfall produced flash flooding of many roads in Fairfield County.

- ❑ October 2005: Although the consistent rainfall of October 7-15, 2005 caused flooding and dam failures in most of Connecticut (most severely in northern Connecticut), the precipitation intensity and duration was such that only moderate flooding occurred in Sherman. A total of 7.15 inches of rain was reported in neighboring New Fairfield from October 8 to October 9, with an additional 7.50 inches reported from October 11 to October 14. Urban flooding of low-lying and poor drainage areas occurred throughout the region. The Housatonic River at Gaylordsville crested at 2.38 feet above flood stage on October 9. On October 14, roads were washed out and some homes were inundated with debris flows in neighboring Kent.
  
- ❑ April 15-18, 2007: A combination of storms caused widespread flooding across New York and Connecticut. Three to eight inches of rain fell in Dutchess County resulting in \$5,700,000 in flooding damages and a disaster declaration. \$750,000 in flooding damage was reported in Litchfield County. Moderate flooding was reported along the Tenmile River upstream of Sherman. In neighboring New Milford, Cross Road and Youngsfield Road were flooded and closed, and a mudslide was reported at Grove Street, which resulted in the evacuation of five homes. The heavy rainfall resulted in moderate flooding on the Housatonic River, with the river cresting at Gaylordsville at 4.97 feet above flood stage on April 16. One of the storms, a spring nor'easter, produced up to almost eight inches of rain in parts of Fairfield County.



In Sherman, Glen Brook overflowed its banks at Wagon Wheel Road and damaged 700 feet of Wagon Wheel Road downstream of the bridge. The Anderson Road detention basin failed. Portions of Chimney Hill Road and Spring Lake Road washed

out. Drainage system failure occurred on Holiday Point Road (private). Bank failure occurred on Hubble Mountain Road. Drainage that was overloaded on Barlow Farm Road washed out part of the road and sent stone into a neighbor's yard. Sawmill Brook damaged the bridge on Old Greenwoods Road just upstream of Route 37/Route 39. The heavy rain also caused a dam failure in town (see Section 8.0).

- ❑ September 6, 2008: The remnants of Tropical Storm Hanna produced rainfall amounts of three to six inches across Dutchess County, causing flooding. Game Farm Road in neighboring Pawling was washed out. The storm caused approximately \$32,000 in damages in Fairfield County, and flash flooding caused one death. Many roads in nearby Danbury were beneath one to three feet of water, including the roads near Western Connecticut State University. At least \$100,000 in damages was reported due to heavy rainfall in Litchfield County. Route 7 in neighboring New Milford flooded resulting in several cars stalling in floodwaters.
- ❑ August 12, 2009: Slow moving thunderstorms produced heavy rainfall, resulting in Saw Mill Road near Route 39 in neighboring New Fairfield to be closed due to flash flooding.

### 3.3.1 Tropical Storm Floyd

As with many upland towns in Connecticut, flooding associated with Tropical Storm Floyd represents the storm of record in Sherman. Total rainfall amounts of 12 to 14 inches were reported in Sherman by the Town Engineer and measured nearly 11 inches in nearby New Fairfield as reported by the NCDC, well above the 100-year rainfall return frequencies presented in the National Weather Service's "Technical Paper No. 40." While flood elevation analysis was not performed in Sherman, it is believed by town personnel that this storm produced flooding equivalent to or greater than the 100-year flood event. The following is a summary of the damage to public infrastructure reported

in 1999 dollars. A total of \$409,000 in damage was reported to Town-owned public infrastructure.

- ❑ Sawmill Brook washed out the Route 37/Route 39 state-owned bridge just south of the Town Center (inset photo). The closure of Route 37/Route 39 effectively isolated southern Sherman from northern Sherman as vehicles had to leave town to get from one end of town to the other. Flood damage also occurred throughout the private communities in town, and federal funding was reportedly secured to assist these entities in rebuilding the infrastructure.



*Route 37 and Route 39  
Southwest of Sherman Center*

- ❑ Church Road: Water depths up to 12 inches over the roadway in a 200-foot wide area were reported. Damage included partial destruction of pavement and destruction of road shoulders at three locations. No roadway closing occurred.
- ❑ Taber Road: Water six inches deep was reported at low areas. Damage included clogging of culverts and partial destruction of pavement in 50-foot wide area and destruction of road shoulders in a 30-foot wide area. No roadway closing occurred.
- ❑ Spring Lake Road: Morrissey Brook overflowed the roadway to two feet deep over the top of the bridge with total flooding width of 100 feet. Damage included destruction of the east shoulder, clogging of the bridge with boulders, and partial destruction of pavement. The roadway was closed for 24 hours.
- ❑ Holiday Point Road: Water rose approximately two feet deep over the existing culvert and adjacent roadway over a total length of 50 feet. Damage included

destruction of the west shoulder and destruction of pavement. No roadway closing occurred.

- ❑ Sawmill Road: Sawmill Brook overtopped the roadway by approximately three feet over the existing bridge and adjacent road for a total flooding length of 100 feet. Major damage occurred to the bridge and roadway (see photo) as well as to the ballfield, soccer field, three tennis courts, and the walking track in adjacent Veterans Field park. The flood also caused a logjam 500 feet downstream of bridge. The roadway closed for 48 hours and the total damage estimate was \$168,000.



*Sawmill Road Bridge*

- ❑ Old Greenwood Road: The water level peaked at two feet below the deck of the bridge. Fill along the east approach was washed out destroying 40 feet of roadway, and both abutments were partially washed out below the footings. The roadway was closed for 24 hours.
- ❑ Old Greenwood Road Extension: The water level peaked at one foot below the bridge deck. The southern concrete wall under the bridge experienced heavy scour, undermining its structural integrity.
- ❑ Briggs Hill Road: Water rose to one foot over the roadway in low areas. Damage included clogging of culverts, partial destruction of pavement over an area of 30 feet, and destruction of road shoulders over a length of 20 feet. The roadway was closed for six hours.

- ❑ **Wakeman Hill Road:** This road was under construction when the flood occurred. Water rose over the road up to one foot in depth over 1,300 feet of width. Major damage occurred including washout of the roadway, washout of pipes and catch basins, and destruction of road shoulders over 20 feet. The roadway was closed for 48 hours, and the total damage estimate was \$112,000.
- ❑ **Wagon Wheel Road:** Glen Brook washed out 500 feet of road below the bridge. While there was no substantial damage to bridge, there was a major washout of roadway and 250 feet of drainage system. The roadway closed for 48 hours, and the total damage estimate was \$57,000.
- ❑ **Glenview Drive:** Floodwaters caused minor damage to the bridge although water did not overtop the roadway. A temporary bridge that was under construction at the time was severely damaged. The bed beneath existing bridge scoured 2.5 feet. No roadway closing occurred.

### 3.4 **Existing Programs, Policies, and Mitigation Measures**

The Town has in place a number of measures to prevent flood damage. These include regulations, codes, and ordinances preventing encroachment and development near floodways. Regulations, codes, and ordinances that apply to flood hazard mitigation in conjunction with and in addition to NFIP regulations include:

- ❑ ***Federal Flood Insurance Program Ordinance:*** This ordinance outlines the minimum requirements for flood protection under the NFIP adopted by Sherman and designates the Land Use Enforcement Officer as the administrator and regulator of the Town's NFIP regulations. A copy is included in Appendix B. The regulations forbid variances for floodway activities that result in any increase in base flood elevation and require compensatory storage activities for activities within floodplains. The regulations also state that new construction or substantial improvement of

residential structures requires that the lowest floor level be elevated above the base flood elevation and that floodproofing is not allowed for nonresidential structures.

- ❑ ***Inland Wetlands and Watercourses Regulations.*** This document defines in detail the Town's regulations regarding development near wetlands, watercourses, and water bodies that are sometimes coincident with floodplains. Section 2 defines "Regulated Activities" covered by the regulations. Section 6 states that no person may conduct or maintain a regulated activity without obtaining a permit. Section 7 outlines the application requirements.
- ❑ ***Plan of Conservation and Development.*** Section III.C of the 2001 Plan states that the amount of land suitable for development is dependent on limitations set by federal statutes (such as the NFIP and FIRM mapping), state statute (such as Inland Wetland and Watercourses Regulations), and Town regulations (such as Zoning and Subdivision regulations).
- ❑ ***Road Ordinance.*** This ordinance regulates the construction of roads in the town of Sherman and requires that storm drainage design will require appropriate safeguards for prevention of flooding and soil erosion. In particular, Section 7.9.2 notes that (a) all drainage systems must be designed to pass the 25-year flood event, (b & c) all cross culverts for intermittent and minor streams must be designed to pass the 50-year storm event, and (d) all cross culverts for major streams must be designed to pass the 100-year flood event.
- ❑ ***Zoning Regulations.*** The Sherman Zoning Regulations require that 100-year flood hazard areas are presented on plans as shown by the official maps stored at Mallory Town Hall. These plans must be certified by a professional engineer licensed in the State of Connecticut and show that adequate provisions have been made for drainage and flood control.

The intent of these regulations is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas of the town of Sherman by the establishment of standards designed to:

- ☐ Protect human life and public health
- ☐ Minimize expenditure of money for costly flood control projects
- ☐ Minimize the need for rescue and relief efforts associated with flooding
- ☐ Minimize prolonged business interruptions
- ☐ Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone, and sewer lines, and streets and bridges located in floodplains;
- ☐ Maintain a stable tax base by providing for the sound use and development of floodprone areas in such a manner as to minimize flood blight areas
- ☐ Ensure that purchasers of property are notified of special flood hazards
- ☐ Ensure the continued eligibility of owners of property in Sherman for participation in the National Flood Insurance Program

The Town of Sherman Land Use Enforcement Officer serves as the NFIP administrator and oversees the enforcement of NFIP regulations. The Town recently revised its "Federal Flood Insurance Program" ordinance in June 2010 concurrent with the recently revised FIS and FIRMs for Fairfield County. The degree of flood protection established by this ordinance meets the minimum reasonable for regulatory purposes under the NFIP. Sherman currently has no plans to enroll in the Community Rating System program.

The Town's Planning and Zoning Commission uses the 100-year flood lines from the FIRM delineated by FEMA to determine floodplain areas. Site plan standards require that all proposals be consistent with the need to minimize flood damage, that public facilities and utilities be located and constructed to minimize flood damage, and that adequate drainage is provided. The

The Town of Sherman can also access the **National Weather Service** website at <http://weather.noaa.gov/> to obtain the latest flood watches and warnings before and during precipitation events.

Sherman Inland Wetlands Agency also reviews new developments and existing land uses on and near wetlands and watercourses.

The Sherman Department of Public Works (DPW) is in charge of the maintenance of the town's drainage systems and performs clearing of bridges and culverts and other maintenance as needed. Drainage complaints are routed to the DPW and recorded. The Town uses these documents to identify potential problems and plan for maintenance and upgrades. The Town receives regular weather updates through DEMHS Region 5 email alerts and can also access the Automated Flood Warning System to monitor precipitation totals. The Connecticut DEP installed the Automated Flood Warning System in 1982 to monitor rainfall totals as a mitigation effort for flooding throughout the state.

The National Weather Service issues a flood watch or a flash flood watch for an area when conditions in or near the area are favorable for a flood or flash flood, respectively. A flash flood watch or flood watch does not necessarily mean that flooding will occur. The National Weather Service issues a flood warning or a flash flood warning for an area when parts of the area are either currently flooding, highly likely to flood, or when flooding is imminent.

The Town commissioned bridge studies in 1999 (following Tropical Storm Floyd) and 2010 to inspect Town-owned bridges and has performed three culvert replacements recently to increase conveyance. The majority of Sherman's drainage structures are considered to be sized for all but the most extreme flood events, and all new construction must be sized for either the 50-year or the 100-year flood event as outlined in the Road Ordinance.

In summary, the Town primarily attempts to mitigate flood damage and flood hazards by restricting building activities inside floodprone areas. This process is carried out through both the Planning and Zoning and the Inland Wetlands Commissions. All watercourses are to be encroached minimally or not at all to maintain the existing flood carrying

capacity. These regulations rely primarily on the FEMA-defined 100-year flood elevations to determine flood areas.

### **3.5 Vulnerabilities and Risk Assessment**

This section discusses specific areas at risk to flooding within the town. Major land use classes and critical facilities within these areas are identified. According to the FEMA FIRMs, 1,583 acres of land in Sherman are located within the 100-year flood boundary. In addition, indirect and nuisance flooding occurs near streams and rivers throughout Sherman due to inadequate drainage and other factors.

The primary waterways in the town are the Tenmile River and the Housatonic River, which form Sherman's northern boundary with Kent and part of New Milford. The remaining waterways in Sherman are mostly small streams and brooks significant for water supply and conservation purposes but are not recreational resources. Candlewood Lake and Lake Mauweehoo are significant recreational resources. Recall from Figure 3-1 that floodplains with elevations are delineated for the Tenmile River and the Housatonic River, while the majority of the smaller brooks and streams, including the major water bodies, have floodplains delineated by approximate methods. All of these delineated floodplains are generally limited to the areas adjacent to the streams.

Due to the steep topography surrounding the major watercourses, there is little wide-scale flooding in Sherman. In addition, the State of Connecticut NFIP Coordinator notes that repetitive loss properties are not located in the Town of Sherman (Appendix B). The majority of flooding problems affect infrastructure such as bridges and drainage systems and occurs due to large amounts of rainfall falling in conjunction with snowmelt as noted below. Specific areas susceptible to flooding were identified by Town personnel and observed by MMI staff during field inspections as described in Section 1.5.

- ❑ Barlow Farm Road – Drainage in this area was overloaded in the April 2007 storms, causing erosion of stones on a nearby hillside.
- ❑ Beaver Creek Lane – Beavers dam Naromi Brook at this crossing, causing minor flooding nearby.
- ❑ Candlewood Echos Association – Shallow flooding occurs in this private community when storm drains along Route 39 become clogged and the backwater flows off the roadway. Drainage system maintenance is reportedly an issue throughout the town.
- ❑ Candlewood Lake Estates – The only access road into this private community has undersized cross culverts. Flood waters during heavy rains are causing damage to the roadway.
- ❑ Church Road Near Babbling Brook Drive – This area flooded and overtopped the road during the April 2007 storms. No structures were affected by flooding.
- ❑ Coote Hill – The culvert beneath this street receives outflow from Pepper Pond. The culvert appears to have been damaged by flooding.
- ❑ Farm Road – Heavy storms can cause the unnamed stream at the intersection end of this dead-end road to overtop the road by up to a foot. This road is the only access into a 22-home subdivision.
- ❑ Old Greenwoods Road – The April 2007 storms damaged the bridge, which conveys Greenwoods Brook under the intersection end of this dead-end road. Repairs to this bridge commenced in 2010.

- ❑ Old Greenwood Road Extension – The bridge over Tollgate Brook is at the intersection end of a dead-end road, and the bridge is considered to be in fair but deteriorating condition due to floodwaters. Three houses lie beyond the bridge.
  
- ❑ Sawmill Road – The bridge over Sawmill Brook required heavy repairs after Tropical Storm Floyd in 1999 and additional repairs after the April 2007 storm. The Town is concerned that they may have to do a complete rebuild of the bridge if another severe flooding event occurs. This bridge is the only means of egress to 15 homes, the town beach, and the town marina.
  
- ❑ Wagon Wheel Road – The culverts conveying Glen Brook beneath this road are likely undersized for peak flood events. This bridge sustained damage during the 1999 and 2007 storms.

Sherman has many dead-end roads, and many of these roads cross a watercourse near the intersection end. These areas could potentially be cut off from emergency services during a severe flooding event. Bridge scour and overtopping from spring floods are also recurring problems on some of these roads, particularly when culverts become blocked by debris. Sherman does not currently regulate the number of homes on dead end streets. Table 3-2 presents a list of the dead-end roads in town that span a mapped watercourse:

In recent years, culverts along dead-end roads have been overtopped and damaged by severe floods. The majority of these culverts were likely designed using rainfall data published in "Technical Paper No. 40" by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These values are the standard used in the current *Connecticut DOT Drainage Manual* (2000) and have been the engineering standard for many years.

**Table 3-2**  
**Dead-End Roads in Sherman That Span a Mapped Watercourse**

<b>Road Name</b>	<b>Road Type</b>	<b>Brook Name</b>	<b>Number of Houses Beyond Watercourse</b>
Big Trail	Private	Quaker Brook	60
Green Pond Road	Private	Outflow from Green Pond to Candlewood Lake	46
Edmonds Road	Public	Western Tributary to Naromi Brook	36
Hillside Drive	Private	Tributary to Allens Cove at Candlewood Lake	34
Mauweehoo Hill	Public	Outflow from Lake Mauweehoo to Glen Brook	30
Farm Road	Public	Tributary to Naromi Brook	22
Sawmill Road	Public	Sawmill Brook	15
Orchard Beach Road	Private	Outflow from Green Pond to Candlewood Lake	14
Timber Lake Road	Private	Quaker Brook	10
Clover Leaf Farm North	Public	Tributary to Wimisink Brook	8
Wagon Wheel Road	Public	Glen Brook	8
Evergreen Drive	Public	Tributary to Wimisink Brook	7
Jericho Road North	Public	Tributary to Naromi Brook	7
Ledgewood Drive	Private	Tributary to Candlewood Lake	7
Coote Hill	Private	Outflow from Pepper Pond	6
Glenview Drive	Public	Glen Brook	6
Edmonds Road	Public	Eastern Tributary to Naromi Brook	4
Old Greenwoods Road	Public	Greenwoods Brook	4
Clover Lear Farm South	Public	Tributary to Wimisink Brook	3
Old Greenwoods Road Ext.	Public	Tollgate Brook	3
Timber Lake Road North	Private	Quaker Brook	2
Beaver Creek Lane	Public	Naromi Brook	1
Hollow Brook Road	Public	Quaker Brook	1

*Source: 2004 Aerial Photography (CLEAR), Connecticut DEP*

As stated in Section 2.4, it is believed that the average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19<sup>th</sup> century (Miller et. al., 1997; NCDC, 2005). This translates to an increase of approximately 4.75 inches of additional rainfall per year under current conditions. Not only has the average annual precipitation been increasing, the study "Precipitation in Connecticut" (Miller et. al., 1997) shows that the rainfall values for various events have also increased since 1958. The result is that culverts that may have been sized to pass, for example, the 25-year, 2-hour storm event are no longer capable of passing that storm without the occurrence of

backwater or overtopping. A recommendation of this plan is to study the existing culvert sizes in relation to the new rainfall data in order to prioritize future culvert replacements.

The 2010 Fairfield County DFIRM mapping was utilized with the 2004 leaf-off aerial photography mosaic available from the Connecticut DEP to determine the number of structures within SFHAs. Structures are not located within the Zone AE 100-year floodplain, and a total of 22 residential structures are located within the Zone A 100-year floodplain throughout the town. This is equivalent to approximately 1% of the total number of structures in town. The highest concentration of houses (nine) in the mapped floodplain is along Sawmill Brook and Tollgate Brook just southwest of the town center. According to AOL Real Estate, the average market value for a home in Sherman for July 2010 was \$388,408. Thus, the estimated value of the homes within the 100-year floodplain is \$8,544,976.

Critical facilities are not regularly impacted by flooding in the town of Sherman, as shown by the spatial relationship between 100-year floodplains and critical facilities on Figure 3-2. Route 37 / Route 39, the only thoroughfare connecting northern and southern Sherman, has received flooding damage from Sawmill Brook during severe storms. This flooding slows emergency response times to the rest of Sherman due to long detours around this area.

The Town of Sherman discourages new construction and substantial reconstruction within the 100-year floodplain by requiring compensatory mitigation activities. According to the Land Use Officer, it is unlikely that new buildings will be built in the floodplain such that the number of structures vulnerable to flooding is unlikely to increase. It is possible that increasing rainfall over time could lead to a wider and deeper mapped floodplain, but such a study is beyond the scope of this document.



Given the relatively few number of homes within the 100-year floodplain along any particular stream, the lack of historic flooding damage to structures in the 100-year floodplain during severe storms such as Tropical Storm Floyd, the lack of critical facilities being within the 100-year floodplain, and the unlikelihood of the town of Sherman increasing its vulnerability to flooding damage by supporting floodplain development, the FEMA HAZUS-MH modeling software was not utilized to calculate potential flooding damages within the town. Instead, a quantitative assessment has been made based on historic damages as discussed below.

It is believed that another 100-year flood event similar to Tropical Storm Floyd would cause approximately \$861,000 in damages to Town property and infrastructure, with no impacts to critical facilities. This value was determined by increasing the damage values reported for Tropical Storm Floyd in 1999 for inflation to 2011 dollars, and will likely increase due to inflation each year in the future. There would be some impacts to private property, but in total it is believed that such impacts would be relatively minor as they were during the 1999 storm. Few serious injuries would be likely, and sheltering requirements would be minimal, temporary, and primarily for travelers stranded on one side of the Town due to flooding along Route 37/39 on Sawmill Brook.

### **3.6 Potential Mitigation Measures, Strategies, and Alternatives**

A number of measures can be taken to reduce the impact of a local or nuisance flood event. These include measures that prevent increases in flood losses by managing new development, measures that reduce the exposure of existing development to flood risk, and measures to preserve and restore natural resources. These are listed below under the categories of *prevention, property protection, structural projects, public education and awareness, natural resource protection, and emergency services*. All of the recommendations discussed in the subsections below are reprinted in a bulleted list in Section 3.7.

### 3.6.1 Prevention

Prevention of damage from flood losses often takes the form of floodplain regulations and redevelopment policies that restrict the building of new structures within defined areas. These are usually administered by building, zoning, planning, and/or code enforcement offices through capital improvement programs and through zoning, subdivision, and wetland ordinances.

Although repetitive loss properties are not located in the town, there may be structures located in or adjacent to floodplains. Municipal departments should identify areas for acquisition to remove the potential for flood damage. Acquisition of heavily damaged structures after a flood may be an economical

*It is important to promote coordination among the various departments that are responsible for different aspects of flood mitigation. Coordination and cooperation among departments should be reviewed every few years as specific responsibilities and staff change.*

and practical means to accomplish this. The Town of Sherman should continue working with the land trusts in Sherman to identify properties worth acquiring as much of the open space in town is owned by the Naromi Land Trust.

Planning and Zoning: Subdivision ordinances should regulate development in flood hazard areas. Flood hazard areas should reflect a balance of development and natural areas, although ideally they will be free from development. Policies can also require the design and location of utilities to areas outside of flood hazard areas and the placement of utilities underground.

Floodplain Development Regulations: Development regulations encompass subdivision regulations, building codes, and floodplain ordinances. Site plan and new subdivision regulations should include the following:

- ❑ Requirements that every lot have a buildable area above the flood level

- ❑ Construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, and drainageways
- ❑ A requirement that developers dedicate open space and flood flow, drainage, and maintenance easements

Building codes should ensure that the foundation of structures will withstand flood forces and that all portions of the building subject to damage are above or otherwise protected from flooding. Floodplain ordinances should at minimum follow the requirements of the National Flood Insurance Program for subdivision and building codes. These could be included in the ordinances for subdivisions and building codes or could be addressed in a separate ordinance.

One recommendation for many municipalities could be to consider using more detailed town topographic maps, if available, to develop a more accurate regulatory flood hazard map using the published FEMA flood elevations. According to the FEMA, communities are encouraged to use different more accurate base maps to expand upon the FIRMs published by FEMA. This is because many FIRMs were originally created using United States Geological Survey quadrangle maps with 10-foot contour intervals, but many municipalities today have contour maps of one- or two-foot intervals that show more recently constructed roads, bridges, and other anthropologic features. Another approach is to record high water marks and establish those areas inundated by a recent severe flood to be the new regulatory floodplain.

Adoption of a different floodplain map is allowed under NFIP regulations as long as the new map covers a larger floodplain than the FIRM. It should be noted that the community's map will not affect the current FIRM or alter the SFHA used for setting insurance rates or making map determinations; it can only be used by the community to regulate floodplain areas. Implementation of this recommendation may be difficult for Sherman as the majority of its floodplains lack flood elevation data. The FEMA Region I

office has more information on this topic. Contact information can be found in Section 11.

Reductions in floodplain area or revisions of a mapped floodplain can only be accomplished through revised FEMA-sponsored engineering studies or Letters of Map Change (LOMC). To date, no Letters of Map Amendment (LOMA) have been submitted under the LOMC program for the Town, so such updates are considered rare.

Stormwater Management Policies: Development and redevelopment policies to address the prevention of flood damage must include effective stormwater management policies. Developers should be required to build detention and retention facilities where appropriate. Infiltration can be enhanced to reduce runoff volume, including the use of swales, infiltration trenches, vegetative filter strips, and permeable paving blocks. Generally, postdevelopment stormwater should not leave a site at a rate higher than under predevelopment conditions.

Standard engineering practice is to avoid the use of detention measures if the project site is located in the lower one-third of the overall watershed. The effects of detention are least effective and even detrimental if used at such locations because of the delaying effect of the peak discharge from the site that typically results when detention measures are used. By detaining stormwater in close proximity of the stream in the lower reaches of the overall watershed, the peak discharge from the site will occur later in the storm event, which will more closely coincide with the peak discharge of the stream, thus adding more flow during the peak discharge during any given storm event. Due to its topography, Sherman is situated in the upper and middle parts of several watersheds. Developers should be required to demonstrate whether detention or retention will be the best management practice for stormwater at specific sites regarding the position of each project site in the surrounding watershed.

Drainage System Maintenance: An effective drainage system must be continually maintained to ensure efficiency and functionality. Maintenance should include programs to clean out blockages caused by overgrowth and debris. Culverts should be monitored, repaired, and improved when necessary. The use of Geographic Information System (GIS) technology can greatly aid the identification and location of problem areas. The Town currently has an annual schedule of drainage system maintenance, with such activities occurring in the spring. The Connecticut Department of Transportation (DOT) is responsible for maintenance along the state roadways.

Education and Awareness: Other prevention techniques include the promotion of awareness of natural hazards among citizens, property owners, developers, and local officials. Technical assistance for local officials, including workshops, can be helpful in preparation for dealing with the massive upheaval that can accompany a severe flooding event. Research efforts to improve knowledge, develop standards, and identify and map hazard areas will better prepare a community to identify relevant hazard mitigation efforts.

The Town of Sherman Inland Wetlands Agency administers the Wetland Regulations and the Sherman Planning and Zoning Commission administers the Zoning Regulations. The regulations simultaneously restrict development in floodplains, wetlands, and other floodprone areas. The Land Use Enforcement Officer is charged with ensuring that development follows the Zoning Regulations and Inland Wetlands Regulations. The Town should have a checklist that cross references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to a proposed project and make this list available to potential applicants. An example is included as appended Table 3.

### 3.6.2 Property Protection

Steps should be taken to protect existing public and private properties. Nonstructural measures for public property protection include relocation of structures at risk for flooding (either to a higher location on the same lot or to a different lot outside of the floodplain), purchase of flood insurance, and relocating valuable belongings above flood levels to reduce the amount of damage caused during a flood event.

Structural flood protection techniques applicable to property protection include home elevation, construction of barriers, dry floodproofing, and wet floodproofing techniques.

***Dry floodproofing refers to the act of making areas below the flood level watertight.***

***Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures.***

- ❑ Home elevation involves the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located above the 100-year flood level. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the first floor level.
- ❑ Barriers include levees, floodwalls, and berms that are useful in protecting areas subject to shallow flooding. Such structural projects are discussed in Section 3.6.6.
- ❑ For dry floodproofing, walls may be coated with compound or plastic sheathing. Openings such as windows and vents should be either permanently closed or covered with removable shields. Flood protection should extend only two to three feet above the top of the foundation because building walls and floors cannot withstand the pressure of deeper water.

- ❑ Wet floodproofing should only be used as a last resort. If considered, furniture and electrical appliances should be moved away or elevated above the 100-year flood elevation.

All of the above *property protection* mitigation measures may be useful for town of Sherman residents to prevent damage from inland and nuisance flooding. Floodproofing is not allowed for nonresidential structures in the town of Sherman. The Building Official should consider outreach and education in these areas where appropriate.

### 3.6.3 Emergency Services

A natural hazard pre-disaster mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for inland flooding include:

- ❑ Forecasting systems to provide information on the time of occurrence and magnitude of flooding
- ❑ A system to issue flood warnings to the community and responsible officials
- ❑ Emergency protective measures, such as an Emergency Operations Plan outlining procedures for the mobilization and position of staff, equipment, and resources to facilitate evacuations and emergency floodwater control
- ❑ Implementing an emergency notification system that combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas or specific groups of people, such as emergency responder teams

Many of these mitigation measures are already in practice in Sherman. Based on the above guidelines, a number of specific proposals for improving *emergency services* are recommended to prevent damage from inland and nuisance flooding. These are common to all hazards in this Plan and are listed in Section 10.1.

### 3.6.4 Public Education and Awareness

The objective of public education is to provide an understanding of the nature of flood risk and the means by which that risk can be mitigated on an individual basis. Public information materials should encourage individuals to be aware of flood mitigation techniques, including discouraging the public from changing channel and detention basins in their yards and dumping in or otherwise altering watercourses and storage basins. Individuals should be made aware of drainage system maintenance programs and other methods of mitigation. The public should also understand what to expect when a hazard event occurs, and the procedures and time frames necessary for evacuation.

Based on the above guidelines, a number of specific proposals for improved *public education* are recommended to prevent damage from inland and nuisance flooding. These are common to all hazards in this Plan and are listed in Section 10.1.

### 3.6.5 Natural Resource Protection

Floodplains can provide a number of natural resources and benefits, including storage of floodwaters, open space and recreation, water quality protection, erosion control, and preservation of natural habitats.

Retaining the natural resources and functions of floodplains can not only reduce the frequency and consequences of flooding but also minimize stormwater management and nonpoint pollution problems.

Through natural resource planning, these objectives can be achieved at substantially reduced overall costs.

***Measures for preserving floodplain functions and resources typically include:***

- ☐ *Adoption of floodplain regulations to control or prohibit development that will alter natural resources*
- ☐ *Development and redevelopment policies focused on resource protection*
- ☐ *Information and education for both community and individual decision-makers*
- ☐ *Review of community programs to identify opportunities for floodplain preservation*

Projects that improve the natural condition of areas or to restore diminished or destroyed resources can reestablish an environment in which the functions and values of these resources are again optimized. Administrative measures that assist such projects include the development of land reuse policies focused on resource restoration and review of community programs to identify opportunities for floodplain restoration.

Based on the above guidelines, the following specific *natural resource protection* mitigation measures are recommended to help prevent damage from inland and nuisance flooding:

- ❑ Pursue the acquisition of additional municipal open space properties as discussed in Section VII of the Plan of Conservation and Development
- ❑ Selectively pursue conservation objectives listed in the Plan of Conservation and Development and/or more recent planning studies and documents
- ❑ Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains

### 3.6.6 Structural Projects

Structural projects include the construction of new structures or modification of existing structures (e.g., floodproofing) to lessen the impact of a flood event. Stormwater controls such as drainage systems, detention dams and reservoirs, and culvert resizing should be employed to lessen floodwater runoff. On-site detention can provide temporary storage of stormwater runoff. Barriers such as levees, floodwalls, and dikes physically control the hazard to protect certain areas from floodwaters. Channel alterations can be made to confine more water to the channel and accelerate flood flows. Care should be taken when using these techniques to ensure that problems are not exacerbated in other areas of the impacted watersheds. Individuals can protect private property by raising structures and constructing walls and levees around structures.

Given the many dead-end roads in Sherman that pass over a watercourse (Table 3-2) and the increasing rainfall rates in Connecticut (Section 3.5), a long-term recommendation of this Plan is for the Town to reevaluate the drainage computations on the various roads in town beginning with the public roads in Table 3-2. The Town should also encourage the owners of private roads to reconsider their drainage computations as well. Should it appear that a culvert or crossing is undersized, the Town or the private entity should pursue funding to resize the infrastructure.

Based on the above guidelines, the following specific *structural* mitigation measures are recommended to prevent damage from inland and nuisance flooding:

- ❑ Pursue/allocate funding to repair the bridge over Tollgate Brook on Old Greenwood Road.
- ❑ Monitor the condition of the culverts conveying Glen Brook beneath Wagon Wheel Road and the bridge conveying Sawmill Brook beneath Sawmill Road.
- ❑ Conduct engineering studies as needed to resize culverts that are suspected of being undersized. Pursue/allocate funding when necessary to repair these structures.
- ❑ Encourage the State Department of Transportation to perform more frequent catch basin cleanouts on Route 39.
- ❑ Reevaluate the drainage computations for public dead-end roads in town that span a watercourse, evaluating the dead-end roads with the most structures at risk first. If any of these roads are considered sufficiently undersized, resize the culvert or crossing to an acceptable level.
- ❑ Encourage the private communities in town to reevaluate the drainage computations for their floodprone streets as well.

### **3.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives**

While many potential mitigation activities were addressed in Section 3.6, the recommended mitigation strategies for addressing inland flooding problems in the Town of Sherman are listed below.

### Prevention, Property Protection, and Natural Resource Protection

- ☐ Continue to regulate activities within SFHAs.
- ☐ Consider requiring buildings constructed in floodprone areas to be protected to the highest recorded flood level, regardless of being within a defined SFHA.
- ☐ Ensure new buildings be designed and graded to shunt drainage away from the building.
- ☐ Require developers to support whether detention or retention of stormwater is the best option for reducing peak flows downstream of a project.
- ☐ In conjunction with the land trusts in town, pursue the acquisition of additional municipal open space inside SFHAs and set it aside as greenways, parks, or other nonresidential, noncommercial, or nonindustrial use.
- ☐ Compile a checklist that cross references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to a proposed project and make this list available to potential applicants.
- ☐ Selectively pursue conservation recommendations listed in the Plan of Conservation and Development and other studies and documents.
- ☐ Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.
- ☐ Provide outreach regarding home elevation, flood barriers, dry floodproofing, and wet floodproofing techniques to private homeowners with flooding problems.

### Structural Projects

- ☐ Pursue/allocate funding to repair the bridge over Tollgate Brook on Old Greenwood Road.
- ☐ Monitor the condition of the culverts conveying Glen Brook beneath Wagon Wheel Road and the bridge conveying Sawmill Brook beneath Sawmill Road.

- ❑ Conduct engineering studies as needed to resize culverts that are suspected of being undersized. Pursue/allocate funding when necessary to repair these structures.
- ❑ Encourage the State Department of Transportation to perform more frequent catch basin cleanouts on Route 39.
- ❑ Reevaluate the drainage computations for public dead-end roads in town that span a watercourse, evaluating the dead-end roads with the most structures at risk first. If any of these roads are considered sufficiently undersized, resize the culvert or crossing to an acceptable level.
- ❑ Encourage the private communities in town to reevaluate the drainage computations for their floodprone streets as well.

In addition, mitigation strategies important to all hazards are included in Section 10.1.

## **4.0 HURRICANES**

### **4.1 Setting**

Hazards associated with tropical storms and hurricanes include winds, heavy rains, and inland flooding. While only some of the areas of Sherman are susceptible to flooding damage caused by hurricanes, wind damage can occur anywhere in the town. Hurricanes therefore have the potential to affect any area within the town of Sherman. A hurricane striking Sherman is considered a possible event each year and could cause critical damage to the town and its infrastructure (refer to Appended Table 1).

### **4.2 Hazard Assessment**

Hurricanes are a class of tropical cyclones that are defined by the National Weather Service as warm-core, non-frontal, low pressure, large scale systems that develop over tropical or subtropical water and have definite organized circulations. Tropical cyclones are categorized based on the speed of the sustained (one-minute average) surface wind near the center of the storm. These categories are Tropical Depression (winds less than 39 mph), Tropical Storm (winds 39-74 mph, inclusive), and Hurricanes (winds at least 74 mph).

The geographic areas affected by tropical cyclones are called tropical cyclone basins. The Atlantic tropical cyclone basin is one of six in the world and includes much of the North Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. The official Atlantic hurricane season begins on June 1 and extends through November 30 of each year, although occasionally hurricanes occur outside this period.

Inland Connecticut is vulnerable to hurricanes despite moderate hurricane occurrences when compared with other areas within the Atlantic Tropical Cyclone basin. Since

hurricanes tend to weaken within 12 hours of landfall, inland areas are relatively less susceptible to hurricane wind damages than coastal areas in Connecticut; however, the heaviest rainfall often occurs inland. Therefore, inland areas are vulnerable to riverine and urban flooding during a hurricane.

### The Saffir-Simpson Scale

The "Saffir-Simpson Hurricane Scale" was used prior to 2009 to categorize hurricanes based upon wind speed, central pressure and storm surge, relating these components to damage potential. In 2009, the scale was revised and is now called the "Saffir-Simpson Hurricane Wind Scale". The modified scale is more scientifically defensible and is predicated only on surface wind speeds. The following descriptions are from the 2010 *Connecticut Natural Hazard Mitigation Plan Update*.

*A **Hurricane Watch** is an advisory for a specific area stating that a hurricane poses a threat to coastal and inland areas. Individuals should keep tuned to local television and radio for updates.*

*A **Hurricane Warning** is then issued when the dangerous effects of a hurricane are expected in the area within 24 hours.*

- ❑ **Category One Hurricane:** Sustained winds 74-95 mph (64-82 kt or 119-153 km/hr). *Damaging winds are expected.* Some damage to building structures could occur, primarily to unanchored mobile homes (mainly pre-1994 construction). Some damage is likely to poorly constructed signs. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possibly death. Numerous large branches of healthy trees will snap. Some trees will be uprooted, especially where the ground is saturated. Many areas will experience power outages with some downed power poles.
  
- ❑ **Category Two Hurricane:** Sustained winds 96-110 mph (83-95 kt or 154-177 km/hr). *Very strong winds will produce widespread damage.* Some roofing material,

door, and window damage of buildings will occur. Considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs is likely. A number of glass windows in high-rise buildings will be dislodged and become airborne. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possibly death. Numerous large branches will break. Many trees will be uprooted or snapped. Extensive damage to power lines and poles will likely result in widespread power outages that could last a few to several days.

- ❑ **Category Three Hurricane:** Sustained winds 111-130 mph (96-113 kt or 178-209 km/hr). *Dangerous winds will cause extensive damage.* Some structural damage to houses and buildings will occur with a minor amount of wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs are destroyed. Many windows in high-rise buildings will be dislodged and become airborne. Persons struck by windborne debris risk injury and possibly death. Many trees will be snapped or uprooted and block numerous roads. Near total power loss is expected with outages that could last from several days to weeks.
- ❑ **Category Four Hurricane:** Sustained winds 131-155 mph (114-135 kt or 210-249 km/hr). *Extremely dangerous winds causing devastating damage are expected.* Some wall failures with some complete roof structure failures on houses will occur. All signs are blown down. Complete destruction of mobile homes (primarily pre-1994 construction). Extensive damage to doors and windows likely. Numerous windows in high-rise buildings will be dislodged and become airborne. Windborne debris will cause extensive damage and persons struck by the wind-blown debris will be injured or killed. Most trees will be snapped or uprooted. Fallen trees could cut off residential areas for days to weeks. Electricity will be unavailable for weeks after the hurricane passes.

- ❑ **Category Five Hurricane:** Sustained winds greater than 155 mph (135 kt or 249 km/hr). *Catastrophic damage is expected.* Complete roof failure on many residences and industrial buildings will occur. Some complete building failures with small buildings blown over or away are likely. All signs blow down. Complete destruction of mobile homes. Severe and extensive window and door damage will occur. Nearly all windows in high-rise buildings will be dislodged and become airborne. Severe injury or death is likely for persons struck by wind-blown debris. Nearly all trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months.

#### 4.3 **Historic Record**

Through research efforts by NOAA's National Climate Center in cooperation with the National Hurricane Center, records of tropical cyclone occurrences within the Atlantic Cyclone Basin have been compiled from 1851 to present. These records are compiled in NOAA's Hurricane database (HURDAT), which contains historical data recently reanalyzed to current scientific standards as well as the most current hurricane data.

During HURDAT's period of record (1851-2008), one Category Three Hurricane, eight Category Two Hurricanes, eight Category One Hurricanes, and 33 tropical storms have passed within a 150 nautical mile radius of Sherman. The representative storm strengths were measured as the peak intensities for each individual storm passing within the 150-mile radius. The 17 hurricanes noted above occurred in July through October as noted in Table 4-1.

**Table 4-1**  
**Hurricanes by Month within 150-miles of Sherman Since 1851**

<b>Category</b>	<b>July</b>	<b>August</b>	<b>September</b>	<b>October</b>
One	1	3	2	2
Two	0	2	6	0
Three	0	0	1	0
<b>Total</b>	<b>1</b>	<b>5</b>	<b>9</b>	<b>2</b>

A description of the historic record of hurricanes near Sherman follows:

1. An unnamed hurricane in 1858 was a Category One Hurricane when its center made landfall in southeastern Connecticut.
2. An unnamed hurricane in 1869 was a Category Three Hurricane when its center made landfall in Rhode Island.
3. An unnamed hurricane in 1878 was a Category One Hurricane when its center passed over eastern Pennsylvania towards Albany, NY.
4. An unnamed hurricane in 1879 was a Category One Hurricane when its center made landfall in East Falmouth, MA.
5. An unnamed hurricane in 1893 was a Category One Hurricane when its center made landfall near New York City and traveled north over western Connecticut.
6. An unnamed hurricane in 1894 was a Category One Hurricane when its center made landfall near Clinton, CT.
7. An unnamed hurricane in 1903 was a Category One Hurricane when its center made landfall in southern New Jersey.

8. An unnamed hurricane in 1916 was a Category One Hurricane when its center passed near Block Island, RI.
9. An unnamed hurricane in 1936 was a Category Two Hurricane when its center passed southeast of Long Island.
10. The most devastating hurricane to strike Connecticut, and believed to be the strongest hurricane to hit New England in recorded history, is believed to have been a Category Three Hurricane at its peak. Dubbed the "Long Island Express of September 21, 1938," this name was derived from the unusually high forward speed of the hurricane (estimated to be 70 mph). As a Category Two Hurricane, the center of the storm passed over Long Island, made landfall near Milford, CT, and moved quickly northward into northern New England.

The majority of damage was caused from storm surge and wind damage. Surges up to 18 feet were recorded along portions of the Connecticut coast, and 130 mile per hour gusts flattened forests, destroyed nearly 5,000 cottages, farms, and homes, and damaged an estimated 15,000 more throughout New York and southern New England. The storm resulted in catastrophic fires in New London and Mystic, CT. Fourteen to seventeen inches of rain were reported in central Connecticut, causing severe flooding. Overall, the storm left an estimated 564 dead, 1,700 injured, and caused physical damages in excess of 38 million 1938 United States dollars (USD).

11. The "Great Atlantic Hurricane" hit the Connecticut coast in September 1944. This storm was a Category Three Hurricane at its peak intensity but was a Category One Hurricane when its center passed over eastern Long Island and made landfall near New London, CT. The storm brought rainfall in excess of six inches to most of the state and rainfall in excess of eight to 10 inches in Fairfield County. Most of the wind damage from this storm occurred in southeastern Connecticut, although wind gusts of 109 mph were reported in Hartford, CT. Injuries and storm damage were lower in

this hurricane than in 1938 because of increased warning time and the fewer structures located in vulnerable areas due to the lack of rebuilding after the 1938 storm.

12. Another Category Two Hurricane, Hurricane Carol (naming of hurricanes began in 1950), made landfall near Clinton, CT in late August of 1954 shortly after high tide and produced storm surges of 10 to 15 feet in southeastern Connecticut. This storm was also a Category Three Hurricane at peak intensity. Rainfall amounts of six inches were recorded in New London, and wind gusts peaked at over 100 mph. Near the coast, the combination of strong winds and storm surge damaged or destroyed thousands of buildings, and the winds toppled trees that left most of the eastern part of the state without power. Overall damages in the northeast were estimated at one billion dollars (1954 USD), and 48 people died as a direct result of the hurricane. Western Connecticut was largely unaffected by Hurricane Carol due to the compact nature of the storm.
13. Hurricane Edna was a Category Two Hurricane when its center passed southeast of Long Island in September 1954.
14. Hurricane Donna of 1960 was a Category Four Hurricane when it made landfall in southwestern Florida and weakened to a Category Two hurricane when it made landfall near Old Lyme, Connecticut.
15. Hurricane Belle of August 1976 was a Category One Hurricane as it passed over Long Island, but was downgraded to a tropical storm before its center made landfall near Stratford, CT. Belle caused five fatalities and minor shoreline damage.
16. Hurricane Gloria of September 1985 was a Category Three Hurricane when it made landfall in North Carolina and weakened to a Category Two Hurricane before its center made landfall near Bridgeport, Connecticut. The hurricane struck at low tide,

resulting in low to moderate storm surges along the coast. The storm produced up to six inches of rain in some areas and heavy winds that damaged structures and uprooted thousands of trees. The amount and spread of debris and loss of power were the major impacts from this storm, with over 500,000 people suffering significant power outages.

17. Hurricane Bob was a Category Two Hurricane when its center made landfall in Rhode Island in August of 1991. The hurricane caused storm surge damage along the Connecticut coast but was more extensively felt in Rhode Island and Massachusetts. Heavy winds were felt across eastern Connecticut with gusts up to 100 mph, light to moderate tree damage, and the storm was responsible for six deaths in the state. Total damage in southern New England was approximately \$680 million (1991 USD).

The most recent tropical cyclone to seriously impact Connecticut was Tropical Storm Floyd in 1999. Floyd is the storm of record in the Connecticut Natural Hazard Mitigation Plan and is discussed in more detail in Section 3.3 due to heavy rainfall causing widespread flood damage. The winds associated with Tropical Storm Floyd caused power outages throughout New England and at least one death in Connecticut.

#### **4.4 Existing Programs, Policies, and Mitigation Measures**

Existing mitigation measures appropriate for inland flooding have been discussed in Section 3. These include the ordinances, codes, and regulations that have been enacted to minimize flood damage. In addition, various structures exist to protect certain areas, including dams and riprap.

Wind loading requirements are addressed through the state building code. The 2005 Connecticut State Building Code was amended in 2009 and adopted with an effective date of August 1, 2009. The code specifies the design wind speed for construction in all the Connecticut municipalities, with the addition of split zones for some towns. For

example, for towns along the Merritt Parkway such as Fairfield and Trumbull, wind speed criteria are different north and south of the parkway in relation to the distance from the shoreline. Effective December 31, 2005, the design wind speed for Sherman is 90 miles per hour. Sherman has adopted the Connecticut Building Code as its building code.

Connecticut is located in FEMA Zone II regarding maximum expected wind speed. The maximum expected wind speed for a three-second gust is 160 miles per hour. This wind speed could occur as a result of either a hurricane or a tornado in western Connecticut and southeastern New York. The American Society of Civil Engineers recommends that new buildings be designed to withstand this peak three-second gust.

Parts or all of tall and older trees may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. Connecticut Light & Power, the local electric utility, provides tree maintenance near its power lines. The response time of the electric company to fallen limbs on power lines is generally considered by the local officials of Sherman to be poor. During one recent storm, the Fire Department had to monitor a downed line along Route 37 for eight hours while waiting for the electric company to respond. During the public meeting that was convened for this plan, the attendees noted that while it is understood that the utility is often responding to many different problem areas following a storm the overall consensus was that coordination with the utility must occur to improve response times.

The Town has a tree warden who encourages residents to cut trees that can be dangerous to power lines. The tree warden is also responsible for maintenance along town roads and advises private associations regarding potentially hazardous trees on private roads. Thus, landowners and community associations are primarily responsible for conducting tree maintenance on private property. In addition, all utilities in new subdivisions must be located underground whenever possible in order to mitigate storm-related damages.

During emergencies, the Town currently has two designated emergency shelters available (Section 2.9). The Sherman Emergency Services Building will soon be the primary shelter with the secondary shelter being Sherman Consolidated School. Both facilities have generators. In addition, the Town has additional facilities available that could be converted to additional shelter space if the need arose. As hurricanes generally pass an area within a day's time, additional shelters can be set up after the storm as needed for long-term evacuees.

The Town relies on radio, television, area newspapers, and the internet to spread information on the location and availability of shelters. It is understood that several of these information sources can be cut off due to power failure, so emergency personnel can also pass this information on manually. The two local newspapers are printed too infrequently to reliably publish shelter information prior to most hazard events, although they can be used for those hazards with a long lead time, such as hurricanes. Prior to severe storm events, the Town ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas.

#### **4.5 Vulnerabilities and Risk Assessment**

In general, it is impossible to predict exactly when and where a hurricane will occur. NOAA believes that "hurricane landfalls are largely determined by the weather patterns in places the hurricane approaches, which are only predictable within several days of the storm making landfall." NOAA does issue an annual hurricane outlook to provide a general guide to each upcoming hurricane season based on various climatic factors.

NOAA has utilized the National Hurricane Center Risk Analysis Program (HURISK) to determine return periods for various hurricane categories at locations throughout the United States. As noted on the NOAA website, hurricane return periods are the frequency at which a certain intensity or category of hurricane can be expected with 75

nautical miles of a given location. For example, a return period of 20 years for a particular category storm means that on average during the pervious 100 years, a storm of that category passed within 75 nautical miles of that location five times. Thus, it is expected that similar category storms would pass within that radius an additional five times during the next 100 years.

Table 4-2 presents return periods for various category hurricanes to impact Connecticut. The nearest two HURISK analysis points were New York City and Block Island, NY – for this analysis, these date are assumed to represent western Connecticut and eastern Connecticut, respectively.

**Table 4-2**  
**Return Period In Years for Hurricanes to Strike Connecticut**

Category	New York City (Western Connecticut)	Block Island, RI (Eastern Connecticut)
One	17	17
Two	39	39
Three	68	70
Four	150	160
Five	370	430

According to the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, hurricanes have the greatest destructive potential of all natural disasters in Connecticut due to the potential combination of high winds, storm surge and coastal erosion, heavy rain, and flooding which can accompany the hazard. It is generally believed that New England is long overdue for another major hurricane strike. As shown in Table 4-2, NOAA estimates that the return period for a Category Two or Category Three storm to strike Fairfield County to be 39 years and 68 years, respectively. The last major hurricane to impact Connecticut was Hurricane Bob in 1991. Category One Hurricane Earl in 2010 was a reminder that hurricanes do track close to Connecticut.

The 2010 *Connecticut Natural Hazard Mitigation Plan Update* also notes some researchers have suggested that the intensity of tropical cyclones have increased over the last 35 years, with some believing that there is a connection between hurricanes and climate change. While most climate simulations agree that greenhouse warming enhances the frequency and intensity of tropical storms, models of the climate system are still limited by resolution and computational ability. However, given the past history of major storms and the possibility of increased frequency and intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Connecticut in the near future that may be of greater frequency and duration than in the past.

### Tropical Cyclone Vulnerability

In general, as the residents and businesses of the State of Connecticut become more dependent on the internet and mobile communications, the impact of hurricanes on commerce will continue to increase. A major hurricane has the potential of causing complete disruption of power and communications for up to several weeks, rendering electronic devices and those that rely on utility towers and lines inoperative.

Debris such as signs, roofing material, and small items left outside become flying missiles in hurricanes. Extensive damage to trees, towers, aboveground and underground utility lines (from uprooted trees or failed infrastructure), and fallen poles cause considerable disruption for residents. Streets may be flooded or blocked by fallen branches, poles, or trees, preventing egress. Downed power lines from heavy winds can also start fires during hurricanes with limited rainfall.

The town of Sherman is vulnerable to hurricane damage from wind and flooding and from any tornadoes accompanying the storm. In fact, most of the damage to the town from historical tropical cyclones has been due to the effects of flooding. Fortunately, Sherman is less vulnerable to hurricane damage than coastal towns in Connecticut

because it does not need to deal with the effects of storm surge. Factors that influence vulnerability to tropical cyclones in the town include building codes currently in place, and local zoning and development patterns and the age and number of structures located in highly vulnerable areas of the community.

Based on the population projections in Section 2.6, the population of the town of Sherman is estimated to increase by approximately 703 people through 2030. All areas of growth and development increase the town's vulnerability to natural hazards such as hurricanes. As noted in Section 4.1, wind damage from hurricanes and tropical storms has the ability to affect all areas of Sherman, while areas susceptible to flooding are even more vulnerable. Areas of known and potential flooding problems are discussed in Section 3, and tornadoes (which sometimes develop during tropical cyclones) will be discussed in Section 5. It is not believed that any town-owned critical facilities have any mitigation measures installed to reduce the effects of wind, so all critical facilities are as likely to be damaged by hurricane-force winds as any other.

Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. There are currently no mobile home parks in the town. Sherman's housing stock consists of historic buildings greater than 50 and sometimes 100 years old, relatively younger buildings built before 1990 when the building code changed to mitigate for wind damage, and relatively recent buildings that utilize the new code changes. Since most of the existing housing stock in the town predates the recent code changes, many structures are highly susceptible to roof and window damage from high winds. In addition, the few homes located within SFHAs are at risk from flooding as a result of the heavy rainfall that typically occurs during tropical storms and hurricanes.

As the town of Sherman is not affected by storm surge, hurricane sheltering needs have not been calculated by the U.S. Army Corps of Engineers for the town. The town of Sherman determines sheltering need based upon areas damaged or needing to be evacuated within the city. Under limited emergency conditions, a high percentage of

evacuees will seek shelter with friends or relatives rather than go to established shelters. During extended power outages, it is believed that only 10% to 20% of the affected population of the town will relocate, while most will stay in their homes until power is restored. In the case of a major (Category Three or above) hurricane, it is likely that the town will depend on state and federal aid to assist sheltering displaced populations until normalcy is restored.

The software program HAZUS-MH is FEMA's national loss estimation methodology for natural hazards. It provides nationally applicable, standardized methodologies for estimated potential wind, flood, and earthquake losses on a regional basis. HAZUS-MH utilizes Census 2000 data to perform its analysis of various damage estimates, with results estimated in 2006 dollars.

HAZUS-MH simulations were run for historical and probabilistic storms for the single census tract representing the town of Sherman. For the historical simulations, the results estimate the potential maximum damage that would occur in the present day (based on year 2000 data) given the same storm track and characteristics of each event. The probabilistic storms estimate the potential maximum damage that would occur based on wind speeds of varying return periods. Note that the simulations noted below calculate damage for wind effects alone and not damages due to flooding. Thus, the damage and displacement estimates presented below are likely lower than would occur during a storm with severe rainfall. Results are presented in Appendix D and summarized below.

Figure 4-1 shows the spatial relationship between the two historical storm tracks used for the HAZUS simulations (the 1938 hurricane and Hurricane Gloria in 1985) and the town of Sherman. These two storm tracks produced the highest winds to affect Sherman out of all the historic hurricanes included in the HAZUS-MH software.



**Figure 4-1: Historical Hurricane Storm Tracks**

The FEMA default values were used for each census tract in the HAZUS simulations. A summary of the default building counts and values is shown in Table 4-3. Approximately \$380 million of building value was estimated to exist in the town of Sherman.

**Table 4-3  
HAZUS-MH Hurricane Scenarios – Basic Information**

Occupancy	Building Count	Dollar Exposure (x 1000) (2006 USD)
Residential	1,645	331,887
Commercial	83	26,394
Other	69	20,804
<b>Total</b>	<b>1,797</b>	<b>379,085</b>

The HAZUS-MH *Hurricane Model Technical Manual* outlines various damage thresholds to classify buildings damaged during hurricanes. The five classifications are summarized below:

- ❑ **No Damage or Very Minor Damage:** Little or no visible damage from the outside. No broken windows or failed roof deck. Minimal loss of roof cover, with no or very limited water penetration.
- ❑ **Minor Damage:** Maximum of one broken window, door, or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.
- ❑ **Moderate Damage:** Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.
- ❑ **Severe Damage:** Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water. Limited, local joist failures. Failure of one wall.
- ❑ **Destruction:** Essentially complete roof failure and/or more than 25% of roof sheathing. Significant amount of the wall envelope opened through window failure and/or failure of more than one wall. Extensive damage to interior.

Table 4-4 presents the peak wind speeds during each wind event simulated by HAZUS for the town of Sherman. The number of expected residential buildings to experience various classifications of damage is presented in Table 4-4, and the total number of buildings expected to experience various classifications of damage is presented in Table 4-5. Minimal damage is expected to buildings for wind speeds less than 70 mph, with overall damages increasing with increasing wind speed.

**Table 4-4**  
**HAZUS-MH Hurricane Scenarios – Number of Residential Buildings Damaged**

Return Period or Storm	Peak Wind Gust (mph)	Minor Damage	Moderate Damage	Severe Damage	Total Destruction	Total
10-Years	37	0	0	0	0	0
20-Years	51	0	0	0	0	0
50-Years	68	1	0	0	0	1
Gloria (1985)	72	4	0	0	0	4
100-Years	79	17	0	0	0	17
Unnamed (1938)	89	76	4	0	0	80
200-Years	90	81	4	0	0	85
500-Years	101	252	29	1	1	283
1000-Years	110	437	85	8	7	537

**Table 4-5**  
**HAZUS-MH Hurricane Scenarios – Total Number of Buildings Damaged**

Return Period or Storm	Minor Damage	Moderate Damage	Severe Damage	Total Destruction	Total
10-Years	0	0	0	0	0
20-Years	0	0	0	0	0
50-Years	2	0	0	0	2
Gloria (1985)	5	0	0	0	5
100-Years	18	0	0	0	18
Unnamed (1938)	81	4	0	0	85
200-Years	87	4	0	0	91
500-Years	268	32	2	1	303
1000-Years	467	97	10	7	581

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. As shown in Table 4-6, minimal damage to essential facilities is expected for wind speeds less than 100 mph. Note that this analysis is based on essential facilities that existed in 2000. Minor damage to the remaining essential facilities occurs for all greater wind events, with the expectation that the essential facilities have a loss of service greater than one day for the highest wind events.

**Table 4-6**  
**HAZUS-MH Hurricane Scenarios – Essential Facility Damage**

<b>Return Period or Storm</b>	<b>Fire Stations (1)</b>	<b>Police Stations (1)</b>	<b>Schools (1)</b>
10-Years	None or Minor	None or Minor	None or Minor
20-Years	None or Minor	None or Minor	None or Minor
50-Years	None or Minor	None or Minor	None or Minor
Gloria (1985)	None or Minor	None or Minor	None or Minor
100-Years	None or Minor	None or Minor	None or Minor
Unnamed (1938)	None or Minor	None or Minor	None or Minor
200-Years	None or Minor	None or Minor	None or Minor
500-Years	Minor damage, loss of use > 1 day	Minor damage, loss of use > 1 day	Minor damage, loss of use > 1 day
1000-Years	Minor damage, loss of use > 1 day	Minor damage, loss of use > 1 day	Minor damage, loss of use > 1 day

Table 4-7 presents the estimated tonnage of debris that would be generated by wind damage during each HAZUS storm scenario. As shown in Table 4-7, minimal debris are expected for storms less than the 50-year event, and reinforced concrete and steel buildings will not generate debris for any of the wind events simulated. Much of the debris that is generated is tree-related.

**Table 4-7**  
**HAZUS-MH Hurricane Scenarios – Debris Generation (Tons)**

<b>Return Period or Storm</b>	<b>Brick / Wood</b>	<b>Reinforced Concrete / Steel</b>	<b>Tree Debris</b>	<b>Total</b>	<b>Estimated Cleanup Truckloads (25 Tons / Truck)</b>
10-Years	None	None	None	None	None
20-Years	None	None	None	None	None
50-Years	7	None	None	7	<1
Gloria (1985)	12	None	None	12	<1
100-Years	48	None	747	795	2
Unnamed (1938)	122	None	5,984	6,106	6
200-Years	122	None	5,996	6,118	6
500-Years	473	None	8,977	9,450	20
1000-Years	1,141	None	21,674	22,815	47

Table 4-8 presents the potential sheltering requirements based on the various wind events simulated by HAZUS. The predicted sheltering requirements for wind damage are relatively minimal even for the largest wind events and can addressed through the use of the existing shelter facilities. However, it is likely that hurricanes will also produce heavy rain and flooding that could increase the overall sheltering need in the town.

**Table 4-8**  
**HAZUS-MH Hurricane Scenarios – Shelter Requirements**

<b>Return Period or Storm</b>	<b>Number of Displaced Households</b>	<b>Short Term Sheltering Need (Number of People)</b>
10-Years	0	0
20-Years	0	0
50-Years	0	0
Gloria (1985)	0	0
100-Years	0	0
Unnamed (1938)	0	0
200-Years	0	0
500-Years	1	0
1000-Years	6	1

Table 4-9 presents the predicted economic losses due to the various simulated wind events. Property damage loss estimates include the subcategories of building, contents, and inventory damages. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building or its contents. Business interruption loss estimates include the subcategories of lost income, relocation expenses, and lost wages. The business interruption losses are associated with the inability to operate a business due to the damage sustained during a hurricane, and also include temporary living expenses for those people displaced from their home because of the storm.

**Table 4-9**  
**HAZUS-MH Hurricane Scenarios – Economic Losses (x \$1,000)**

<b>Return Period or Storm</b>	<b>Residential Property Damage Losses</b>	<b>Total Property Damage Losses</b>	<b>Business Interruption (Income) Losses</b>
10-Years	0	0	0
20-Years	0	0	0
50-Years	165.33	169.78	0.02
Gloria (1985)	297.41	301.85	0.05
100-Years	628.79	644.72	0.77
Unnamed (1938)	1,442.76	1,502.30	71.51
200-Years	1,476.34	1,539.62	71.94
500-Years	3,803.68	4,085.89	297.79
1000-Years	9,303.42	10,123.20	1,155.15

Losses are minimal for storms with return periods of less than 50-years (68 mph) but increase rapidly as larger storms are considered. For example, a reenactment of the 1938 hurricane would cause approximately three million dollars in wind damages to the town of Sherman. Note that the losses are presented in 2006 dollars, which implies that they will be greater in the future due to inflation. It is also believed that the next plan update will be able to utilize 2010 census data, providing a more recent dataset for analysis.

In summary, hurricanes are a very real and potentially costly hazard to the town of Sherman. Based on the historic record and HAZUS-MH simulations of various wind events, the entire town is vulnerable to wind damage from hurricanes. These damages can include direct structural damages, interruptions to business and commerce, emotional impacts, and injury or death.

#### **4.6 Potential Mitigation Measures, Strategies, and Alternatives**

Many potential mitigation measures for hurricanes include those appropriate for inland flooding. These were presented in Section 3.6. However, hurricane mitigation measures must also address the effects of heavy winds that are inherently caused by hurricanes. Mitigation for wind damage is therefore emphasized in the subsections below.

#### 4.6.1 Prevention

Although hurricanes and tropical storms cannot be prevented, a number of methods are available to continue preventing damage from the storms and perhaps to mitigate damage. The following actions have been identified as potential preventive measures:

- ❑ Continue townwide tree limb inspection and maintenance programs to ensure that the potential for downed power lines is diminished.
- ❑ Continue location of utilities underground in new developments or as related to redevelopment.
- ❑ Continue to review the currently enacted Emergency Operations Plan for the Town and update when necessary.

#### 4.6.2 Property Protection

Property protection measures include those described for flooding in Section 3.6.2. Various structural projects for wind damage mitigation are described in Section 4.6.5. The local tree warden should continue education and outreach regarding dangerous trees on private property, particularly for trees near homes with dead branches overhanging the structure or nearby power lines. These limbs are the most likely to fall during a storm.

#### 4.6.3 Public Education and Awareness

The public should be made aware of evacuation routes and available shelters. A number of specific proposals for improved public education are recommended to prevent damage and loss of life during hurricanes. These are common to all hazards in this Plan and are listed in Section 10.1.

#### 4.6.4 Emergency Services

The Emergency Operation Plan of the Town of Sherman includes guidelines and specifications for communication of hurricane warnings and watches as well as for a call for evacuation. The public needs to be made aware of evacuation routes and the locations of public shelters in advance of a hurricane event which can be accomplished by (1) placing this information on the Town website, (2) by creating informational displays in local municipal buildings, and (3) through press releases to local radio and television stations and local newspapers. In addition, Sherman should identify and prepare additional facilities for evacuation and sheltering needs. The Town should also continue to review its mutual aid agreements and update as necessary to ensure help is available as needed. The Town should also initiate a dialogue with Connecticut Light & Power regarding its response time for downed trees.

#### 4.6.5 Structural Projects

Potential mitigation measures include designs for hazard-resistant construction and retrofitting techniques. These may take the form of increased wind and flood resistance as well as the use of storm shutters over exposed glass and the inclusion of hurricane straps to hold roofs to buildings. Structural projects for wind damage mitigation include the installation of shutters, load path projects, roof projects, and code plus projects on private homes and critical facilities.

- ❑ Shutter mitigation projects protect all windows and doors of a structure with shutters, lamentations, or other systems that meet debris impact and wind pressure design requirements. All openings of a building are to be protected, including garage doors on residential buildings, large overhead doors on commercial buildings, and apparatus bay doors at fire stations.
- ❑ Load path projects improve and upgrade the structural system of a building to transfer loads from the roof to the foundation. This retrofit provides positive connection from

the roof framing to the walls, better connections within the wall framing, and connections from the wall framing to the foundation system.

- ❑ Roof projects involve retrofitting a building's roof by improving and upgrading the roof deck and roof coverings to secure the building envelope and integrity during a wind or seismic event.
- ❑ Code plus projects are those designed to exceed the local building codes and standards to achieve a greater level of protection.

Given the relative rarity of hurricane wind damage in the town of Sherman, it is unlikely that any structural projects for extreme wind damage would be cost effective unless it was for a critical facility. The Town should encourage the above measures in new construction, and require it for new critical facilities. Compliance with the amended Connecticut Building Code for wind speeds is necessary. Literature should be made available by the Building Department to developers during the permitting process regarding these design standards.

#### **4.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives**

While many potential mitigation activities were addressed in Section 4.6, the recommended mitigation strategies for mitigating hurricane and tropical storm winds in the town of Sherman are listed below.

- ❑ Continue tree limb maintenance and inspections, especially along state roads and other evacuation routes. Increase inspections of trees on private property near power lines and Town right-of-ways. Encourage property owners to trim dead branches located over structures and power lines leading to a building.
- ❑ Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.

- ❑ Review potential evacuation plans to ensure timely migration of people seeking shelter in all areas of Sherman and post evacuation and shelter information on the Town website and in municipal buildings.
- ❑ Continue to review and update the Town's Emergency Operations Plan as necessary.
- ❑ Provide for the Building Department to have literature available regarding appropriate design standards for wind.
- ❑ Encourage the use of structural techniques related to mitigation of wind damage in new structures to protect new buildings to a standard greater than the minimum building code requirements and require them for new critical facilities.

In addition, important recommendations that apply to all hazards are listed in Section 10.1.

## **5.0 SUMMER STORMS AND TORNADOES**

### **5.1 Setting**

Like hurricanes and winter storms, summer storms and tornadoes have the potential to affect any area within the Town of Sherman. Furthermore, because these types of storms and the hazards that result (flash flooding, wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the Town without harming another. The entire Town of Sherman is therefore susceptible to summer storms (including heavy rain, flash flooding, wind, hail, and lightning) and tornadoes.

Based on the historic record, it is considered highly likely that a summer storm that includes lightning will impact the Town of Sherman each year although lightning strikes have a limited effect. Strong winds and hail are considered likely to occur during such storms but also generally have limited effects. A tornado is considered a possible event in Litchfield County each year that could cause significant damage to a small area (refer to Appended Table 2).

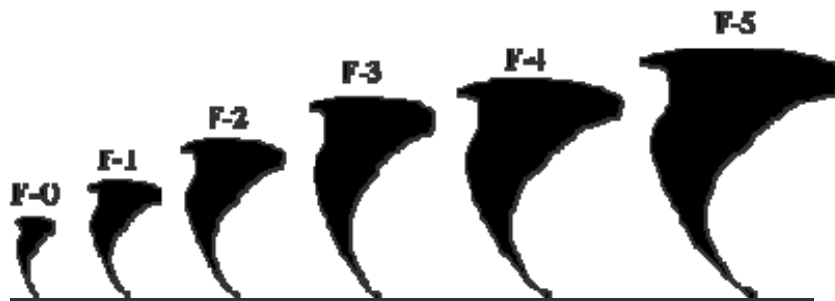
### **5.2 Hazard Assessment**

Heavy wind (including tornadoes and downbursts), lightning, heavy rain, hail, and flash floods are the primary hazards associated with summer storms. Inland flooding and flash flooding caused by heavy rainfall was covered in Section 3.0 of this plan and will not be discussed in detail here.

## Tornadoes

Tornadoes are spawned by certain thunderstorms. NOAA defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." The Fujita scale was accepted as the official classification system for tornado damage for many years following its publication in 1971. The Fujita scale rated the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. The scale ranked tornadoes using the now-familiar notation of F0 through F5, increasing with wind speed and intensity. The following graphic of the Fujita scale is provided by FEMA. A description of the scale follows in Table 5-1.

### **Fujita Tornado Scale**



**Table 5-1  
Fujita Scale**

<b>F-Scale Number</b>	<b>Intensity</b>	<b>Wind Speed</b>	<b>Type of Damage Done</b>
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.

**Table 5-1 (Continued)**  
**Fujita Scale**

<b>F-Scale Number</b>	<b>Intensity</b>	<b>Wind Speed</b>	<b>Type of Damage Done</b>
F3	Severe tornado	158-206 mph	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 winds that would surround the F6 winds. Missiles, such as cars and refrigerators, would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern for it may never be identifiable through engineering studies.

According to NOAA, weak tornadoes (F0 and F1) account for approximately 69% of all tornadoes. These tornadoes last an average of five to 10 minutes and account for approximately 3% of tornado-related deaths. Strong tornadoes (F2 and F3) account for approximately 29% of all tornadoes and approximately 27% of all tornado deaths. These storms may last for 20 minutes or more. Violent tornadoes (F4 and above) are rare but extremely destructive and account for only 2% of all tornadoes. These storms sometimes last over an hour and result in approximately 70% of all tornado-related deaths.

The Enhanced Fujita Scale was released by NOAA for implementation on February 1, 2007. According to the NOAA web site, the Enhanced Fujita Scale was developed in response to a number of weaknesses to the Fujita Scale that were apparent over the years, including the subjectivity of the original scale based on damage, the use of the worst damage to classify the tornado, the fact that structures have different construction

depending on location within the United States, and an overestimation of wind speeds for F3 and greater.

Similar to the Fujita Scale, the Enhanced F-scale is also a set of wind estimates based on damage. It uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 specific indicators. Table 5-2 relates the Fujita and enhanced Fujita scales.

**Table 5-2**  
**Enhanced Fujita Scale**

<b>Fujita Scale</b>			<b>Derived EF Scale</b>		<b>Operational EF Scale</b>	
<i>F Number</i>	<i>Fastest 1/4-mile (mph)</i>	<i>3 Second Gust (mph)</i>	<i>EF Number</i>	<i>3 Second Gust (mph)</i>	<i>EF Number</i>	<i>3 Second Gust (mph)</i>
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Official records of tornado activity date back to 1950. According to NOAA, an average of 800 tornadoes is reported each year in the United States. The historic record of tornadoes near Sherman is discussed in Section 5.3. Tornadoes are most likely to occur in Connecticut in June, July, and August of each year.

According to the New York State Hazard Mitigation Plan, adjacent Dutchess County (11 events) is tied with four other counties in New York as having the fifth-highest occurrence of tornado activity since 1950. According to NOAA, the highest relative risk for tornadoes in Connecticut is Litchfield (22 events) and Hartford Counties, followed by New Haven, Fairfield, Tolland, Middlesex, Windham, and finally New London County. By virtue of its location in Fairfield County (moderate risk), but adjacent to Litchfield County (high risk) and Dutchess County (moderate risk), the town of Sherman is therefore at a relatively high risk for tornadoes. The pattern of occurrence in Connecticut

is expected to remain unchanged according to the Connecticut Natural Hazards Mitigation Plan (2007).

### Lightning

Lightning is a circuit of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. In the initial stages of development, air acts as an insulator between the positive and negative charges.

However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs.

In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud-to-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom of a second cloud. Cloud-to-ground lightning is the most dangerous. In summertime, most cloud-to-ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

According to NOAA's National Weather Service, there is an average of 100,000 thunderstorms per year in the United States. An average of 41 people per year died and an average of 262 people were injured from lightning strikes in the United States from 2000 to 2009. Most lightning deaths and injuries occur outdoors, with 45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities. Only 17 lightning-related fatalities occurred in Connecticut between 1959 and 2009. Most recently, on June 8, 2008, lightning struck a pavilion at Hamonasset Beach in Madison, Connecticut, injuring five and killing one.

Thunderstorms occur on 18 to 35 days each year in Connecticut. In general, thunderstorms in Connecticut are more frequent in the western and northern parts of the state, and less frequent in the southern and eastern parts. Although lightning is usually

associated with thunderstorms, it can occur on almost any day. The likelihood of lightning strikes in the Sherman area is very high during any given thunderstorm although no one area of the town is at higher risk of lightning strikes.

### Downbursts

A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes in Connecticut. Depending on the size and location of downburst events, the destruction to property may be significant.

Downburst activity is, on occasion, mistaken for tornado activity.

Both storms have very damaging winds (downburst wind speeds can exceed 165 miles per hour) and are very loud. These "straight line"

winds are distinguishable from tornadic activity by the pattern of destruction and debris such that the best way to determine the damage source is to fly over the area.

#### ***Downbursts fall into two categories:***

- ❑ ***Microbursts*** affect an area less than 2.5 miles in diameter, last five to 15 minutes, and can cause damaging winds up to 168 mph.
- ❑ ***Macrobursts*** affect an area at least 2.5 miles in diameter, last five to 30 minutes, and can cause damaging winds up to 134 mph).

Town of Sherman personnel recall that the town had a bad downburst "a few years ago," but no details were available for this report. The town of Sherman most recently had a microburst occur during the early evening of August 16, 2010. Damage was reported from west to east across Spring Lake Road, Route 39 North, and Church Road. The winds damaged lots of trees, closed roads, and caused power outages. No structures were damaged in the event.

It is difficult to find statistical data regarding frequency of downburst activity. NOAA reports that there are 10 downburst reports for every tornado report in the United States. Assuming that on average there are 8,000 downbursts reported per year, downbursts occur in approximately 8% of all thunderstorms in the United States each year. This

value suggests that downbursts are a relatively uncommon yet persistent hazard. The risk to the town of Sherman is believed to be low for any given year.

## Hail

Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than 1.5 pounds have been recorded. While crops are the major victims of hail, it is also a hazard to vehicles and property.

According to NOAA's National Weather Service, hail caused four deaths and an average of 47 injuries per year in the United States from 2000 to 2009. Hailstorms typically occur in at least one part of Connecticut each year during a severe thunderstorm. As with thunderstorms, hailstorms are more frequent in the northwest and western portions of the state and less frequent in the southern and eastern portions. Overall, the risk of at least one hailstorm occurring in Sherman is considered moderate in any given year.

### **5.3 Historic Record**

An extensively researched list of tornado activity in Connecticut is available on Wikipedia. This list extends back to 1648, although it is noted that the historical data prior to 1950 is incomplete due to lack of official records and gaps in populated areas. Based on available information through August 2010, Litchfield County and Fairfield County, respectively, have experienced a total of 28 and 19 tornado events with reported damages totaling tens of millions of dollars. Table 5-3 summarizes the tornado events near Sherman from 1950 through August 2010 based on the Wikipedia list.

**Table 5-3**  
**Tornado Events Near Sherman From 1648 to August 2010**

<b>Date</b>	<b>County</b>	<b>Fujita Tornado Scale</b>	<b>Property Damage</b>	<b>Injuries / Deaths</b>
June 20, 1682	Fairfield	-	NR	NR
August 17, 1784	Litchfield	-	18 structures	5 inj.
October 8, 1797	Fairfield	-	NR	6 inj.
August 1, 1812	Fairfield	-	NR	NR
July 22, 1817	Litchfield	-	NR	NR
August 14, 1820	Fairfield	-	NR	NR
June 3, 1836	Dutchess & Litchfield	-	NR	"Many"
August 9, 1878	Litchfield	-	"Major"	NR
September 14, 1882	Litchfield	-	14 structures	2 dead, 18 inj.
September 27, 1899	Fairfield	-	Buildings	NR
September 15, 1901	Fairfield	-	Several barns	1 dead
August 28, 1911	Fairfield	-	Roofs	NR
July 14, 1950	Fairfield	F2	\$250,000	3 inj.
August 21, 1951	Litchfield	F2	\$250,000	9 inj.
August 15, 1958	Fairfield	F1	\$2,500	NR
August 21, 1958	Litchfield	F1	\$0	NR
May 12, 1959	Litchfield	F2	\$2,500	NR
June 18, 1962	Litchfield	F2	\$25,000	NR
August 11, 1966	Litchfield	F2	\$25,000	NR
August 9, 1968	Fairfield	F1	\$0	NR
August 20, 1968	Litchfield	F1	\$2,500	NR
July 19, 1971	Fairfield	F2	\$25,000	NR
August 7, 1972	Litchfield	F1	\$250,000	NR
August 9, 1972	Litchfield	F1	\$25,000	NR
June 12, 1973	Litchfield	F2	\$0	NR
June 29, 1973	Litchfield	F1	\$2,500	NR
September 18, 1973	Fairfield	F1	\$0	NR
July 3, 1974	Litchfield	F1	\$2,500	NR
June 19, 1975	Litchfield	F1	\$0	NR
July 20, 1975	Litchfield	F1	\$2,500	NR
June 30, 1976	Litchfield	F2	\$25,000	NR
August 7, 1978	Dutchess	F-	\$25,000	NR
May 12, 1984	Dutchess	F0	\$25,000	NR
July 25, 1987	Dutchess	F0	\$250,000	NR
July 21, 1988	Dutchess	F1	\$25,000	NR
July 10, 1989 2:45 P.M.	Litchfield	F2	\$25,000,000	4 inj.
July 10, 1989 3:15 P.M.	Litchfield	F2	\$25,000,000	70 inj.
June 29, 1990	Fairfield	F0	\$2,500	7 inj.
July 5, 1992	Dutchess	F0	\$250,000	NR
July 5, 1992	Fairfield	F0	\$0	NR
July 31, 1992	Dutchess	F1	\$2,500,000	NR
August 4, 1992	Fairfield	F1	\$300	NR
May 29, 1995	Dutchess	F-	\$10,000,000	5 inj.
July 9, 1996	Fairfield	F1	\$0	NR
May 31, 1998	Litchfield	F1	\$4,000	NR
May 18, 2000	Dutchess	F0	\$70,000	NR

**Table 5-3 (Continued)**  
**Tornado Events Near Sherman 1648 – August 2010**

June 23, 2001 1:00 P.M.	Litchfield	F1	\$150,000	1 inj.
June 23, 2001 1:50 P.M.	Litchfield	F2	\$250,000	NR
June 23, 2001 2:18 P.M.	Litchfield	F0	"Minor"	NR
July 1, 2001	Litchfield	F0	\$75,000	NR
May 31, 2002	Dutchess	F1	\$35,000	NR
May 31, 2002	Fairfield	F1	\$0	NR
June 5, 2002	Litchfield	F1	\$40,000	NR
June 16, 2002	Dutchess	F1	\$20,000	NR
June 16, 2002	Litchfield	F0	\$10,000	NR
September 28, 2003	Dutchess	F1	\$10,000	NR
June 25, 2006	Dutchess	F1	\$0	NR
July 12, 2006	Fairfield	F1	\$2,000,000	NR
May 16, 2007	Fairfield	EF1	\$0	NR
July 31, 2009	Fairfield	F1	\$10,000	NR
June 24, 2010	Fairfield	EF1	\$7,000,000	23 inj.
July 22, 2010	Litchfield	EF1	\$0	NR

NR = None Reported

A limited selection of summer storm damage in and around Sherman, taken from the NCDC Storm Events database, is listed below:

- ❑ July 5, 1992 – An F0 tornado struck near neighboring New Fairfield.
- ❑ August 28, 1993 – Police reported several trees down in New Fairfield due to thunderstorm winds.
- ❑ April 4, 1995 – Thunderstorm winds caused \$100,000 in damage throughout Dutchess County. Some of the damage was reported in neighboring Pawling.
- ❑ May 21, 1996 – Severe thunderstorms produced damage across parts of Litchfield County and caused approximately \$5,000 in property damage. Numerous wires and trees were downed by the wind in neighboring New Milford.
- ❑ July 9, 1997 – Severe thunderstorms produced flooding and damaging winds that downed trees throughout Litchfield County, causing approximately \$5,000 in damage. The wind downed trees and wires in New Fairfield.

- ❑ May 31, 1998 – A strong low pressure system produced an F1 tornado near Washington in Litchfield County, and a severe thunderstorm downed trees and wires in New Milford.
- ❑ September 16, 1999 – In addition to the flooding damages described in Section 3.3, the remnants of Tropical Storm Floyd also produced wind gusts up to 60 miles per hour in Litchfield County, causing widespread downing of trees and power lines. Up to 5,000 homes were left without power, and approximately \$100,000 in wind damage was reported.
- ❑ May 18, 2000 – Severe thunderstorms caused widespread damage across Dutchess County. In Pawling, a large tree fell on power lines and then onto a car causing extensive damage. Pea-sized hail was reported that caused a million dollars in crop damage.
- ❑ July 1, 2001 – An F0 tornado tracked across southern Litchfield County, touching down seven times along its path from New Milford to Roxbury. The storm caused \$75,000 in damages.
- ❑ July 10, 2001 – Locally severe thunderstorms produced dime-sized hail in Sherman.
- ❑ May 31, 2002 – Severe weather in Litchfield County produced hail up to two inches in diameter in Thomaston, blew down trees, and caused 37,000 power outages and \$10,000 in damages across the county. In Dutchess County, Dover reported one-inch hail, and an F1 tornado touched down near Wingdale in southern Dover.
- ❑ June 16, 2002 – A severe storm produced an F1 tornado in Pawling and an F0 tornado in the Lanesville section of New Milford. The F0 tornado produced tree damage near the intersection of Cross Road and Route 7. Nickel-sized hail was also reported in New Milford and Sherman.
- ❑ August 22, 2003 – A severe thunderstorm produced high winds that knocked down several trees in Sherman.
- ❑ October 27, 2003 – Thunderstorm winds downed trees and power lines in New Fairfield and nearby Danbury.

- ❑ August 20, 2004 – Hail measuring 0.75 inches was reported in New Milford and Sherman. Fallen trees blocked roads in Pawling. The following day, lightning struck a house on Hurds Corners Road in Pawling.
- ❑ July 27, 2005 – Severe thunderstorms with winds approaching 60 mph blew down numerous trees and some wires in New Milford, New Fairfield, and Pawling.
- ❑ June 21, 2006 – A man was struck by lightning in New Fairfield, causing minor injuries.
- ❑ July 19, 2007 – A severe thunderstorm produced damaging straight-line winds estimated at 85 to 95 miles per hour that downed numerous trees on Straight Rock Drive and Long Mountain Road in Gaylordsville and New Milford. Trees were reported down on power lines near Route 55 in Sherman.
- ❑ May 12, 2008 – High winds downed trees and power lines in Danbury and across Route 37 in New Fairfield.
- ❑ June 14, 2008 and June 16, 2008 – Strong thunderstorm winds (50 mph) blew down trees in New Milford on both dates. On June 16, quarter sized hail was reported in Dover.
- ❑ July 16, 2009 – Ping-pong ball sized hail was reported in New Milford.
- ❑ July 26, 2009 – Strong thunderstorm winds (50 mph) blew down wires in neighboring Kent. Nickel to ping-pong ball sized hail was reported in New Milford, and ping-pong ball sized hail was reported in Pawling. Trees were reported down in South Dover and Pawling.
- ❑ June 25, 2010 – An EF-1 tornado struck Bridgeport in southern Fairfield County causing massive damage throughout parts of the city. The storm caused over seven million dollars in damages to Bridgeport and the surrounding towns and 23 people were injured.

## 5.4 Existing Programs, Policies, and Mitigation Measures

Warning is the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. Tables 5-4 and 5-5 list the NOAA Watches and Warnings, respectively, as pertaining to actions to be taken by emergency management personnel in connection with summer storms and tornadoes.

*A severe thunderstorm watch is issued by the National Weather Service when the weather conditions are such that a severe thunderstorm (winds greater than 58 miles per hour, or hail three-fourths of an inch or greater, or can produce a tornado) is likely to develop.*

*A severe thunderstorm warning is issued when a severe thunderstorm has been sighted or indicated by weather radar.*

**Table 5-4**  
**NOAA Weather Watches**

Weather Condition	Meaning	Actions
Severe Thunderstorm	Severe thunderstorms are possible in your area.	Notify personnel and watch for severe weather.
Tornado	Tornadoes are possible in your area.	Notify personnel and be prepared to move quickly if a warning is issued.
Flash Flood	It is possible that rains will cause flash flooding in your area.	Notify personnel to watch for street or river flooding.

Aside from warnings, several other methods of mitigation for wind damage are employed in Sherman. Continued location of utilities underground is an important method of reducing wind damage to utilities and the resulting loss of services. The Connecticut Building Codes include guidelines for Wind Load Criteria that are specific to each municipality as explained in Section 4.0. In addition, specific mitigation measures address debris removal and tree trimming.

**Table 5-5  
NOAA Weather Warnings**

<b>Weather Condition</b>	<b>Meaning</b>	<b>Actions</b>
Severe Thunderstorm	Severe thunderstorms are occurring or are imminent in your area.	Notify personnel and watch for severe conditions or damage (i.e., downed power lines and trees). Take appropriate actions listed in municipal emergency plans.
Tornado	Tornadoes are occurring or are imminent in your area.	Notify personnel, watch for severe weather, and ensure personnel are protected. Take appropriate actions listed in emergency plans.
Flash Flood	Flash flooding is occurring or imminent in your area.	Watch local rivers and streams. Be prepared to evacuate low-lying areas. Take appropriate actions listed in emergency plans.

In the town of Sherman, the local utilities are responsible for tree branch removal and maintenance above and near their lines. The Town also performs tree branch trimming along town roads and on town property. In addition, all new developments in Sherman must place utilities underground wherever possible. The Tree Warden also approaches residents on a case-by-case basis when trees and branches on their property look hazardous, though ultimately tree removal on private property is up to the property owner.

Municipal responsibilities relative to tornado mitigation and preparedness include:

- ☐ Developing and disseminating emergency public information and instructions concerning tornado safety, especially guidance regarding in-home protection and evacuation procedures and locations of public shelters.
- ☐ Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- ☐ Periodically test and exercise tornado response plans.
- ☐ Put emergency personnel on standby at tornado "watch" stage.

## 5.5 **Vulnerabilities and Risk Assessment**

The central and southern portions of the United States are at higher risk for lightning and thunderstorms than is the northeast. However, FEMA reports that more deaths from lightning occur on the East Coast than elsewhere. Lightning-related fatalities have declined in recent years due to increased education and awareness.

Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Straight-line winds occur as the first gust of a thunderstorm or from the downburst from a thunderstorm and have no associated rotation. Sherman is particularly susceptible to damage from high winds due to its high elevation and heavily treed landscape.

Heavy winds can take down trees near power lines, leading to the start and spread of fires. Such fires can be extremely dangerous during the summer months during dry and drought conditions. Most downed power lines in Sherman are detected quickly and any associated fires are quickly extinguished. However, it is important to have adequate water supply for fire protection to ensure this level of safety is maintained.

According to Town personnel, no single area of town is more susceptible to wind damage than any other. Secondary damage from falling branches and trees is more common than direct wind damage to structures.

## 5.6 **Potential Mitigation Measures, Strategies, and Alternatives**

Both the FEMA and the NOAA websites contain valuable information regarding preparing for and protecting

oneself during a tornado as well as information on a number of other natural hazards.

***More information is available at:***

FEMA – <http://www.fema.gov/library/>  
NOAA – <http://www.nssl.noaa.gov/NWSTornado/>

Available information from FEMA includes:

- ❑ Design and construction guidance for creating and identifying community shelters
- ❑ Recommendations to better protect your business, community, and home from tornado damage, including construction and design guidelines for structures
- ❑ Ways to better protect property from wind damage
- ❑ Ways to protect property from flooding damage
- ❑ Construction of safe rooms within homes

NOAA information includes a discussion of family preparedness procedures and the best physical locations during a storm event. Although tornadoes pose a legitimate threat to public safety, their occurrence is considered too infrequent to justify the construction of tornado shelters in Connecticut. Residents should instead be encouraged to purchase a NOAA weather radio containing an alarm feature.

The implementation of an emergency notification system would be beneficial in warning residents of an impending tornado. A community warning system that relies on radios and television is less effective at warning residents during the night when the majority of the community is asleep. This fact was evidenced most recently by the severe storm that struck Lake County, Florida on February 2, 2007. This powerful storm, which included several tornadoes, struck at about 3:15 a.m. According to National Public Radio, local broadcast stations had difficulty warning residents due to the lack of listeners and viewers and encouraged those awake to telephone warnings into the affected area.

Specific mitigation steps that can be taken to prevent property damage and protect property follow.

### Prevention

- ☐ Continue or increase tree limb inspection programs to ensure that the potential for downed power lines is minimized.
- ☐ Continue to place utilities underground.

### Property Protection

- ☐ Require compliance with the amended Connecticut Building Code for wind speeds.
- ☐ Provide for the Building Official to make literature available during the permitting process regarding appropriate design standards.
- ☐ Encourage residents to trim dead branches overhanging their homes and wires leading to their homes.

## **5.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives**

While many potential mitigation activities were addressed in Section 5.6, the recommended mitigation strategies for mitigating wind, hail, tornadoes, and downbursts in the town of Sherman are listed below.

- ☐ Increase tree limb maintenance and inspections, especially in the Town Center
- ☐ Continue outreach regarding dangerous trees on private property such as by encouraging residents to trim dead branches overhanging their homes
- ☐ Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas
- ☐ Continue to require compliance with the amended Connecticut Building Code for wind speeds
- ☐ Have the Building Department make literature available during the permitting process regarding appropriate design standards

- ❑ Encourage the use of structural techniques related to mitigation of wind damage in new structures to protect new buildings to a standard greater than the minimum building code requirements

In addition, important recommendations that apply to all hazards are listed in Section 10.1.

## 6.0 WINTER STORMS

### 6.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any area of the town of Sherman. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. The entire town of Sherman is susceptible to winter storms and, due to its high elevation, can have higher amounts of snow than surrounding communities. In general, winter storms are considered highly likely to occur each year (major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of the town (refer to appended Tables 1 and 2).

### 6.2 Hazard Assessment

This section focuses on those effects commonly associated with winter storms, including those from blizzards, ice storms, heavy snow, freezing rain, and extreme cold. Most deaths from winter storms are indirectly related to the storm, such as from traffic

accidents on icy roads and hypothermia from prolonged exposure to cold.

Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects include loss of power and heat.

*According to the National Weather Service, approximately 70% of winter deaths related to snow and ice occur in automobiles, and approximately 25% of deaths occur from people being caught in the cold. In relation to deaths from exposure to cold, 50% are people over 60 years old, 75% are male, and 20% occur in the home.*

The classic winter storm in New England is the nor'easter, which is caused by a warm, moist, low pressure system moving up from the south colliding with a cold, dry high pressure system moving down from the north. The nor'easter derives its name from the northeast winds typically accompanying such storms, and such storms tend to produce a

large amount of precipitation. Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets, flooding, heavy winds, and extreme cold. The National Weather Service defines a blizzard as having winds over 35 mph with blowing snow that reduces visibility to less than one-quarter mile for at least three hours.

Connecticut experiences at least one severe winter storm every five years, although a variety of small and medium snow and ice storms occur nearly every winter. The likelihood of a nor'easter occurring in any given winter is therefore considered high, and the likelihood of other winter storms occurring in any given winter is very high.

The Northeast Snowfall Impact Scale (NESIS) was developed by Paul Kocin and Louis Uccellini (Kocin and Uccellini, 2004) and is used by NOAA to characterize and rank high-impact northeast snowstorms. These storms have wide areas of snowfall with accumulations of 10 inches and above. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements, thus giving an indication of a storm's societal impacts.

NESIS values are calculated within a geographical information system (GIS). The aerial distribution of snowfall and population information are combined in an equation that calculates a NESIS score, which varies from around one for smaller storms to over 10 for extreme storms. The raw score is then converted into one of the five NESIS categories. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. Table 6-1 presents the NESIS categories, their corresponding NESIS values, and a descriptive adjective.

**Table 6-1**  
**NESIS Categories**

Category	NESIS Value	Description
1	1—2.499	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

### **6.3    Historic Record**

Eight major winter nor'easters have occurred in Connecticut during the past 30 years (in 1983, 1988, 1992, 1996, 2003, 2006, 2009, and 2010). The 1992 nor'easter, in particular, caused the third-highest tides ever recorded in Long Island Sound and damaged 6,000 coastal homes. Inland areas received up to four feet of snow. Winter Storm Ginger in 1996 caused up to 27 inches of snow in 24 hours and shut down the state of Connecticut for an entire day. The nor'easter that occurred on February 12 and 13, 2006 resulted in 18 to 24 inches of snow across Connecticut and was rated on NESIS as a Category 3 "Major" storm across the northeast. This storm is ranked 23<sup>rd</sup> out of 40 major winter storms ranked by NESIS for the northeastern United States since 1956.

The most damaging winter storms are not always nor'easters. According to the NCDC, there have been 134 snow and ice events in the state of Connecticut between 1993 and April 2010, causing over \$18 million in damages. Notably, heavy snow in December 1996 caused \$6 million in property damage. Snow removal and power restoration for a winter storm event spanning March 31 and April 1, 1997 cost \$1 million. On March 5, 2001, heavy snow caused \$5 million in damages, followed by another heavy snow event four days later that caused an additional \$2 million in damages. The last documented winter storm event that qualified as a blizzard was Winter Storm Ginger in January 1996. These events were recorded for various counties throughout the state.

Catastrophic ice storms are less frequent in Connecticut than the rest of New England due to the close proximity of the warmer waters of the Atlantic Ocean and Long Island Sound. The most severe ice storm in Connecticut on record was Ice Storm Felix on December 18, 1973. This storm resulted in two deaths and widespread power outages throughout the state. An ice storm in November 2002 that hit Litchfield and western Hartford Counties resulted in \$2.5 million in public sector damages.

Additional examples of recent winter storms to affect Dutchess County, Fairfield County, and Litchfield County, taken from the NCDC database, include:

- ❑ February 6 -7, 1993 – Record cold caused \$5 million in damage in Dutchess County.
- ❑ March 13-14, 1993 – A powerful storm caused blizzard conditions and up to 21 inches of snow in Litchfield County, with 40,000 power outages and \$550,000 in property damage reported throughout Connecticut.
- ❑ January 15-16, 1994 – A Siberian airmass brought record to near-record low temperatures across Connecticut. Strong northwest winds accompanied the cold and drove wind chill values to 30 to 50 degrees below zero. Neighboring Danbury recorded a low of minus eight degrees Fahrenheit.
- ❑ February 11, 1994 – A major nor'easter produced eight to 13 inches of snow across Connecticut. Four to 12 inches were reported in Dutchess County.
- ❑ December 23, 1994 – An unusual snowless late December storm caused gale force winds across the state. The high winds caused widespread power outages affecting up to 130,000 customers statewide. Numerous trees and limbs were blown down, damaging property, vehicles, and power lines to a total of \$5 million in damages. Peak wind gusts of up to 64 miles per hour were reported.
- ❑ December 19, 1995 – A winter storm produced six to eight inches of snow in Litchfield County and nine to 14 inches of snow in Fairfield County.
- ❑ January 7-8, 1996 – An intense winter storm caused heavy snow throughout Litchfield County, causing many power outages, several roofs to collapse, and

approximately \$80,000 in damages. Reported snowfall totals included 24 inches in New Hartford and 22 inches in Harwinton, both northeast of Sherman. The storm was classified as a blizzard in Fairfield County. Nearby Standfordville in Dutchess County experienced 36 inches of snow and the storm caused \$640,000 in damages across several New York counties.

- ❑ December 8, 1996 – A coastal storm produced over nine inches of snow in New Fairfield. 12,000 customers lost power in Dutchess County.
- ❑ February 22, 1997 – High winds downed trees and wires across Litchfield County, resulting in approximately \$6,000 in property damage. The winds caused \$219,000 in property damage in Dutchess County.
- ❑ March 31 – April 1, 1997 – A late season storm produced rain and wet snow across Litchfield County, with 12 inches of snow reported in nearby Litchfield and 13.2 inches reported in Danbury. This storm caused over \$1 million in property damage and over 30,000 homes lost power across the county. A state of emergency was declared in Dutchess County.
- ❑ January 15, 1998 – An ice storm caused widespread icing across northern Fairfield County, northern New Haven County, and northern Middlesex County. At least one-half inch of ice accumulated on power lines and trees. Power outages were reported in New Fairfield and Danbury.
- ❑ March 15, 1999 – A heavy snow storm produced nine inches of snow in Danbury, and six to 11 inches of snow across most of the rest of Connecticut.
- ❑ January 25, 2000 – A winter storm produced snow, sleet, and freezing rain in Litchfield County with accumulations of six to 10 inches. \$25,000 in property damage was reported. The storm caused whiteout conditions in Fairfield County and seven inches of snow was reported in Danbury.
- ❑ December 12, 2000 – High winds downed trees and power lines in numerous locations across Connecticut, including in Brookfield, New Fairfield, and Sherman.
- ❑ January 21, 2001 – Heavy snowfall occurred across interior Connecticut, producing 6.3 inches at Danbury and eight inches in Sherman.
- ❑ February 5, 2001 – Heavy snowfall produced 19 inches of snow in Danbury.

- ❑ December 25, 2002 – Six to 12 inches of snow fell throughout Litchfield and Fairfield Counties.
- ❑ February 17, 2003 – A heavy snow storm caused near blizzard conditions and produced 24 inches of snow in New Fairfield.
- ❑ December 5, 2003 – Heavy snowfall produced 13 inches of snow in Danbury.
- ❑ January 22-23, 2005 – Sherman received FEMA assistance related to snow plowing efforts after a major winter storm. Ten inches of snow was reported across Dutchess County.
- ❑ December 9, 2005 – Heavy snowfall produced 12.5 inches in New Fairfield.
- ❑ February 12-13, 2006 – The Category III storm produced 28 inches of snow in Danbury. Sherman received money from FEMA related to snow plowing operations.
- ❑ March 16, 2007 – A winter storm beginning during the Friday afternoon rush hour produced six to 12 inches of snow across Litchfield and Fairfield Counties. The storm caused treacherous travel conditions that resulted in many accidents.
- ❑ December 19, 2008 – Heavy snowfall produced 8.5 inches of snow in Danbury.
- ❑ January 6, 2009 – An ice storm produced up to 0.4 inches of ice across Fairfield County. The storm caused one death and injured three.

#### **6.4 Existing Programs, Policies, and Mitigation Measures**

Existing programs applicable to inland flooding and wind are the same as those discussed in Sections 3.0 and 4.0. Programs that are specific to winter storms are generally those related to preparing plows, sand and salt trucks; tree-trimming to protect power lines; and other associated snow removal and response preparations.

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important for municipalities to budget fiscal resources toward snow management. The Town ensures that all warning/notification and communications systems are ready before a storm, and ensures that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order. The Town also prepares for the

possible evacuation and sheltering of some populations which could be impacted by the upcoming storm (especially the elderly and special needs persons).

The amount of snowfall in Sherman is elevation-dependent during storms. The Town of Sherman primarily uses town staff for plowing operations. The town utilizes plow trucks to clear and treat all town-owned roadways, properties, and sidewalks. The Connecticut Department of Transportation plows Routes 37, 39, and 55. Private communities are responsible for plowing their own roads. Town roads are not prioritized for plowing. During emergencies, a plow vehicle can be dispatched ahead of an emergency vehicle.

## **6.5 Vulnerabilities and Risk Assessment**

As mentioned for summer storms, the heavily treed landscape in close proximity to populated residential areas in the town of Sherman poses problems in relation to blizzard condition damage. Tree limbs and some building structures may not be suited to withstand high wind and snow loads. Ice can damage or collapse power lines, render steep gradients impassable for motorists, undermine foundations, and cause "flood" damage from freezing water pipes in basements. There have been a few notable power outages in Sherman due to winter storms in the past few years; one was for two days.

In addition, winter storms present additional problems for motorists all over the state. As the population of Connecticut and its dependence on transportation continues to increase, the vulnerability of the state to winter storms also increases. There is a high propensity for traffic accidents and traffic jams during heavy snow and even light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots and the accessibility to medical and shelter facilities. Stranded motorists, especially senior and/or handicapped citizens, are at particularly high risk of injury or death from exposure during a blizzard. After a storm, snow piled on the sides of roadways can inhibit line of sight and reflect a blinding amount of sunlight. When

coupled with slippery road conditions, poor sightlines and heavy glare create dangerous driving conditions.

Icing causes difficult driving conditions throughout the hillier sections of Sherman, but Town personnel note that there are no unusual areas or particular "trouble spots" in town for icing. The largest problems occur on narrow, steeply sloped private roads.

Fortunately, many of these roads contain seasonal cottages that are unoccupied during the winter months. Drifting snow is not as large a problem in Sherman as other areas, but it still occurs. This problem is mitigated through municipal plowing efforts. Ice jams are not a problem along the rivers in Sherman.

Recall from Figure 2-8, Figure 2-9, and Figure 2-10 that elderly, linguistically isolated, and disabled populations reside in the town of Sherman. It is possible that several hundred of the population impacted by a severe winter storm could consist of the elderly, a small number could consist of linguistically isolated households, and several hundred could be disabled. Thus, it is important for Sherman's emergency personnel to be prepared to assist these special populations during emergencies such as winter storms.

## **6.6 Potential Mitigation Measures, Strategies, and Alternatives**

Potential mitigation measures for flooding caused by nor'easters include those appropriate for flooding. These were presented in Section 3.6. Winter storm mitigation measures must also address blizzard, snow, and ice hazards. These are emphasized on the following page. Note that structural projects are generally not applicable to hazard mitigation for wind, blizzard, snow, and ice hazards.

### 6.6.1 Prevention

Cold air, wind, snow, and ice can not be prevented from impacting any particular area. Thus, mitigation should be focused on property protection and emergency services (discussed below) and prevention of damage as caused by breakage of tree limbs.

Previous recommendations for tree limb inspections and maintenance in Sections 4.0 and 5.0 are thus applicable to winter storm hazards as well. As mentioned previously, utilities in Sherman should continue to be placed underground where possible. This can occur in connection with new development and also in connection with redevelopment work. Underground utilities cannot be directly damaged by heavy snow, ice, and winter winds.

### 6.6.2 Property Protection

Property can be protected during winter storms through the use of structural measures such as shutters, storm doors, and storm windows. Where flat roofs are used on structures, snow removal is important as the heavy load from collecting snow may exceed the bearing capacity of the structure. Heating coils may be used to remove snow from flat roofs. Pipes should be adequately insulated to protect against freezing and bursting. All of these recommendations should apply to new construction although they may also be applied to existing buildings during renovations. Finally, as recommended in previous sections, dead limbs overhanging homes should be trimmed, and compliance with the amended Connecticut Building Code for wind speeds is necessary.

### 6.6.3 Public Education and Awareness

The public is typically more aware of the hazardous effects of snow, ice, and cold weather than they are with regard to other hazards discussed in this plan. Nevertheless,

people are still stranded in automobiles, get caught outside their homes in adverse weather conditions, and suffer heart failure while shoveling during each winter in Connecticut. Public education should therefore focus on safety tips and reminders to individuals about how to prepare for cold and icy weather, including stocking homes, preparing vehicles, and taking care of themselves during winter storms.

#### 6.6.4 Emergency Services

Emergency services personnel should identify areas that may be difficult to access during winter storm events and devise contingency plans to continue servicing those areas during moderate storms. The creation of through streets with new developments increases the amount of egress for residents and emergency personnel into neighborhoods. However, the creation of through streets may not be consistent with the Town's Plan of Conservation and Development (currently being revised).

The Town of Sherman by default has plowing routes that prioritize access to and from most critical facilities as these facilities are almost all located along state roads. However, the Town should consider standardizing plowing routes that prioritize the remaining critical facilities and secondary access routes to shelters. Residents should be made aware of the plow routes in order to plan how to best access critical facilities, perhaps via posting of the general routes on the Town website. Such routes should also be posted in other municipal buildings such as the library and the post office. It is recognized that plowing critical facilities may not be a priority to all residents as people typically expect their own roads to be cleared as soon as possible.

Available shelters should continue to be advertised and their locations known to the public prior to a storm event. Finally, existing mutual aid agreements with surrounding municipalities should be reviewed and updated as necessary to ensure help will be available when needed.

### 6.6.5 Structural Projects

Structural projects for many aspects of winter storms are not possible. Projects can be designed to mitigate icing due to poor drainage and other factors as well as performing retrofits for flat-roofed buildings such as heating coils or insulating pipes. Other potential structural projects related to flooding and wind damage associated with winter storms were discussed in Sections 3.6 and 4.6, respectively.

## 6.7 **Summary of Recommended Mitigation Measures, Strategies, and Alternatives**

Most of the recommendations in Sections 3.6 for mitigating flooding are suitable for mitigation of flooding caused by winter storms. These are not repeated in this subsection. While many potential mitigation activities for the remaining winter storm hazards were addressed in Section 6.6, the recommended mitigation strategies for mitigating wind, snow, and ice in the town of Sherman are listed below.

- ☐ Increase tree limb maintenance and inspections, especially in the Town Center
- ☐ Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas
- ☐ Continue to provide information on the dangers of cold-related hazards
- ☐ Review and post evacuation plans to ensure timely migration of people seeking shelter in all areas of Sherman
- ☐ Post a list of Town sheltering facilities in the Town Hall and on the Town's website so residents can best plan how to access to critical facilities during a winter storm event
- ☐ Provide for the building department to have information available for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings such as heating coils
- ☐ Consider prioritizing plowing routes and post the snow plowing prioritization in Town buildings each winter to increase public awareness

- ❑ Consider including in the updated Town Plan of Conservation and Development a provision to encourage two modes of egress into every new neighborhood by the creation of through streets where possible. Any such modification would then become an amendment of the subdivision regulations.

In addition, important recommendations that apply to all hazards are listed in Section 10.1.

## **7.0 EARTHQUAKES**

### **7.1 Setting**

The entire town of Sherman is susceptible to earthquakes. However, even though earthquakes have the potential to occur anywhere both in the town and in the northeastern United States, the effects may be felt differently in some areas based on the type of geology. In general, earthquakes are considered a hazard that may possibly occur but that may cause significant effects to a large area of the town (appended Table 1).

### **7.2 Hazard Assessment**

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse, disrupt gas, electric and telephone lines, and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time without warning.

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. The magnitude and intensity of an earthquake is determined by the use of the Richter scale and the Mercalli scale, respectively.

The Richter scale defines the magnitude of an earthquake. Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The magnitude of an earthquake is thus represented by a single instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The magnitude of an earthquake is determined from the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called micro-earthquakes and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects.

***The following is a description of the 12 levels of Modified Mercalli intensity from the USGS:***

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

Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known faults. Instead, earthquakes with epicenters in Connecticut are referred to as intra-plate activity. Bedrock in Connecticut and New England in general is highly capable of transmitting seismic energy; thus, the area impacted by an earthquake in Connecticut can be four to 40 times greater than that of California. In addition, population density is up to 3.5 times greater in Connecticut than in California, potentially putting a greater number of people at risk.

The built environment in Connecticut includes old nonreinforced masonry that is not seismically designed. Those who live or work in nonreinforced masonry buildings, especially those built on filled land or unstable soils, are at the highest risk for injury due to the occurrence of an earthquake.

### **7.3 Historic Record**

According to the USGS Earthquake Hazards Program, Connecticut is a region of very minor seismic activity. This assessment is based on lack of historical and instrumental reports of strong earthquakes. However, earthquakes do occur in this region. The New England states regularly register seismic events.

According to the Northeast Region Emergency Consortium, there were 137 recorded earthquakes in Connecticut between 1668 and 2007. The most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. Stone walls and chimneys were toppled during this quake. Additional instances of seismic activity occurring in and around Connecticut is provided below, based on information provided in USGS documents, the Connecticut Natural Hazards Mitigation Plan (2007), other municipal hazard mitigation plans, and newspaper articles.

- ❑ A devastating earthquake near Three Rivers, Quebec on February 5, 1663 caused moderate damage in parts of Connecticut.
- ❑ Strong earthquakes in Massachusetts in November 1727 and November 1755 were felt strongly in Connecticut.
- ❑ In April 1837, a moderate tremor occurred at Hartford, causing alarm but little damage.
- ❑ In August 1840, another moderate tremor with its epicenter 10 to 20 miles north of New Haven shook Hartford buildings but caused little damage.
- ❑ In October 1845, an Intensity V earthquake occurred in Bridgeport. An Intensity V earthquake would be approximately 4.3 on the Richter scale.
- ❑ On June 30, 1858, New Haven and Derby were shaken by a moderate tremor.
- ❑ On July 28, 1875, an early morning tremor caused Intensity V damage throughout Connecticut and Massachusetts.
- ❑ The second strongest earthquake to impact Connecticut occurred near Hartford on November 14, 1925. No significant damage was reported.
- ❑ The Timiskaming, Ontario earthquake of November 1935 caused minor damage as far south as Cornwall, Connecticut. This earthquake affected one million square miles of Canada and the United States.
- ❑ An earthquake near Massena, New York in September 1944 produced mild effects in Hartford, Marion, New Haven, and Meriden, Connecticut.
- ❑ An Intensity V earthquake was reported in Stamford in March of 1953, causing shaking but no damage.
- ❑ On November 3, 1968, another Intensity V earthquake in southern Connecticut caused minor damage in Madison and Chester.
- ❑ Recent earthquake activity has been recorded near New Haven in 1988, 1989, and 1990 (2.0, 2.8, and 2.8 in magnitude, respectively), in Greenwich in 1991 (3.0 magnitude), and on Long Island in East Hampton, New York in 1992.
- ❑ The most recent earthquake to occur in Connecticut happened on March 11, 2008. It was a 2.0 magnitude with its epicenter three miles northwest of the center of Chester.

- ❑ Most recently, a magnitude 5.0 earthquake struck at the Ontario-Quebec border region of Canada on June 23, 2010. This earthquake did not cause damage in Connecticut but was felt by residents in Hartford and New Haven Counties.

#### 7.4 **Existing Programs, Policies, and Mitigation Measures**

The Connecticut Building Codes include design criteria for buildings specific to each municipality as adopted by the Building Officials and Code Administrators (BOCA). These include the seismic coefficients for building design in the town of Sherman. The Town has adopted these codes for new construction, and they are enforced by the Town Building Official. Due to the infrequent nature of damaging earthquakes, land use policies in the town of Sherman do not directly address earthquake hazards.

The Subdivision Regulations of the Town of Sherman (Section 3.7.2) prohibits development on slopes greater than 25%. The Town reserves the right to impose more stringent regulations on a site to maintain the stability of the bank under the proposed conditions.

#### 7.5 **Vulnerabilities and Risk Assessment**

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can

***Liquefaction is a phenomenon in which the strength and stiffness of a soil are reduced by earthquake shaking or other rapid loading. It occurs in soils at or near saturation and especially in finer textured soils.***

amplify the shaking associated with an earthquake. In addition, artificial fill material has the potential for liquefaction. When liquefaction occurs, the strength of the soil decreases, and the ability of soil to support building foundations and bridges is reduced. Increased shaking and liquefaction can cause greater damage to buildings and structures and a greater loss of life.

As explained in Section 2.3, several areas in the town of Sherman are underlain by sand and gravel, such as areas along Route 39 north of the town center. Figure 2-5 depicts surficial materials in the town. Structures in these areas are at increased risk from earthquakes due to amplification of seismic energy and/or collapse. The best mitigation for future development in areas of sandy material may be application of the most stringent building codes or possibly the prohibition of new construction. However, many of these areas occur in floodplains associated with the various streams and rivers in Sherman so they are already regulated. The areas that are not at increased risk during an earthquake due to unstable soils are the areas in Figure 2-4 underlain by glacial till.

Areas of steep slopes can collapse during an earthquake, creating landslides. Seismic activity can also break utility lines such as water mains, electric and telephone lines, and stormwater management systems. Damage to utility lines can lead to fires, especially in electric and gas mains. Dam failure can also pose a significant threat to developed areas during an earthquake. For this plan, dam failure has been addressed separately in Section 9.0.

According to the FEMA HAZUS-MH Estimated Annualized Earthquake Losses for the United States (2008) document, FEMA used probabilistic curves developed by the USGS for the National Earthquakes Hazards

*The AEL is the expected losses due to earthquakes each year. Note that this number represents a long-term average; thus, actual earthquake losses may be much greater or nonexistent for a particular year.*

Reduction Program to calculate Annualized Earthquake Losses (AEL) for the United States. Based on the results of this study, FEMA calculated the AEL for Connecticut to be \$11,622,000. This value placed Connecticut 30<sup>th</sup> out of the 50 states in terms of AEL. The magnitude of this value stems from the fact that Connecticut has a large building inventory that would be damaged in a severe earthquake and takes into account the lack of damaging earthquakes in the historical record.

According to the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, Connecticut is at a low to moderate risk for experiencing an earthquake of a magnitude greater than 3.5 and at a moderate risk of an experiencing an earthquake of a magnitude less than 3.0 in the future. No earthquake with a magnitude greater than 3.5 has occurred in Connecticut within the last 30 years, and the USGS currently ranks Connecticut 43<sup>rd</sup> out of the 50 states for overall earthquake activity.

A series of earthquake probability maps were generated using the 2009 interactive web-based mapping tools hosted by the USGS. These maps were used to determine the probability of an earthquake of greater than magnitude 5.0 or greater than magnitude 6.0 damaging the town of Sherman. Results are presented in Table 7-1 below.

**Table 7-1**  
**Probability of a Damaging Earthquake in the Vicinity of Sherman**

<b>Timeframe (Years)</b>	<b>Probability of the Occurrence of an Earthquake Event &gt; Magnitude 5.0</b>	<b>Probability of the Occurrence of an Earthquake Event &gt; Magnitude 6.0</b>
50	2% to 3%	< 1%
100	4% to 6%	< 1%
250	10% to 12%	2% to 3%
350	12% to 15%	3% to 4%

Based on the historic record and the probability maps generated from the USGS database, the State of Connecticut has areas of seismic activity. It is likely that Connecticut will continue to experience minor earthquakes (magnitude less than 3.0) in the future. While the risk of an earthquake affecting Sherman is relatively low over the short-term, long-term probabilities suggest that a damaging earthquake (magnitude greater than 5.0) could occur within the vicinity of Sherman.

The 2010 *Connecticut Natural Hazard Mitigation Plan Update* created four "maximum plausible" earthquake scenarios (three historical, one potential) within HAZUS-MH to generate potential earthquake risk to the State of Connecticut. The same four scenarios

were simulated within HAZUS-MH to generate potential damages in the town of Sherman from those events using the default year 2000 building inventories and census data. The four events are as follows:

- ❑ Magnitude 5.7, epicenter in Portland, CT, based on historic event
- ❑ Magnitude 5.7, epicenter in Haddam, CT, based on historic event
- ❑ Magnitude 6.4, epicenter in East Haddam, CT, based on historic event
- ❑ Magnitude 5.7, epicenter in Stamford, CT, magnitude based on USGS probability mapping

The results for each HAZUS-MH earthquake simulation are presented in Appendix D. These results are conservatively high and considered appropriate for planning purposes for the town of Sherman. The range of potential impacts from any earthquake scenario is very large, ranging from minor impacts to the maximum possible impacts generated by HAZUS-MH. Note that potentially greater impacts could also occur.

Table 7-2 presents the number of residential buildings damaged by the various earthquake scenarios, while Table 7-3 presents the total number of buildings damaged by each earthquake scenario. A significant percentage of building damage is to single-family residential buildings, while other building types include agriculture, commercial, education, government, industrial, other residential and religious buildings. The exact definition of each damage state varies based on building construction. See Chapter 5 of the *HAZUS-MH Earthquake Model Technical Manual* for the definitions of building damage states based on building construction.

**Table 7-2**  
**HAZUS-MH Earthquake Scenarios – Number of Residential Buildings Damaged**

<b>Epicenter Location and Magnitude</b>	<b>Slight Damage</b>	<b>Moderate Damage</b>	<b>Extensive Damage</b>	<b>Complete Damage</b>	<b>Total</b>
Haddam – 5.7	14	2	0	0	16
Portland – 5.7	17	3	0	0	20
Stamford – 5.7	51	8	1	0	60
East Haddam – 6.4	76	13	1	0	90

**Table 7-3**  
**HAZUS-MH Earthquake Scenarios – Total Number of Buildings Damaged**

<b>Epicenter Location and Magnitude</b>	<b>Slight Damage</b>	<b>Moderate Damage</b>	<b>Extensive Damage</b>	<b>Complete Damage</b>	<b>Total</b>
Haddam – 5.7	19	3	0	0	22
Portland – 5.7	22	4	0	0	26
Stamford – 5.7	62	12	1	0	75
East Haddam – 6.4	91	19	2	0	102

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. As shown in Table 7-4 minimal damage to essential facilities is expected for each earthquake scenario.

**Table 7-4**  
**HAZUS-MH Earthquake Scenarios – Essential Facility Damage**

<b>Epicenter Location and Magnitude</b>	<b>Fire Stations (1)</b>	<b>Police Stations (1)</b>	<b>Schools (1)</b>
Haddam – 5.7	None or Minor	None or Minor	None or Minor
Portland – 5.7	None or Minor	None or Minor	None or Minor
Stamford – 5.7	None or Minor	None or Minor	None or Minor
East Haddam – 6.4	None or Minor	None or Minor	None or Minor

Table 7-5 presents potential damage to utilities and infrastructure based on the various earthquake scenarios. The transportation network includes four major bridges and four important highway segments in the town. Utilities include potable water, waste water,

natural gas, and electrical lines. Very little damage is expected to utilities and infrastructure as a result of the four earthquake scenarios and no resultant fires or fire damage is expected.

**Table 7-5**  
**HAZUS-MH Earthquake Scenarios – Utility, Infrastructure, and Fire Damage**

<b>Epicenter Location and Magnitude</b>	<b>Transportation Network</b>	<b>Utilities</b>	<b>Fire Damage</b>
Haddam – 5.7	None or Minor	None or Minor	Zero ignitions, no damage
Portland – 5.7	None or Minor	None or Minor	Zero ignitions, no damage
Stamford – 5.7	None or Minor	None or Minor	Zero ignitions, no damage
East Haddam – 6.4	None or Minor	One leak in potable water system, remaining systems have none or minor damage. Total damage: Approximately \$10,000	Zero ignitions, no damage

Table 7-6 presents the estimated tonnage of debris that would be generated by earthquake damage during each HAZUS-MH scenario. As shown in Table 7-6, minimal debris is expected for the four scenarios in the town.

**Table 7-6**  
**HAZUS-MH Earthquake Scenarios – Debris Generation (Tons)**

<b>Epicenter Location and Magnitude</b>	<b>Brick / Wood</b>	<b>Reinforced Concrete / Steel</b>	<b>Total</b>	<b>Estimated Cleanup Truckloads (25 Tons / Truck)</b>
Haddam – 5.7	Minimal	Minimal	Minimal	0
Portland – 5.7	Minimal	Minimal	Minimal	0
Stamford – 5.7	Minimal	Minimal	Minimal	0
East Haddam – 6.4	Minimal	Minimal	Minimal	0

Table 7-7 presents the potential sheltering requirements based on the various earthquake events simulated by HAZUS-MH. The predicted sheltering requirements for earthquake damage are relatively minimal even for the stronger events and can addressed through the

use of the existing shelter facilities. However, it is possible that an earthquake could also produce a wildfire or a dam failure (flooding) that could increase the overall sheltering need in the town.

**Table 7-7**  
**HAZUS-MH Earthquake Scenarios – Shelter Requirements**

<b>Epicenter Location and Magnitude</b>	<b>Number of Displaced Households</b>	<b>Short Term Sheltering Need (Number of People)</b>
Haddam – 5.7	0	0
Portland – 5.7	0	0
Stamford – 5.7	0	0
East Haddam – 6.4	0	0

Table 7-8 presents the casualty estimates generated by HAZUS-MH for the various earthquake scenarios. Casualties are broken down into four severity levels that describe the extent of injuries. The levels are as follows:

- ☐ Severity Level 1: Injuries will require medical attention but hospitalization is not needed
- ☐ Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- ☐ Severity Level 3: Injuries will require hospitalization and can become life-threatening if not promptly treated
- ☐ Severity Level 4: Victims are killed by the earthquake.

**Table 7-8**  
**HAZUS-MH Earthquake Scenarios – Casualty Estimates**

<b>Epicenter Location - Magnitude</b>	<b>2 AM Earthquake</b>	<b>2 PM Earthquake</b>	<b>5 PM Earthquake</b>
Haddam – 5.7	None	None	None
Portland – 5.7	None	None	None
Stamford – 5.7	None	None	None
East Haddam – 6.4	None	None	None

Minimal casualties are expected due to earthquake damage in the town of Sherman for the four earthquake scenarios. The casualty categories include commuters, educational, hotels, industrial, other-residential, and single family residential, and are accounted for during the night, in the early afternoon, and during afternoon rush-hour.

Table 7-9 presents the total estimated losses and direct economic impact that may result from the four earthquake scenarios created for the town of Sherman as estimated by the HAZUS-MH software. Capital damage loss estimates include the subcategories of building, contents, and inventory damages. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building or its contents. Business interruption loss estimates include the subcategories of lost income, relocation expenses, and lost wages. The business interruption losses are associated with the inability to operate a business due to the damage sustained during a hurricane, and also include temporary living expenses for those people displaced from their home because of the storm.

**Table 7-9**  
**HAZUS-MH Estimated Direct Losses from Earthquake Scenarios (x \$1,000)**

<b>Epicenter Location and Magnitude</b>	<b>Estimated Total Capital Losses</b>	<b>Estimated Total Income Losses</b>	<b>Estimated Total Losses</b>
Haddam – 5.7	230	50	280
Portland – 5.7	300	50	350
Stamford – 5.7	1,270	160	1,430
East Haddam – 6.4	1,610	260	1,880

Note that the losses are presented in 2006 dollars, which implies that they will be greater in the future due to inflation. It is also believed that the next plan update will be able to utilize 2010 census data, providing a more recent dataset for analysis.

Despite the low probability of occurrence, earthquake damage presents a very real hazard to the town of Sherman. However, it is very unlikely that the town would be at the

epicenter of such a damaging earthquake. Should a damaging earthquake occur in Connecticut, it is likely that Sherman medical personnel will be needed in other parts of the state that are harder hit by the earthquake.

## **7.6 Potential Mitigation Measures, Strategies, and Alternatives**

As earthquakes are difficult to predict and can affect the entire town of Sherman, potential mitigation can only include adherence to building codes, education of residents, and adequate planning. The following potential mitigation measures have been identified:

- ☐ Consider preventing new residential development in areas most prone to collapse or liquefaction
- ☐ Continue to require adherence to the state building codes
- ☐ Ensure that municipal departments have adequate backup facilities such as portable generators in case earthquake damage occurs to critical facilities

In addition, important recommendations that apply to all hazards are listed in Section 10.1.

## 8.0 DAM FAILURE

### 8.1 Setting

Dam failures can be triggered suddenly, with little or no warning, and often from other natural disasters such as floods and earthquakes. Dam failures often occur during flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail. With 18 registered dams and potentially several other minor dams in the town, dam failure can occur almost anywhere in Sherman. While flooding from a dam failure generally has a medium geographic extent, the effects are potentially catastrophic. Fortunately, a major dam failure is considered only a possible natural hazard event in any given year (appended Table 2).

### 8.2 Hazard Assessment

The Connecticut DEP administers the statewide Dam Safety Program and designates a classification to each state-registered dam based on its potential hazard.

- ❑ *Class AA* dams are negligible hazard potential dams that upon failure would result in no measurable damage to roadways and structures, and negligible economic loss.
- ❑ *Class A* dams are low hazard potential dams that upon failure would result in damage to agricultural land and unimproved roadways, with minimal economic loss.
- ❑ *Class BB* dams are moderate hazard potential dams that upon failure would result in damage to normally unoccupied storage structures, damage to low volume roadways, and moderate economic loss.
- ❑ *Class B* dams are significant hazard potential dams that upon failure would result in possible loss of life, minor damage to habitable structures, residences, hospitals,

convalescent homes, schools, and the like, damage or interruption of service of utilities, damage to primary roadways, and significant economic loss.

- ❑ *Class C* dams are high potential hazard dams that upon failure would result in loss of life and major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways with great economic loss.

As of 1996, there were 18 DEP-registered dams within the town of Sherman, of which eight were Class A, two are Class BB, five were Class B, and three were undefined. The list of Class B and C dams was updated by the DEP in 2007, with only three dams maintaining Class B status. Dams in Sherman are listed in Table 8-1.

**Table 8-1**  
**Dams Registered With the DEP in the Town of Sherman**

Number	Name	Location	Class
12701	Deer Pond Dam <sup>1</sup>	Off Route 37 South	B
12702	Rogers Pond Dam	Off Jericho Road North	BB <sup>2</sup>
12703	Timber Lake Dam	Timber Lake Road North	B
12704	Lake Mauweehoo Dam	Mauweehoo Hill	BB
12705	Pepper Pond Dam	Coote Hill	BB <sup>2</sup>
12706	Green Pond Dam	Green Pond Road	BB
12707	Valley Lake Dam	Off Route 37	BB <sup>2</sup>
12708	Jennings Pond Dam	Chapel Hill Road	A
12709	Chapel Pond Dam	Chapel Hill Road	A
12710	Greenwood Pond Dam	Off Route 37 South	A
12711	{Unnamed Dam}	Route 37 South	-
12712	Tollgate Pond Dam	Old Greenwoods Road Ext.	A
12713	Spring Lake Dam	Off Spring Lake Drive	B
12714	Wimisink Pond Dam	Off Route 39 North	A
12715	{Unnamed Dam}	Off Route 55	A
12716	Haviland Millpond Dam	Off Candlewood Lake Drive	A
12717	Hughson Dam	Jericho Road North	-
12718	Edmonds Pond Dam	Edmonds Road	A

<sup>1</sup>Reported as breached on the 2007 DEP list.

<sup>2</sup>Listed as a Class B dam in 1996, but was not included 2007 DEP list of Class B and C dams

As there are no Class C dams in or upstream of the town of Sherman, this section primarily discusses the possible effects of failure of significant hazard (Class B) dams. Failure of a Class B dam has a minor potential for loss of life but could cause significant

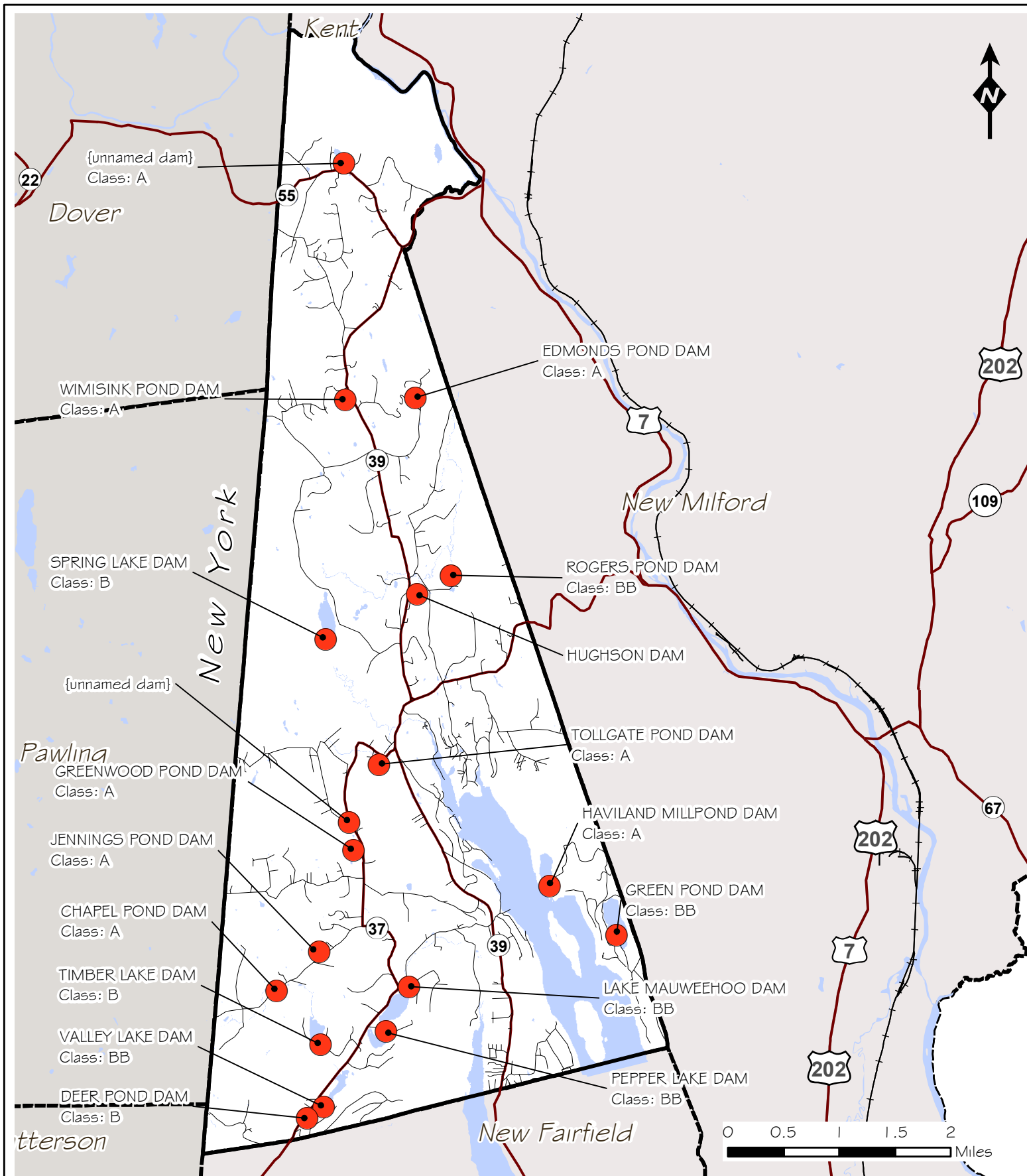
property damage. Deer Pond Dam, Timber Lake Dam, and Spring Lake Dam are the Class B dams in Sherman. The Class B dams are shown in Figure 8-1. Dam failure analyses are not believed to have been performed for these dams.

The town of Sherman lies at the northwestern end of Candlewood Lake, which is impounded by a series of Class C dams and dikes in New Milford and Danbury. A failure of one or all of these dams would cause severe flooding in New Milford and Danbury, but damage related to such a failure would be minimal in Sherman.

### **8.3 Historic Record**

Approximately 200 notable dam and reservoir failures occurred worldwide in the 20th century. More than 8,000 people died in these disasters. The following is a listing of some of the more catastrophic dam failures in Connecticut's recent history:

- ❑ 1938 and 1955: Exact numbers of dam failures caused by these floods are unavailable, but the Connecticut DEP believes that more dams were damaged in these events than in the 1982 or 2005 flooding events.
- ❑ 1961: Crystal Lake dam in Middletown failed, injuring three and severely damaging 11 homes.
- ❑ 1963: Failure of the Spaulding Pond Dam in Norwich caused six deaths and \$6 million in damage.
- ❑ June 5-6, 1982: Connecticut experienced a severe flood that caused 17 dams to fail and seriously damaged 31 others. Failure of the Bushy Hill Pond Dam in Deep River caused \$50 million in damages, and the remaining dam failures caused nearly \$20 million in damages.



**Figure 8-1:  
Dams Registered with the DEP**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION: Sherman, CT**

**DATE: 9/1/2010**

**MMI#: 3101-04**

**SOURCE: UCONN CLEAR, 2010.  
StreetMaps USA, 2010.  
CTDEP, Map & Geographic Information  
Center (2009).**



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More recently, the NCDC reports that flash flooding on April 16, 1996 caused three small dams in Middletown and one in Wallingford to breach, and the Connecticut DEP reported that the sustained heavy rainfall from October 7 to 15, 2005 caused 14 complete or partial dam failures and damage to 30 other dams throughout the state. A sample of damaged dams is summarized in Table 8-2.

**Table 8-2**  
**Dams Damaged Due to Flooding From October 2005 Storms**

Number	Name	Location	Class	Damage Type	Ownership
-----	Somerville Pond Dam	Somers	--	Partial Breach	DEP
4701	Windsorville Dam	East Windsor	BB	Minor Damage	Private
10503	Mile Creek Dam	Old Lyme	B	Full Breach	Private
-----	Staffordville Reservoir #3	Union	--	Partial Breach	CT Water Co.
8003	Hanover Pond Dam	Meriden	C	Partial Breach	City of Meriden
-----	ABB Pond Dam	Bloomfield	--	Minor Damage	Private
4905	Springborn Dam	Enfield	BB	Minor Damage	DEP
13904	Cains Pond Dam	Suffield	A	Full Breach	Private
13906	Schwartz Pond Dam	Suffield	BB	Partial Breach	Private
14519	Sessions Meadow Dam	Union	BB	Minor Damage	DEP

The Association of State Dam Safety Officials states that no one knows precisely how many dam failures have occurred, but they have been documented in every state. From January 1, 2005 through January 1, 2009, state dam safety programs reported 132 dam failures and 434 incidents requiring intervention to prevent failure.

A significant dam failure occurred in the town of Sherman due to the April 2007 storm. Floodwaters at Rogers Pond Dam (Class BB) overtopped the spillway and caused a full failure that drained the pond. Part of the earthen embankment failed, and the floodwaters cut a breach 30 feet wide and 15 feet



*Rogers Pond Dam Breach, April 2007*

deep. The dam was originally constructed in 1945 and was repaired following the breach. According to the Association of State Dam Safety Officials, a dam in Bethany, Connecticut and a dam in Waterford, Connecticut also experienced failures due to the April 2007 flood.

#### **8.4 Existing Programs, Policies, and Mitigation Measures**

The Dam Safety Section of the DEP Inland Water Resources Division is charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. The existing statutes require that permits be obtained to construct, repair, or alter dams and that existing dams be registered and periodically inspected to assure that their continued operation does not constitute a hazard to life, health, or property.

The dam safety statutes are codified in Section 22a-401 through 22a-411 inclusive of the Connecticut General Statutes. Sections 22a-409-1 and 22a-409-2 of the Regulations of Connecticut State Agencies, have been enacted which govern the registration, classification, and inspection of dams. Dams must be registered by the owner with the DEP, according to Connecticut Public Act 83-38.

Dam Inspection Regulations require that nearly 700 dams in Connecticut be inspected annually. The DEP currently prioritizes inspections of those dams which pose the greatest potential threat to downstream persons and properties. Dams found to be unsafe under the inspection program must be repaired by the owner. Depending on the severity of the identified deficiency, an owner is allowed reasonable time to make the required repairs or remove the dam. If a dam owner fails to make necessary repairs to the subject structure, the DEP may issue an administrative order requiring the owner to restore the structure to a safe condition and may refer

***Dams regulated by the DEP must be designed to pass the 100-year rainfall event with one foot of freeboard, a factor of safety against overtopping.***

***Significant and high hazard dams are required to meet a design standard greater than the 100-year rainfall event.***

noncompliance with such an order to the Attorney General's office for enforcement. As a means of last resort, the DEP Commissioner is empowered by statute to remove or correct, at the expense of the owner, any unsafe structures that present a clear and present danger to public safety.

Owners of Class C dams are required to maintain Emergency Operation Plans. It is believed that none of the Class B dam owners in Sherman maintain such plans.

The Connecticut DEP also administers the Flood and Erosion Control Board program, which can provide noncompetitive state funding for repair of municipality-owned dams. Funding is limited by the State Bond Commission. State statute Section 25-84 allows municipalities to form Flood and Erosion Control Boards, but municipalities must take action to create the board within the context of the local government such as by revising the municipal charter. The Town of Sherman established a Flood and Erosion Control Board by ordinance dated January 28, 2000. More information regarding the Flood and Erosion Control Board program can be found at [http://www.ct.gov/dep/lib/dep/water\\_inland/flood\\_mgmt/fecb\\_program.pdf](http://www.ct.gov/dep/lib/dep/water_inland/flood_mgmt/fecb_program.pdf).

## **8.5 Vulnerabilities and Risk Assessment**

As no Class C dams lie within or upstream of the town of Sherman, the failure of any of the Class B dams in the town would likely have the highest impact on the residents and infrastructure of the town of Sherman. However, the failure of any of the 15 other dams in town could also have impacts within the town of Sherman. The impacts related to the larger and higher-hazard dams in town, namely the Deer Pond Dam, Spring Lake Dam, and Timber Lake Dam are described in general detail below.

According to Town personnel, the dams throughout town are in varying stages of condition, with the higher hazard dams being in generally good condition. The following

paragraphs provide a description and highlight the general condition these dams based on information available at the Connecticut DEP:

- ❑ Deer Pond Dam – This reservoir dam is owned by the Timber Trails Corporation and located along Quaker Brook in southwestern Sherman. It was reported as breached on the 2007 high hazard dam list compiled by DEP. This dam impounds Quaker Brook. A dam failure has the potential to cause damage to the bridge on Big Trail, which leads to 60 homes in the Timber Trails Association, and potentially could also cause some damage to the bridge downstream on Route 37 in neighboring New Fairfield.
- ❑ Spring Lake Dam – This private dam is located off Spring Lake Road. The outlet from the dam feeds a major unnamed tributary to Saw Mill Brook. The dam is maintained by the owner and is believed to be in good condition. Floodwaters from a dam failure would follow Sawmill Brook through an undeveloped area of Sherman for approximately one mile before reaching State Route 37/Route 39. A dam failure could potentially cause damage to the bridges at the state road and on Sawmill Road before the floodwaters were mitigated by Candlewood Lake.
- ❑ Timber Lake Dam – This dam is owned by the Timber Trails Corporation and is located on Timber Lake Road North. It is an earthen dam with concrete abutments and a concrete spillway that impounds Quaker Brook. Flashboards are used to raise the water level of the pond approximately six additional inches above the spillway. The dam is believed to be in fair to good condition. A dam failure could potentially cause damage to the Timber Lake Road North and Timber Lake Road bridges and possibly the Route 37 South bridge before the flow was mitigated by Valley Pond and Deer Pond downstream.
- ❑ Pepper Pond Dam – According to Town personnel, this dam was cited by the DEP as being poorly maintained. It is a Class BB dam that drains into Lake Mauweehoo.

Field inspections suggest that the maintenance issues may be related to poor vegetation management on the embankments near the spillway.

While the failure of any of the Candlewood Lake dams or dikes would not have a direct impact on the town of Sherman, residents bordering the lake and those who have boats moored at the lake would be indirectly affected. Any failure would cause the lake level to lower, and a complete failure could cause the entire lake to drain. A rapid drawdown could cause damage to boats as they come to rest on the bed of the lake, and if the dams are not restored, the failure would negatively impact individual property values.

## **8.6 Potential Mitigation Measures, Strategies, and Alternatives**

The Town should work with private property owners and the Connecticut DEP to stay up to date on the evolution of any Emergency Operations Plans and Dam Failure Analyses for the significant hazard dams in Sherman should any be produced. Copies of these documents should be made available at the Town Hall for reference and public viewing.

The Town should maximize its emergency preparedness for a potential dam failure. In addition, all B dams in the town should continue to be regularly inspected by their respective owners (and occasionally inspected by the DEP) with maintenance performed as required to keep the dams in safe and functional order. The Town should also consider offering occasional Town inspections of Class A, AA, BB, and unranked dams with the assistance of private property owners and inform dam owners of resources available to them through various governmental agencies. This work could be conducted through the Town's Flood and Erosion Control Board.

The Town should consider including future dam failure areas into a CodeRED-style emergency notification system. This system

*FEMA and the Association of Dam Safety Officials have a variety of resources available for dam owners. More information can be found at <http://www.fema.gov> and <http://www.damsafety.org/resources/downloads/>*

combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas or specific groups of people such as emergency responder teams at a rate of up to 60,000 calls per hour. This technology should be used to warn downstream residents of an impending dam failure and facilitate evacuation. In the interim, areas within and immediately adjacent to 100-year floodplains located downstream of a Class BB or Class B dam could be used to delineate potential dam failure areas.

In addition, there are several suggested potential mitigation strategies that are applicable to all hazards in this plan. These are outlined in the Section 10.1.

## **9.0 WILDFIRES**

### **9.1 Setting**

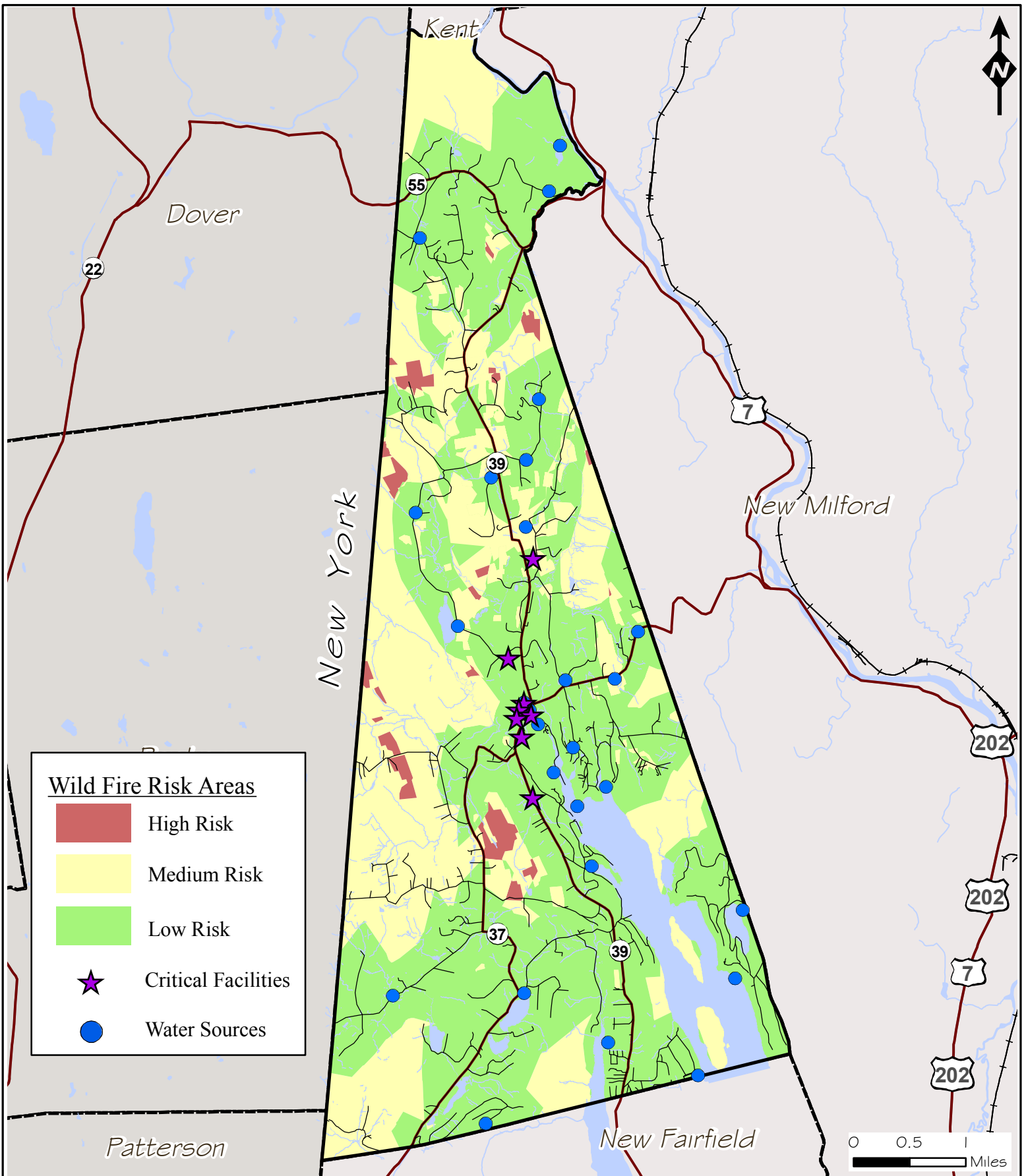
The ensuing discussion about wildfires is focused on the undeveloped wooded and shrubby areas of Sherman, along with low-density suburban type development found at the margins of these areas known as the wildland interface. Structural fires in higher density areas of the town are not considered.

The town of Sherman is considered a low-risk area for wildfires. Wildfires are of particular concern in the many wooded areas and other areas with poor access for fire-fighting equipment. Figure 9-1 presents the wildfire risk areas for the town of Sherman. Hazards associated with wildfires include property damage and loss of habitat. Wildfires are considered a likely event each year, but when one occurs it is generally contained to a small range with limited damage to non-forested areas.

### **9.2 Hazard Assessment**

Wildfires are considered to be highly destructive, uncontrollable fires. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially under dry conditions. Wildfires are also known as "wildland fires."

Nationwide, humans have caused approximately 90% of all wildfires in the last decade. Accidental and negligent acts include unattended campfires, sparks, burning debris, and irresponsibly discarded cigarettes. The remaining 10% of fires are caused primarily by lightning.



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Cheshire, Connecticut 06410  
(203) 271-1773 Fax: (203) 272-9733  
www.miloneandmacbroom.com

**Figure 9-1:  
Wildfire Risk Area**

**Natural Hazard  
Pre-Disaster Mitigation Plan  
Town of Sherman, Connecticut**

**LOCATION:** Sherman, CT  
**DATE:** 10/5/2010  
**MMI#:** 3101-04

**SOURCE:**  
Sherman Volunteer Fire Department  
Town of Sherman  
CTDEP, Map & Geographic Information  
Center (2009).  
Street Maps USA, (2010).

Nevertheless, wildfires are also a natural process, and their suppression is now recognized to have created a larger fire hazard as live and dead vegetation accumulates in areas where fire has been prevented. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, federal, state, and local agencies are committed to finding ways such as prescribed burning to reintroduce fire into natural ecosystems, while recognizing that fire fighting and suppression are still important.

Connecticut has a particular vulnerability to fire hazards where urban development and wildland areas are in close proximity. The "wildland/urban interface" is where many such fires are fought. Wildland areas are subject to fires because of weather conditions and fuel supply. An isolated wildland fire may not be a threat, but the combined effect of having residences, businesses, and lifelines near a wildland area causes increased risk to life and property. Thus, a fire that might have been allowed to burn itself out with a minimum of fire fighting or containment in the past is now fought to prevent fire damage to surrounding homes and commercial areas as well as smoke threats to health and safety in these areas.

### **9.3 Historic Record**

According to the Connecticut Natural Hazards Mitigation Plan (2007), Connecticut enacted its first statewide forest fire control system in 1905, when the state was largely rural with very little secondary growth forest. By 1927, the state had most of the statutory foundations for today's forest fire control programs and policies in place such as the State Forest Fire Warden system, a network of fire lookout towers and patrols, and regulations regarding open burning. The severe fire weather in the 1940s prompted the state legislature to join the Northeastern Interstate Forest Fire Protection Compact with its neighbors in 1949. Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEP, forest has reclaimed over 500,000 acres of land that was used for agriculture in 1914. However, that new forest has been

fragmented in the past few decades by residential development. The urban/wildland interface is increasing each year as sprawl extends further out from Connecticut's cities.

The technology used to combat wildfires has significantly improved since the early 20<sup>th</sup> century. An improved transportation network, coupled with advances in firefighting equipment, communication technology, and training has improved the ability of firefighters to minimize damage due to wildfires in the state. For example, radio and cellular technologies have greatly improved firefighting command capabilities.

According to the USDA Forest Service Annual Wildfire Summary Report for 1994 through 2003, an average of 600 acres per year in Connecticut was burned by wildfires. The National Interagency Fire Center reports that a total of 2,778 acres of land burned in Connecticut due to 1,940 nonprescribed wildfires, an average of 1.4 acres per fire (Table 9-1). In general, the fires are small and detected quickly, with most of the largest wildfires being contained to less than 10 acres in size. The number one cause of wildfires is arson, with about half of all wildfires being intentionally set.

**Table 9-1**  
**Wildland Fire Statistics for Connecticut**

<b>Year</b>	<b>Number of Wildland Fires</b>	<b>Acres Burned</b>	<b>Number of Prescribed Burns</b>	<b>Acres Burned</b>	<b>Total Acres Burned</b>
2010*	75	253	6	53	306
2009	264	246	6	76	322
2008	330	893	6	68	961
2007	361	288	7	60	348
2006	322	419	6	56	475
2005	316	263	10	130	393
2004	74	94	12	185	279
2003	97	138	8	96	234
2002	101	184	13	106	290
<b>Total</b>	<b>1,940</b>	<b>2,778</b>	<b>74</b>	<b>830</b>	<b>3,608</b>

\*Through the middle of August 2010

*Source: National Interagency Fire Center*

Traditionally, the highest forest fire danger in Connecticut occurs in the spring from mid-March to mid-May. The worst wildfire year for Connecticut in the past decade occurred during the extremely hot and dry summer of 1999. Over 1,733 acres of Connecticut burned in 345 separate wildfires, an average of about five acres per fire. Only one wildfire occurred between 1994 and 2003 that burned over 300 acres, and a wildfire in 1986 in the Mattatuck State Forest in the town of Watertown, Connecticut burned 300 acres.

Much of Sherman is privately and publicly owned forest and fires have occurred throughout the town. The Sherman Volunteer Fire Department responded to 800 fire-related calls from 2001 to 2009, equating to an average of 88 calls per year. While not all of these calls were related to wildfires, the call volume suggests that fire in general is a relatively common and persistent hazard in the town of Sherman.

#### **9.4 Existing Programs, Policies, and Mitigation Measures**

Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. The Town has an ordinance requiring the creation of dry hydrants for residential or commercial building developments, with pertinent water sources being either underground storage tanks or surface water supplies. This ordinance is enforced by the Planning and Zoning Commission. In addition, new roads, subdivisions, and fire ponds are required to allow for fire truck access.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the Sherman Volunteer Fire Department goes to the fires whenever possible. This proactive approach is believed to be effective for controlling wildfires. The Fire Department has some water storage capability in its tanker trucks but primarily relies on the use of 27 water sources (fire ponds or water tanks) to fight fires throughout town (Figure 9-1).

The Sherman Fire Department has a four-wheel drive brush truck and a gator capable of accessing remote locations with firefighting water. The Town also has mutual aid agreements with all of its neighbors. Finally, the DEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system (see Section 3.4) to compile forest fire probability forecasts. This allows the DEP and the Town of Sherman to monitor the drier areas of the state to be prepared for forest fire conditions.

## **9.5 Vulnerabilities and Risk Assessment**

The most common causes of wildfires are arson, lightning strikes, and fires started from downed trees hitting electrical lines. Thus, wildfires have the potential to occur anywhere and at any time in both undeveloped and lightly developed areas. The extensive forests and fields covering the state are prime locations for a wildfire. In many areas, structures and subdivisions are built abutting forest borders, creating areas of particular vulnerability. Wildfires are more common in rural areas than in developed areas as most fires in populated areas are quickly noticed and contained. The likelihood of a severe wildfire developing is lessened by the vast network of water features in the state, which create natural breaks likely to stop the spread of a fire. During long periods of drought, these natural features may dry up, increasing the vulnerability of the state to wildfires.

According to the Connecticut DEP, the actual forest fire risk in Connecticut is low due to several factors. First, the overall incidence of forest fires is very low (233 fires occurred in Connecticut per year from 2002 to 2009, which is a rate slightly higher than one per municipality per year). Secondly, as the wildfire/forest fire prone areas become fragmented due to development, the local fire departments have increased access to those neighborhoods for firefighting equipment. Third, the problematic interface areas are site specific such as driveways too narrow to permit emergency vehicles. Finally, trained

firefighters at the local and state level are readily available to fight fires in the state, and intermunicipal cooperation on such instances is common.

As suggested by the historic record presented in Section 9.3, most wildfires in Connecticut are relatively small. In the drought year of 1999, the average wildfire burned five acres in comparison to the two most extreme wildfires recorded since 1986 that burned 300 acres each. Given the availability of firefighting water in the town, including the use of nearby water bodies, and longstanding mutual aid assurances the Sherman Volunteer Fire Department has with neighboring communities, it is believed that this average value for a drought year and the extreme value are applicable to the town as well. Indeed, Town personnel report that in a typical year, the largest fires only burn a couple of acres before being contained despite the rural nature of the town.

There are limited public camping areas in town, so there are few fires caused by out of control campfires. The only state park in town is the Pootatuck State Forest along Candlewood Lake in southern Sherman, but there is no vehicular access within Sherman. Town personnel report that the larger private tracts of forest do not tend to attract children. As much of the town has firefighting water available nearby in the form of fire ponds, a large amount of water can be made readily available for firefighting equipment.

Nevertheless, the Town of Sherman believes that there are weaknesses in its firefighting capability. The Fire Department relies on the relative water levels in Candlewood Lake and other smaller water bodies in the town. While the 27 water sources outlined on Figure 9-1 provide a large area of town with potential firefighting water, there are still many areas of town not served by a formal water source. During the summer months, many smaller streams in Sherman dry up and cannot be used as water sources.

In addition, there are many areas of town where roads are narrow and one way. This hinders emergency access to fight fires. This is a particular problem within many of the private community associations. Fire trucks often need to drive into such areas in line

with the last one in being the first one to back out as there is no place to turn around. In other places, fire trucks simply can't get to the houses that are up narrow dirt roads and driveways. The Fire Department should continue public education in these areas and encourage homeowners and private communities to widen the access for emergency vehicles wherever possible.

The wildfire risk areas on Figure 9-1 were defined by the following algorithm. Areas within 1.5 miles of a water source along a roadway were defined as the low-risk zone. In addition, areas within a quarter mile of such roadways were also defined as the low-risk zone. This zone represents areas where the Sherman Volunteer Fire Department can respond to a fire quickly and rely on a large source of water. Areas outside of the low-risk zone were designated as being medium risk as the Fire Department must rely on tankers and occasionally off-road vehicles to move firefighting water into these areas.

As described in Section 2, Sherman continues to have many areas in agriculture and pasture today. Town personnel feel that these areas are one of the highest risk areas for wildfires as a fire could quickly encompass a dry field or pasture during a drought. Such areas appearing to be in agriculture or pasture were identified from the 2008 aerial photography available through Microsoft® Virtual Earth. The identified fields increased the risk of wildfire by one step, e.g., low-risk areas became medium-risk areas, and medium-risk areas became high-risk areas. These areas are outlined in Figure 9-1.

In addition, there is concern about fires in the wooded southwestern, western, and northwestern sections of town where there is limited firefighting water available. While fires are infrequent in these areas, they can often be difficult to access and fight. The Town has the support of the owners of the tracts of open space to provide access to their lands in case of a wildfire.

In summary, the highest risk areas for wildfires in Sherman are associated with agricultural fields or pastures. As each area borders residential sections of the town,

residents on the outskirts of these risk areas are the most vulnerable to fire, heat, and smoke effects of wildfires. Despite having a large amount of forest/suburban interface, the overall risk of wildfires occurring in the town of Sherman is considered to be low. Such fires fail to spread far due speed of detection and strong fire response.

Should a wildfire occur, it seems reasonable to estimate that the average area to burn would be five acres during a drought period and one to two acres during wetter periods, consistent with the state averages. In the case of an extreme wildfire during a long drought on forested lands, it is estimated that up to 300 acres could burn before containment due to the limited access of those lands. Residential areas bordering such lands would also be vulnerable to wildfire, but would likely be more impacted by heat and smoke than by structure fires due to the strong fire response in the town.

Recall from Figure 2-7, Figure 2-8, and Figure 2-9 that elderly, linguistically isolated, and disabled populations reside in the town of Sherman. In comparing these figures with the wildfire risk areas presented in Figure 9-1, it is possible that several hundred of the population impacted by a wildfire could consist of the elderly, a small number could consist of linguistically isolated households, and several with disabilities could reside near wildfire impact areas. Thus, it is important for the Sherman Fire Department to be prepared to assist these special populations during emergencies, including wildfire.

## **9.6 Potential Mitigation Measures, Strategies, and Alternatives**

Potential mitigation measures for wildfires include a mixture of prevention, education, and emergency planning. Although educational materials are available through the Fire Department, they should be made available at other municipal offices as well. Education of homeowners on methods of protecting their homes is far more effective than trying to steer growth away from potential wildfire areas, especially given that the available land that is environmentally appropriate for development may be forested.

Water system improvements are an important class of potential mitigation for wildfires. The following recommendations could be implemented to mitigate forest fire risk:

- ❑ The Town should continue to require the installation of fire ponds with dry hydrants and water tanks in new subdivisions and commercial developments.
- ❑ The Town should consider adding additional supplies of firefighting water where adequate water supplies do not currently exist as inferred on Figure 9-1. These areas include Briggs Hill Road, Route 37 South between Briggs Hill Road and Wakeman Road, and Wakeman Road near Bridgeworth Lane.
- ❑ Continue to encourage property owners to widen access roads such that fire trucks and other emergency vehicles can access remote locations.

Other potential mitigation strategies for preventing wildfires include:

- ❑ Continue to promote intermunicipal cooperation in firefighting efforts
- ❑ Continue to support public outreach programs to increase awareness of forest fire danger and how to use common firefighting equipment
- ❑ Continue reviewing subdivision applications to ensure new neighborhoods and driveways are properly sized to allow access of emergency vehicles
- ❑ Provide outreach programs on how to properly manage burning and campfires on private property
- ❑ Distribute copies of a booklet such as "Is Your Home Protected from Wildfire Disaster? – A Homeowner's Guide to Wildfire Retrofit" when developers and homeowners pick up or drop off applications
- ❑ Patrol Town-owned open space and parks to prevent unauthorized campfires
- ❑ Enforce regulations and permits for open burning
- ❑ Continue to place utilities underground

In addition, specific recommendations that apply to all hazards are listed in Section 10.1.

## 10.0 RECOMMENDATIONS

Recommendations that are applicable to two, three, or four hazards were discussed in the applicable subsections of Sections 3.0 through 9.0. For example, placing utilities underground is a recommendation for hurricane, summer storm, winter storm, and wildfire mitigation. Public education and awareness is a type of mitigation applicable to all hazards because it includes recommendations for improving public safety and planning for emergency response. Instead of repeating these recommendations in section after section of this Plan, these are described below.

### 10.1 Public Education and Awareness

Informing and educating the public about how to protect themselves and their property from natural hazards is essential to any successful hazard mitigation strategy. The Office of Emergency Management or Fire Department should be charged with creating and disseminating informational pamphlets and guides to public locations such as the library, post office, senior center, and town hall. In particular, additional guides are recommended regarding fire protection, fire safety, and the importance of prevention. Such pamphlets include *"Are you ready? A Guide to Citizen Preparedness"* co-published by the American Red Cross, FEMA, and the National Oceanic & Atmospheric Administration and includes recommendations for dealing with heat waves, hurricanes, tornadoes, thunderstorms, flooding, fire, and winter storms. Other useful pamphlets include (but are not limited to):

- ❑ *"Food & Water in an Emergency"*
- ❑ *"Disaster Supply Kit"*
- ❑ *"Family Disaster Plan"* (currently available on the Town of Sherman website)
- ❑ *"Preparing for Disaster for People with Disabilities and Other Special Needs"*, and
- ❑ *"Helping Children Cope with Disaster"*
- ❑ *"Is Your Home Protected from Wildfire Disaster? – A Homeowner's Guide to Wildfire Retrofit"*

In addition, the Town should consider adding pages to its website dedicated to citizen education and preparation for natural hazard events.

A community warning system that relies on radios and television is less effective at warning residents during the night when the majority of the community is asleep. Thus, Sherman should attempt to acquire an emergency notification system such as CodeRED. It is understood that such a program may not be economically viable for Sherman alone, but such a program could potentially be spearheaded by the HVCEO or through DEMHS Region 5. Databases could be set up as best possible for hazards with a specific geographic extent, particularly dam failure. Residents should also be encouraged to purchase a NOAA weather radio containing an alarm feature. In addition, the Town Emergency Operations Plan should continue to be reviewed and updated at least once annually.

## **10.2 Summary of Specific Recommendations**

Recommendations have been presented throughout this document in individual sections as related to each natural hazard. This section lists specific recommendations of the Plan without any priority ranking. Recommendations that span multiple hazards are only reprinted once in this section under the most appropriate hazard event. Refer to the matrix in Appendix A for recommendations with scores based on the STAPLEE methodology described in Section 1.0.

### **All Hazards**

- ☐ Disseminate informational pamphlets regarding natural hazards to public locations.
- ☐ Add pages to the Town website (<http://www.townofshermanct.org/>) dedicated to citizen education and preparation for natural hazard events.

- ❑ Post a list of Town sheltering facilities in the Town Hall and on the Town's website so residents can best plan how to access to critical facilities during a natural hazard event.
- ❑ Advertise the location of emergency shelters on the Town website and in local municipal buildings. If there is a warning period prior to a natural hazard event, advertise the location on local radio and television stations and in the local newspapers.
- ❑ Consider implementation of an enhanced emergency notification system such as CodeRED.
- ❑ Upgrade emergency communications as necessary to better facilitate emergency response, particularly in coordination with neighboring municipalities.
- ❑ Consider upgrading the unpaved portions of Jericho Road North to provide an additional means of egress from the center of Sherman to the north part of town.
- ❑ Encourage residents to purchase and use NOAA weather radios with alarm features.
- ❑ Continue to review and update the Town Emergency Operations Plan at least once annually.
- ❑ Review potential evacuation routes to ensure timely migration of people seeking shelter in all areas of Sherman, and post evacuation information on the Town website and in municipal buildings.
- ❑ Consider modifying the Plan of Conservation and Development and the Subdivision Regulations to encourage two modes of egress into new neighborhoods by the creation of through streets. Any such modification would then become an amendment of the subdivision regulations.
- ❑ Continue reviewing subdivision applications to ensure new neighborhoods and driveways are properly sized to allow access of emergency vehicles.
- ❑ Continue to encourage property owners to widen access roads such that fire trucks and other emergency vehicles can access remote locations.
- ❑ Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.

## Inland Flooding

### *Prevention, Property Protection, and Natural Resource Protection*

- ❑ Continue to regulate activities within SFHAs.
- ❑ Consider requiring buildings constructed in floodprone areas to be protected to the highest recorded flood level, regardless of being within a defined SFHA.
- ❑ Ensure new buildings be designed and graded to shunt drainage away from the building.
- ❑ Require developers to support whether detention or retention of stormwater is the best option for reducing peak flows downstream of a project.
- ❑ In conjunction with the land trusts in town, pursue the acquisition of additional municipal open space inside SFHAs and set it aside as greenways, parks, or other nonresidential, noncommercial, or nonindustrial use.
- ❑ Compile a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to a proposed project and make this list available to potential applicants.
- ❑ Selectively pursue conservation recommendations listed in the Plan of Conservation and Development and other studies and documents.
- ❑ Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.
- ❑ Provide outreach regarding home elevation, flood barriers, dry floodproofing, and wet floodproofing techniques to private homeowners with flooding problems.

### Structural Projects

- ❑ Pursue/allocate funding to repair the bridge over Tollgate Brook on Old Greenwood Road.
- ❑ Monitor the condition of the culverts conveying Glen Brook beneath Wagon Wheel Road, and the bridge conveying Sawmill Brook beneath Sawmill Road.
- ❑ Conduct engineering studies as needed to redefine culverts that are suspected of being undersized. Pursue/allocate funding when necessary to repair these structures.
- ❑ Encourage the State Department of Transportation to perform more frequent catch basin cleanouts on Route 39.
- ❑ Reevaluate the drainage computations for public dead-end roads in town that span a watercourse, evaluating the dead-end roads with the most structures at risk first. If any of these roads are considered sufficiently undersized, resize the culvert or crossing to an acceptable level.
- ❑ Encourage the private communities in town to reevaluate the drainage computations for their floodprone streets as well.

### Wind Damage Related to Hurricanes, Summer Storms, and Winter Storms

- ❑ Continue tree limb maintenance and inspections, especially along state roads and other evacuation routes. Continue inspections and outreach regarding trees on private property near power lines and town rights-of-way.
- ❑ Provide for the Building Department to have literature available regarding appropriate design standards for wind.
- ❑ Continue to require compliance with the amended Connecticut Building Code for wind speeds.
- ❑ Encourage the use of structural techniques related to mitigation of wind damage in new structures to protect new buildings to a standard greater than the minimum building code requirements.

### Winter Storms

- ❑ Continue to provide information on the dangers of cold-related hazards.
- ❑ Consider prioritizing plowing routes and post the snow plowing prioritization in Town buildings each winter to increase public awareness.
- ❑ Provide for the building department to have information available for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings such as heating coils.

### Earthquakes

- ❑ Consider preventing new residential development in areas prone to collapse or liquefaction.
- ❑ Continue to require adherence to the state building codes.
- ❑ Ensure that municipal departments have adequate backup facilities, such as portable generators, in case earthquake damage occurs to critical facilities.

### Dam Failure

- ❑ Stay current on the evolution of EOPs and Dam Failure Analyses for Class B dams whose failure could impact areas of Sherman. Place copies of any dam Emergency Operations Plans and Dam Failure Analyses on file in the Town Hall for public viewing.
- ❑ Consider implementing Town inspections of Class AA, A, BB, and unranked dams.
- ❑ If the Town acquires an emergency notification system, include dam failure areas in the contact database.
- ❑ Consider utilizing the Flood and Erosion Control Board in Sherman to oversee private dam maintenance and problems with flooding and erosion.

## Wildfires

- ❑ The Town should continue to require the installation of fire ponds with dry hydrants and water tanks in new subdivisions and commercial developments.
- ❑ The Town should consider adding additional supplies of firefighting water where adequate water supplies do not currently exist as inferred on Figure 9-1. These areas include Briggs Hill Road, Route 37 South between Briggs Hill Road and Wakeman Road, and Wakeman Road near Bridgeworth Lane.
- ❑ Continue to promote intermunicipal cooperation in firefighting efforts.
- ❑ Continue to support public outreach programs to increase awareness of forest fire danger and how to use common firefighting equipment.
- ❑ Provide outreach programs on how to properly manage burning and campfires on private property.
- ❑ Patrol Town-owned open space and parks to prevent unauthorized campfires.
- ❑ Enforce regulations and permits for open burning.

### **10.3 Priority Projects and Procedures**

As discussed in Section 1.4, the STAPLEE method was used to prioritize projects. MMI prepared the STAPLEE with comments and input from the First Selectwoman of Sherman. The large table in Appendix A ranks the projects proposed in Section 10.1 and 10.2 and also lists possible funding sources. The top 11 projects and procedures (a STAPLEE score of eight and above) are summarized below.

1. Continue to promote inter-municipal firefighting efforts (9).
2. Add pages to the Town website dedicated to citizen education and preparedness for natural hazard events (8).
3. Upgrade emergency communications as necessary to ensure adequate communication with all areas of town and each of Sherman's neighbors (8).

4. Continue reviewing subdivision applications to ensure proper access for emergency vehicles (8).
5. Continue to require that utilities be placed underground in new developments whenever possible (8).
6. Continue to regulate activities within Special Flood Hazard Areas (floodplains), and in protected and sensitive areas such as steep slopes and wetlands (8).
7. Encourage the State DOT to perform more frequent catch basin cleanouts on Route 39 (8).
8. Re-evaluate the drainage computations for culverts on public dead-end roads and resize if necessary (8).
9. Utilize the Flood and Erosion Control Board to oversee municipal dam maintenance and problems with flooding and erosion (8).
10. Continue to require the installation of fire ponds with dry hydrants or water tanks in new developments (8).
11. Enforce regulations and permits for open burning (8).

Capital improvement projects and studies will often carry a higher capital cost to the Town than prevention and public information projects. As a result, such projects are often ranked lower than other types of projects. The top nine of these projects are summarized below.

1. Upgrade emergency communications as necessary to ensure adequate communication with all areas of town and each of Sherman's neighbors (in progress) (8).
2. Re-evaluate the drainage computations for culverts on public dead-end roads and resize if necessary (8).
3. Pursue additional supplies of firefighting water where adequate water supplies do not currently exist, including Briggs Hill Road, Route 37 South between Briggs Hill Road and Wakeman Road, and Wakeman Road near Bridgeworth Lane (7).
4. Acquire open space properties within floodplains and set aside as greenways, parks, or other nondeveloped uses (7).

5. Monitor culverts throughout town, especially those on Saw Mill Road (Saw Mill Brook) and Wagon Wheel Road (Glen Brook) and pursue funding for when repairs are necessary (6).
6. Conduct engineering studies to reevaluate the flood event bridges can pass without overtopping and pursue funding to resize if necessary (5).
7. Consider implementation of an emergency notification system such as CodeRED or Alert Now (4). Include dam failure areas in the emergency notification system contact area (8).
8. Pursue funding to repair the bridge on Old Greenwoods Road Extension over Tollgate Brook (in progress) (3).
9. Pursue funding to place utilities underground in existing developments where they are at risk of damage from natural hazard events (0).

#### **10.4 Sources of Funding**

The following sources of funding and technical assistance may be available for the priority projects listed above. This information comes from the FEMA website (<http://www.fema.gov/government/grant/index.shtm>). Funding requirements and contact information is given in Section 11.4.

#### **FEMA (Federal Emergency Management Agency) Grants and Assistance Programs**

##### **American Recovery & Reinvestment Act (ARRA)**

<http://www.fema.gov/government/grant/arra/index.shtm>

The ARRA is an economic stimulus package that was designed to jumpstart the U.S. economy, create or save millions of jobs, and put a down payment on addressing long-neglected challenges nationally. The Fire Station Construction Grant (SCG) Program is one aspect of the ARRA. A total of \$210,000,000 is available to non-federal fire departments and state and local governments that fund/operate fire departments to achieve goals of firefighter safety and improved response capability/capacity based on need through the construction, renovation or modification of fire stations.

**Buffer Zone Protection Program (BZPP)**

<http://www.fema.gov/government/grant/bzpp/index.shtm>

This grant provides security and risk management capabilities at State and local level for Tier I and II critical infrastructure sites that are considered high-risk/high-consequence facilities. Each State with a BZPP site is eligible to submit applications for its local communities to participate in and receive funding under the program. The funding for this grant is based on the number, type, and character of the site.

**Citizen Corps Program National Emergency Technology Guard (NET Guard) Pilot Program**

<http://www.fema.gov/government/grant/netguard/index.shtm>

The purpose of this grant, under the Homeland Security Act of 2002, is to re-establish a communication network in the event that the current information systems is attacked and rendered inoperable. A total of \$80,000 may be available to each applicant provided they are a locality that meets the required criteria.

**Commercial Equipment Direct Assistance Program (CEDAP)**

<http://www.fema.gov/government/grant/cedap/index.shtm>

This direct assistance program provides equipment and technical assistance to enhance regional response capabilities, mutual aid, and interoperable communications. Eligible applicants include law enforcement agencies and emergency responder agencies who demonstrate that the equipment would improve their capability and capacity to respond to a major critical incident or to work with other first responders.

**Community Disaster Loan Program**

[http://www.fema.gov/government/grant/fs\\_cdl.shtm](http://www.fema.gov/government/grant/fs_cdl.shtm)

This program provides funds to any eligible jurisdiction in a designated disaster area that has suffered a substantial loss of tax and other revenue. The assistance is in the form of loans not to exceed twenty-five percent of the local government's annual operating budget for the fiscal year in which the major disaster occurs, up to a maximum of five million dollars.

**Emergency Food and Shelter Program**

<http://www.fema.gov/government/grant/efs.shtm>

This program was created in 1983 to supplement the work of local social service organizations, both private and governmental, to help people in need of emergency assistance.

**Emergency Management Institute**

<http://training.fema.gov/>

Provides training and education to the fire service, emergency management officials, its allied professions, and the general public.

**Emergency Management Performance Grants**

<http://www.fema.gov/emergency/empg/empg.shtm>

The Emergency Management Performance Grant (EMPG) is designed to assist local and state governments in maintaining and strengthening the existing all-hazards, natural and man-made, emergency management capabilities. Allocations of this fund is authorized by the 9/11 Commission Act of 2007, and grant amount is determined demographically at the state and local level.

**Emergency Operations Center (EOC) Grant Program**

<http://www.fema.gov/government/grant/eoc/index.shtm>

The Emergency Operations Center Grant is designated to support the needed construction, renovation or improvement of emergency operation centers at the State, Local, or Tribal governments. The State Administrative Agency (SAA) is the only eligible entity able to apply for the available funding on behalf of qualified State, local, and tribal EOCs.

**Flood Mitigation Assistance (FMA) Program**

<http://www.fema.gov/government/grant/fma/index.shtm>

The FMA was created as part of the National Flood Insurance Reform Act of 1994 with the goal of reducing or eliminating claims under the NFIP. FEMA provides funds in the form of planning grants for Flood Mitigation Plans and project grants to implement measures to reduce flood losses, including elevation, acquisition, or relocation of NFIP-insured structures. Repetitive loss properties are prioritized under this program. This grant program is administered through the DEP.

**Hazard Mitigation Grant Program (HMGP)**

<http://www.fema.gov/government/grant/hmgp/index.shtm>

The HMGP provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. This grant program is administered through the DEP.

**Homeland Security Grant Program (HSGP)**

<http://www.fema.gov/government/grant/hsgp/index.shtm>

The objective of the FY 2008 HSGP is to enhance the response, preparedness, and recovery of local, State, and tribal governments in the event of a disaster or terrorist attack. Eligible applicants include all 50 states, the District of Columbia, Puerto Rico, American Samoa, Guam, Northern Mariana Islands, and the Virgin Islands. Risk and effectiveness, along with a peer review, determine the amount allocated to each applicant.

**Interoperable Emergency Communications Grant Program (IECGP)**

<http://www.fema.gov/government/grant/iecgp/index.shtm>

The FY 2009 IECGP provides governance, planning, training and exercise, and equipment funding to States, Territories, and local and tribal governments to carry out initiatives to improve interoperable emergency communications, including communications in collective response to natural disasters, acts of terrorism, and other man-made disasters. All proposed activities must be integral to interoperable emergency communications and must be aligned with the goals, objectives, and initiatives identified in the grantee's approved Statewide Communication Interoperability Plans (SCIP).

**National Flood Insurance Program (NFIP)**

<http://www.fema.gov/library/viewRecord.do?id=3005>

This program enables property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. Municipalities that join the associated Community Rating System can gain discounts of flood insurance for their residents.

**Pre-Disaster Mitigation Grant Program**

<http://www.fema.gov/government/grant/pdm/index.shtm>

The purpose of the PDM program is to fund communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. PDM grants are provided to states, territories, Indian tribal governments, communities, and universities, which, in turn, provide sub-grants to local governments. PDM grants are awarded on a competitive basis. This grant program is administered through the DEP.

**Public Assistance Grant Program**

<http://www.fema.gov/government/grant/pa/index.shtm>

The Public Assistance Grant Program (PA) is designed to assist State, Tribal and local governments, and certain types of private non-profit organizations in recovering from major disasters or emergencies. Along with helping to recover, this grant also encourages prevention against potential future disasters by strengthening hazard mitigation during the recovery process. The first grantee to apply and receive the PA would usually be the State, and the State could then allocate the granted funds to the sub-grantees in need of assistance.

**Repetitive Flood Claims Program**

<http://www.fema.gov/government/grant/rfc/index.shtm>

The Repetitive Flood Claims (RFC) grant program was set into place to assist States or communities with insured properties that have had prior claims to the National Flood Insurance Program (NFIP) but do not meet the requirements for FMA. This grant is provided to eligible States/Tribes/Territories that, in turn, will allocate sub-grants to local governments.

**Severe Repetitive Loss (SRL) Program**

<http://www.fema.gov/government/grant/srl/index.shtm>

The SRL provides funding to reduce or eliminate the long-term risk of flood damage to SRL structures insured under the NFIP. This program is for residential properties only, and eligible project activities include acquisition and demolition or relocation of the structure with conversion of the property to open space, elevation, minor localized flood reduction projects, and dry flood proofing (historic properties only).

**Transit Security Grant Program (TSGP)**

<http://www.fema.gov/government/grant/tsgp/index.shtm>

The purpose of TSGP is to bolster security and safety for public transit infrastructure within Urban Areas throughout the United States. Applicable grantees include only the state Governor and the designated State Administrative Agency (SAA) appointed to obligate program funds to the appropriate transit agencies.

**Trucking Security Program (TSP)**

<http://www.fema.gov/government/grant/tsp/index.shtm>

The TSP provides funding for an anti-terrorism and security awareness program for highway professionals in support of the National Preparedness Guidelines. All applicants are accepted so long as they support all four funding priority areas: participant identification and recruitment; training; communications; and information analysis and distribution for an anti-terrorism and security awareness program.

## **U.S. Fire Administration**

### **Assistance to Firefighters Grant Program (AFGP)**

<http://www.firegrantsupport.com/afg/>

<http://www.usfa.dhs.gov/fireservice/grants/>

The primary goal of the Assistance to Firefighters Grants (AFG) is to meet the firefighting and emergency response needs of fire departments and nonaffiliated emergency medical services organizations. Since 2001, AFG has helped firefighters and other first responders to obtain critically needed equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards. The Grant Programs Directorate of the Federal Emergency Management Agency administers the grants in cooperation with the U.S. Fire Administration.

### **Fire Prevention & Safety Grants (FP&S)**

<http://www.firegrantsupport.com/fps/>

The Fire Prevention and Safety Grants (FP&S) are part of the Assistance to Firefighters Grants (AFG) and are under the purview of the Grant Programs Directorate in the Federal Emergency Management Agency. FP&S grants support projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to target high-risk populations and mitigate high incidences of death and injury. Examples of the types of projects supported by FP&S include fire prevention and public safety education campaigns, juvenile firesetter interventions, media campaigns, and arson prevention and awareness programs.

### **National Fire Academy Education and Training**

<http://www.usfa.dhs.gov/nfa/>

Provides training to increase the professional level of the fire service and others responsible for fire prevention and control.

### **Reimbursement for Firefighting on Federal Property**

<http://www.usfa.dhs.gov/fireservice/grants/rfff/>

Reimbursement may be made to fire departments for fighting fires on property owned by the federal government for firefighting costs over and above normal operating costs. Claims are submitted directed to the U.S. Fire Administration. For more information, please contact Tim Ganley at (301) 447-1358.

## **Staffing for Adequate Fire & Emergency Response (SAFER)**

<http://www.firegrantsupport.com/safer/>

The goal of SAFER is to enhance the local fire departments' abilities to comply with staffing, response and operational standards established by NFPA and OSHA (NFPA 1710 and/or NFPA 1720 and OSHA 1910.134 - see <http://www.nfpa.org/SAFERActGrant> for more details). Specifically, SAFER funds should assist local fire departments to increase their staffing and deployment capabilities in order to respond to emergencies whenever they may occur. As a result of the enhanced staffing, response times should be sufficiently reduced with an appropriate number of personnel assembled at the incident scene. Also, the enhanced staffing should provide that all front-line/first-due apparatus of SAFER grantees have a minimum of four trained personnel to meet the OSHA standards referenced above. Ultimately, a faster, safer and more efficient incident scene will be established and communities will have more adequate protection from fire and fire-related hazards.

## **Other Grant Programs**

### **Flood Mitigation**

- ❑ U.S. Army Corps of Engineers – *50/50 match funding for floodproofing and flood preparedness projects.*
- ❑ U.S. Department of Agriculture – *financial assistance to reduce flood damage in small watersheds and to improve water quality.*
- ❑ CT Department of Environmental Protection – *assistance to municipalities to solve flooding and dam repair problems through the Flood and Erosion Control Board Program.*

### **Hurricane Mitigation**

- ❑ FEMA State Hurricane Program - *financial and technical assistance to local governments to support mitigation of hurricanes and coastal storms.*
- ❑ FEMA Hurricane Program Property Protection – *grants to hurricane prone states to implement hurricane mitigation projects.*

### General Hazard Mitigation

- ❑ Americorps – *teams may be available to assist with landscaping projects such as surveying, tree planting, restoration, construction, and environmental education, and provide volunteers to help communities respond to natural hazard-related disasters.*

### Erosion Control and Wetland Protection

- ❑ U.S. Department of Agriculture – *technical assistance for erosion control.*
- ❑ CT Department of Environmental Protection – *assistance to municipalities to solve beach erosion problems through the Flood and Erosion Control Board Program.*
- ❑ North American Wetlands Conservation Act Grants Program – *funding for projects that support long term wetlands acquisition, restoration, and/or enhancement. Requires a 1-to-1 funds match.*

## **11.0 PLAN IMPLEMENTATION**

### **11.1 Implementation Strategy and Schedule**

The Town is authorized to update this hazard mitigation plan as needed. HVCEO will assist the Town with plan adoption at the local level and assist with guiding the Plan through the FEMA approval process. Appendix E contains a record of the adoption of this plan in the Town of Sherman.

The individual recommendations of the hazard mitigation plan must be implemented by the municipal departments that oversee these activities. The Office of the First Selectman and the Department of Public Works in the Town of Sherman will primarily be responsible for developing and implementing selected projects. Appendix A incorporates an implementation strategy and schedule, detailing the responsible department and anticipated time frame for the specific recommendations listed throughout this document.

Upon adoption, the Plan will be made available to all Town departments and agencies as a planning tool to be used in conjunction with existing documents. It is expected that revisions to other Town plans and regulations such as the Plan of Conservation and Development, department annual budgets, and Zoning and Subdivision Regulations will reference this Plan and its updates. The Office of the First Selectman will be responsible for ensuring that the actions identified in this plan are incorporated into ongoing Town planning activities, and that the information and requirements of this Plan are incorporated into existing planning documents within five years from the date of adoption or when other plans are updated, whichever is sooner.

The Office of the First Selectman will be responsible for assigning appropriate Town officials to update the Plan of Conservation and Development, Subdivision Regulations, Wetlands Regulations, and Emergency Operations Plan to include the provisions in this

Plan. Should a general revision be too cumbersome or cost prohibitive, simple addendums to these documents will be added that include the provisions of this plan. The Plan of Conservation and Development and the Emergency Operations Plan are the two documents most likely to benefit from the inclusion of the Plan in the Town's library of planning documents.

Finally, information and projects in this planning document will be included in the annual budget and capital improvement plans as part of implementing the projects recommended in this plan. This will primarily include the annual budget and capital improvement projects lists maintained and updated by the Department of Public Works.

## **11.2 Progress Monitoring and Public Participation**

The Office of the First Selectman will be the party responsible for monitoring the successful implementation of the Plan as part of its oversight of all municipal departments. Such monitoring may include periodic reports to the HVCEO regarding certain projects, meetings, site visits, and telephone calls as befits the project being implemented. HVCEO will assist the Town of Sherman with its annual review and evaluation of the Plan. Participants in each annual review may include, but need not be limited to, representatives of the departments listed in Section 11.1.

Matters to be reviewed will include the goals and objectives of the original plan, hazards or disasters that occurred during the preceding period, mitigation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and recommendations for new projects and revised activities. The meeting should be conducted in the summer at least two months before the annual application cycle for pre-disaster grants under the HMA programs (applications are typically due to DEP in October of any given year). This will enable a list of possible projects to be circulated for Town departments to review, with sufficient time for developing an application.

Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the Plan. Public input may be solicited through community meetings and input to web-based information gathering tools. Public comment on changes to the Plan may be sought through posting of public notices, and notifications posted to the website of the HVCEO as well as of the Town.

### **11.3 Updating the Plan**

The Town will update this hazard mitigation plan if a consensus to do so is reached by the Board of Selectmen of Sherman, or at least once every five years. A committee will be formed consisting of representatives of many of the same departments solicited for input to this plan. In addition, local business leaders, community and neighborhood group leaders, relevant private and nonprofit interest groups, and the six neighboring municipalities will be solicited for representation, including the following:

- ❑ Representatives from HVCEO
- ❑ Candlewood Lake Watershed Association
- ❑ Key organizations from the list presented on Page 1-10
- ❑ Representatives from the public works and planning departments in the municipalities of Kent, New Fairfield, and New Milford (in Connecticut), and in Dover, Pawling, and Patterson, New York

Updates may include deleting recommendations as projects are completed, adding recommendations as new hazard effects arise, or modifying hazard vulnerabilities as land use changes. In addition, the list of shelters and critical facilities should be updated as necessary, or at least every five years.

## 11.4 Technical and Financial Resources

This Section is comprised of a list of resources to be considered for technical assistance and potentially financial assistance for completion of the actions outlined in this Plan. This list is not all-inclusive and is intended to be updated as necessary.

### Federal Resources

#### Federal Emergency Management Agency

Region I  
99 High Street, 6<sup>th</sup> floor  
Boston, MA 02110  
(617) 956-7506  
<http://www.fema.gov/>

#### Mitigation Division

The Mitigation Division is comprised of three branches that administer all of FEMA's hazard mitigation programs. The **Risk Analysis Branch** applies planning and engineering principles to identify hazards, assess vulnerabilities, and develop strategies to manage the risks associated with natural hazards. The **Risk Reduction Branch** promotes the use of land use controls and building practices to manage and assess risk in both the existing built developments and future development areas in both pre- and post-disaster environments. The **Risk Insurance Branch** mitigates flood losses by providing affordable flood insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations.

FEMA Programs administered by the Risk Analysis Branch include:

- ❑ *Flood Hazard Mapping Program*, which maintains and updates National Flood Insurance Program maps
- ❑ *National Dam Safety Program*, which provides state assistance funds, research, and training in dam safety procedures
- ❑ *National Hurricane Program*, which conducts and supports projects and activities that help protect communities from hurricane hazards
- ❑ *Mitigation Planning*, a process for states and communities to identify policies, activities, and tools that can reduce or eliminate long-term risk to life and property from a hazard event

FEMA Programs administered by the Risk Reduction Branch include:

- ❑ *Hazard Mitigation Grant Program (HMGP)*, which provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration
- ❑ *Flood Mitigation Assistance Program (FMA)*, which provides funds to assist states and communities to implement measures that reduce or eliminate long-term risk of flood damage to structures insurable under the National Flood Insurance Program
- ❑ *Pre-Disaster Mitigation Grant Program (PDM)*, which provides program funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event
- ❑ *Severe Repetitive Loss Program (SRL)*, which provides funding to reduce or eliminate the long-term risk of flood damage to "severe repetitive loss" structures insured under the National Flood Insurance Program
- ❑ *Community Rating System (CRS)*, a voluntary incentive program under the National Flood Insurance Program that recognizes and encourages community floodplain management activities
- ❑ *National Earthquake Hazards Reduction Program (NEHRP)*, which in conjunction with state and regional organizations supports state and local programs designed to protect citizens from earthquake hazard

The Risk Insurance Branch oversees the *National Flood Insurance Program (NFIP)*, which enables property owners in participating communities to purchase flood insurance. The NFIP assists communities in complying with the requirements of the program and publishes flood hazard maps and flood insurance studies to determine areas of risk.

FEMA also can provide information on past and current acquisition, relocation, and retrofitting programs, and has expertise in many natural and technological hazards. FEMA also provides funding for training state and local officials at Emergency Management Institute in Emmitsburg, Maryland.

The Mitigation Directorate also has in place several *Technical Assistance Contracts (TAC)* that support FEMA, states, territories, and local governments with activities to enhance the effectiveness of natural hazard reduction program efforts. The TACs support FEMA's responsibilities and legislative authorities for implementing the earthquake, hurricane, dam safety, and floodplain management programs. The range of technical assistance services provided through the TACs varies based on the needs of the eligible contract users and the natural hazard programs. Contracts and services include:

- ❑ *The Hazard Mitigation Technical Assistance Program (HMTAP) Contract*-supporting post-disaster program needs in cases of large, unusual, or complex projects; situations where resources are not available; or where outside technical

assistance is determined to be needed. Services include environmental and biological assessments, benefit/cost analyses, historic preservation assessments, hazard identification, community planning, training, and more.

- ❑ *The Wind and Water Technical Assistance Contract (WAWTAC)* - supporting wind and flood hazards reduction program needs. Projects include recommending mitigation measures to reduce potential losses to post-FIRM structures, providing mitigation policy and practices expertise to states, incorporating mitigation into local hurricane program outreach materials, developing a Hurricane Mitigation and Recovery exercise, and assessing the hazard vulnerability of a hospital.
- ❑ *The National Earthquake Technical Assistance Contract (NETAC)* – supporting earthquake program needs. Projects include economic impact analyses of various earthquakes, vulnerability analyses of hospitals and schools, identification of and training on nonstructural mitigation measures, and evaluating the performance of seismically rehabilitated structures, post-earthquake.

#### Response & Recovery Division

As part of the National Response Plan, this division provides information on dollar amounts of past disaster assistance including Public Assistance, Individual Assistance, and Temporary Housing, as well as information on retrofitting and acquisition/relocation initiatives. The Response & Recovery Division also provides mobile emergency response support to disaster areas, supports the National Disaster Medical System, and provides urban search and rescue teams for disaster victims in confined spaces.

The division also coordinates federal disaster assistance programs. The Public Assistance Grant Program (PA) that provides 75% grants for mitigation projects to protect eligible damaged public and private non-profit facilities from future damage. "Minimization" grants at 100% are available through the Individuals and Family Grant Program. The Hazard Mitigation Grant Program and the Fire Management Assistance Grant Program are also administered by this division.

### **Computer Sciences Corporation**

New England Regional Insurance Manager  
Bureau and Statistical Office  
(781) 848-1908

Corporate Headquarters  
3170 Fairview Park Drive  
Falls Church, VA 22042  
(703) 876-1000  
<http://www.csc.com/>

A private company contracted by the Federal Insurance Administration as the National Flood Insurance Program Bureau and Statistical Agent, CSC provides information and assistance on flood insurance, including handling policy and claims questions, and providing workshops to leaders, insurance agents, and communities.

### **Small Business Administration**

Region I  
10 Causeway Street, Suite 812  
Boston, MA 02222-1093  
(617) 565-8416  
<http://www.sba.gov/>

SBA has the authority to "declare" disaster areas following disasters that affect a significant number of homes and businesses, but that would not need additional assistance through FEMA. (SBA is triggered by a FEMA declaration, however.) SBA can provide additional low-interest funds (up to 20% above what an eligible applicant would "normally" qualify for) to install mitigation measures. They can also loan the cost of bringing a damaged property up to state or local code requirements. These loans can be used in combination with the new "mitigation insurance" under the NFIP, or in lieu of that coverage.

### **Environmental Protection Agency**

Region I  
1 Congress Street, Suite 1100  
Boston, MA 02114-2023  
(888) 372-7341

Provides grants for restoration and repair, and educational activities, including:

- ☐ *Capitalization Grants for State Revolving Funds*: Low interest loans to governments to repair, replace, or relocate wastewater treatment plans damaged in floods. Does not apply to drinking water or other utilities.

- ❑ *Clean Water Act Section 319 Grants*: Cost-share grants to state agencies that can be used for funding watershed resource restoration activities, including wetlands and other aquatic habitat (riparian zones). Only those activities that control non-point pollution are eligible. Grants are administered through the CT DEP, Bureau of Water Management, Planning and Standards Division.

### **U.S. Department of Housing and Urban Development**

20 Church Street, 19<sup>th</sup> Floor  
Hartford, CT 06103-3220  
(860) 240-4800  
<http://www.hud.gov/>

The U.S. Department of Housing and Urban Development offers *Community Development Block Grants (CDBG)* to communities with populations greater than 50,000, who may contact HUD directly regarding CDGB. One program objective is to improve housing conditions for low and moderate income families. Projects can include acquiring floodprone homes or protecting them from flood damage. Funding is a 100% grant; can be used as a source of local matching funds for other funding programs such as FEMA's "404" Hazard Mitigation Grant Program. Funds can also be applied toward "blighted" conditions, which is often the post-flood condition. A separate set of funds exists for conditions that create an "imminent threat." The funds have been used in the past to replace (and redesign) bridges where flood damage eliminates police and fire access to the other side of the waterway. Funds are also available for smaller municipalities through the state-administered CDBG program participated in by the State of Connecticut.

### **U.S. Army Corps of Engineers**

Institute for Water Resources  
7701 Telegraph Road  
Alexandria, VA 22315  
(703) 428-8015  
<http://www.iwr.usace.army.mil/>

The Corps provides 100% funding for floodplain management planning and technical assistance to states and local governments under the Floodplain Management Services Program (FPMS). Various flood protection measures such as beach renourishment, stream clearance and snagging projects, floodproofing, and flood preparedness are funded on a 50/50 matching basis by Section 22 planning Assistance to States program. They are authorized to relocate homes out of the floodplain if it proves to be more cost effective than a structural flood control measure.

**U.S. Department of Commerce***National Weather Service*

Northeast River Forecast Center  
445 Myles Standish Blvd.  
Taunton, MA 02780  
(508) 824-5116  
<http://www.nws.noaa.gov/>

The National Weather Service prepares and issues flood, severe weather, and coastal storm warnings. Staff hydrologists can work with communities on flood warning issues and can give technical assistance in preparing flood warning plans.

**U.S. Department of the Interior***National Park Service*

Steve Golden, Program Leader  
Rivers, Trails, & Conservation Assistance  
15 State Street  
Boston, MA 02109  
(617) 223-5123  
<http://www.nps.gov/rtca/>

The National Park Service provides technical assistance to community groups and local, state, and federal government agencies to conserve rivers, preserve open space, and develop trails and greenways as well as identify nonstructural options for floodplain development.

**U.S. Fish and Wildlife Service**

New England Field Office  
70 Commercial Street, Suite 300  
Concord, NH 03301-5087  
(603) 223-2541  
<http://www.fws.gov/>

The U.S. Fish and Wildlife Service provides technical and financial assistance to restore wetlands and riparian habitats through the North American Wetland Conservation Fund and Partners for Wildlife programs. It also administers the *North American Wetlands Conservation Act Grants Program*, which provides matching grants to organizations and individuals who have developed partnerships to carry out wetlands projects in the United States, Canada, and Mexico. Funds are available for projects focusing on protecting, restoring, and/or enhancing critical habitat.

**U.S. Department of Agriculture**

*Natural Resources Conservation Service* (formerly SCS)

Connecticut Office

344 Merrow Road, Suite A

Tolland, CT 06084-3917

(860) 871-4011

The Natural Resources Conservation Service provides technical assistance to individual landowners, groups of landowners, communities, and soil and water conservation districts on land use and conservation planning, resource development, stormwater management, flood prevention, erosion control and sediment reduction, detailed soil surveys, watershed/river basin planning and recreation, and fish and wildlife management. Financial assistance is available to reduce flood damage in small watersheds and to improve water quality. Financial assistance is available under the Emergency Watershed Protection Program, the Cooperative River Basin Program, and the Small Watershed Protection Program.

**Regional Resources****Northeast States Emergency Consortium**

1 West Water Street, Suite 205

Wakefield, MA 01880

(781) 224-9876

<http://www.serve.com/NESEC/>

The Northeast States Emergency Consortium (NESEC) develops, promotes, and coordinates "all-hazards" emergency management activities throughout the northeast. NESEC works in partnership with public and private organizations to reduce losses of life and property. They provide support in areas including interstate coordination and public awareness and education, along with reinforcing interactions between all levels of government, academia, nonprofit organizations, and the private sector.

## **State Resources**

### **Connecticut Department of Economic and Community Development**

505 Hudson Street  
Hartford, CT 06106-7106  
(860) 270-8000  
<http://www.ct.gov/ecd/>

The Connecticut Department of Economic and Community Development administers HUD's State CDBG Program, awarding smaller communities and rural areas grants for use in revitalizing neighborhoods, expanding affordable housing and economic opportunities, and improving community facilities and services.

### **Connecticut Department of Environmental Protection**

79 Elm Street  
Hartford, CT 06106-5127  
(860) 424-3000  
<http://www.dep.state.ct.us/>

The Connecticut DEP includes several divisions with various functions related to hazard mitigation:

*Bureau of Water Management, Inland Water Resources Division* - This division is generally responsible for flood hazard mitigation in Connecticut, including administration of the National Flood Insurance Program. Other programs within the division include:

- ❑ *National Flood Insurance Program State Coordinator*: Provides flood insurance and floodplain management technical assistance, floodplain management ordinance review, substantial damage/improvement requirements, community assistance visits, and other general flood hazard mitigation planning including the delineation of floodways.
- ❑ *State Hazard Mitigation Officer (shared role with the Department of Emergency Management and Homeland Security)*: Hazard mitigation planning and policy; oversight of administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program. Has the responsibility of making certain that the Natural Hazard Mitigation Plan is updated every three years.
- ❑ *Flood Warning and Forecasting Service*: Prepares and issues flood, severe weather, and coastal storm warnings. Staff engineers and forecaster can work with communities on flood warning issues and can give technical assistance in

preparing flood warning plans. This service has helped the public respond much faster in flooding condition.

- ❑ *Flood & Erosion Control Board Program:* Provides assistance to municipalities to solve flooding, beach erosion, and dam repair problems. Have the power to construct and repair flood and erosion management systems. Certain nonstructural measures that mitigate flood damages are also eligible. Funding is provided to communities that apply for assistance through a Flood & Erosion Control Board on a noncompetitive basis.
- ❑ *Stream Channel Encroachment Line Program:* Similar to the NFIP, this state regulatory program places restrictions on the development of floodplains along certain major rivers. This program draws in environmental concerns in addition to public safety issues when permitting projects.
- ❑ *Inland Wetlands and Watercourses Management Program:* Provides training, technical, and planning assistance to local Inland Wetlands Commissions, reviews and approves municipal regulations for localities. Also controls flood management and natural disaster mitigations.
- ❑ *Dam Safety Program:* Charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. Regulates the operation and maintenance of dams in the state. Permits the construction, repair or alteration of dams, dikes or similar structures and maintains a registration database of all known dams statewide. This program also operates a statewide inspection program.
- ❑ *Rivers Restoration Grant Program:* Administers funding and grants under the Clean Water Act involving river restoration and reviews and provides assistance with such projects.

*Bureau of Water Management - Planning and Standards Division* - Administers the Clean Water Fund and many other programs directly and indirectly related to hazard mitigation including the Section 319 nonpoint source pollution reduction grants and municipal facilities program which deals with mitigating pollution from wastewater treatment plants.

*Office of Long Island Sound Programs (OLISP)* - Administers the Coastal Area Management Act (CAM) program and Long Island Sound License Plate Program.

**Connecticut Department of Emergency Management and Homeland Security**

25 Sigourney Street, 6<sup>th</sup> Floor

Hartford, CT 06106-5042

(860) 256-0800

<http://www.ct.gov/demhs/>

DEMHS is the lead agency responsible for emergency management. Specifically, responsibilities include emergency preparedness, response and recovery, mitigation, and an extensive training program. DEMHS is the state point of contact for most FEMA grant and assistance programs. DEMHS administers the Earthquake and Hurricane programs described above under the FEMA resource section. Additionally, DEMHS operates a mitigation program to coordinate mitigation throughout the state with other government agencies.

**Connecticut Department of Public Safety**

1111 Country Club Road

Middletown, CT 06457

(860) 685-8190

<http://www.ct.gov/dps/>

*Office of the State Building Inspector* - The Office of the State Building Inspector is responsible for administering and enforcing the Connecticut State Building Code and is also responsible for the municipal Building Inspector Training Program.

**Connecticut Department of Transportation**

2800 Berlin Turnpike

Newington, CT 06131-7546

(860) 594-2000

<http://www.ct.gov/dot/>

The Department of Transportation administers the federal Intermodal Surface Transportation Efficiency Act (ISTEA) that includes grants for projects that promote alternative or improved methods of transportation. Funding through grants can often be used for projects with mitigation benefits such as preservation of open space in the form of bicycling and walking trails. CT DOT is also involved in traffic improvements and bridge repairs that could be mitigation related.

### **Private and Other Resources**

#### **Association of State Dam Safety Officials**

450 Old Vine Street  
Lexington, KY 40507  
(859) 257-5140  
<http://www.damsafety.org>

ASDSO is a non-profit organization of state and federal dam safety regulators, dam owners/operators, dam designers, manufacturers/suppliers, academia, contractors and others interested in dam safety. Their mission is to advance and improve the safety of dams by supporting the dam safety community and state dam safety programs, raising awareness, facilitating cooperation, providing a forum for the exchange of information, representing dam safety interests before governments, providing outreach programs, and creating an unified community of dam safety advocates.

#### **The Association of State Floodplain Managers (ASFPM)**

2809 Fish Hatchery Road, Suite 204  
Madison, WI 53713  
(608) 274-0123  
<http://www.floods.org/>

ASFPM is a professional association of state employees that assist communities with the NFIP with a membership of over 1,000. ASFPM has developed a series of technical and topical research papers and a series of Proceedings from their annual conferences. Many "mitigation success stories" have been documented through these resources and provide a good starting point for planning.

#### **Institute for Business & Home Safety**

4775 East Fowler Avenue  
Tampa, FL 33617  
(813) 286-3400  
<http://www.ibhs.org/>

A nonprofit organization put together by the insurance industry to research ways of reducing the social and economic impacts of natural hazards. The Institute advocates the development and implementation of building codes and standards nationwide and may be a good source of model code language.

**Multidisciplinary Center for Earthquake Engineering and Research (MCEER)**

University at Buffalo  
State University of New York  
Red Jacket Quadrangle  
Buffalo, New York 14261  
(716) 645-3391  
<http://mceer.buffalo.edu/>

A source for earthquake statistics, research, and for engineering and planning advice.

**The National Association of Flood & Stormwater Management Agencies (NAFSMA)**

1301 K Street, NW, Suite 800 East  
Washington, DC 20005  
(202) 218-4122  
<http://www.nafsma.org>

NAFSMA is an organization of public agencies who strive to protect lives, property, and economic activity from the adverse impacts of stormwater by advocating public policy, encouraging technology, and conducting educational programs. NAFSMA is a voice in national politics on water resources management issues concerning stormwater management, disaster assistance, flood insurance, and federal flood management policy.

**National Emergency Management Association (NEMA)**

P.O. Box 11910  
Lexington, KY 40578  
(859)-244-8000  
<http://www.nemaweb.org/>

A national association of state emergency management directors and other emergency management officials, the NEMA Mitigation Committee is a strong voice to FEMA in shaping all-hazard mitigation policy in the nation. NEMA is also an excellent source of technical assistance.

**Natural Hazards Center**

University of Colorado at Boulder  
482 UCB  
Boulder, CO 80309-0482  
(303) 492-6818  
<http://www.colorado.edu/hazards/>

The Natural Hazards Center includes the Floodplain Management Resource Center, a free library and referral service of the ASFPM for floodplain management publications. The Natural Hazards Center is located at the University of Colorado in Boulder. Staff can use keywords to identify useful publications from the more than 900 documents in the library.

**New England Flood and Stormwater Managers Association, Inc. (NEFSMA)**

c/o MA DEM  
100 Cambridge Street  
Boston, MA 02202

NEFSMA is a nonprofit organization made up of state agency staff, local officials, private consultants, and citizens from across New England. NEFSMA sponsors seminars and workshops and publishes the NEFSMA News three times per year to bring the latest flood and stormwater management information from around the region to its members.

***Volunteer Organizations*** - Volunteer organizations including the American Red Cross, the Salvation Army, Habitat for Humanity, and the Mennonite Disaster Service are often available to help after disasters. Service Organizations such as the Lions Club, Elks Club, and the Veterans of Foreign Wars are also available. Habitat for Humanity and the Mennonite Disaster Service provide skilled labor to help rebuild damaged buildings while incorporating mitigation or floodproofing concepts. The office of individual organizations can be contacted directly or the FEMA Regional Office may be able to assist.

***Flood Relief Funds*** - After a disaster, local businesses, residents, and out-of-town groups often donate money to local relief funds. They may be managed by the local government, one or more local churches, or an ad hoc committee. No government disaster declaration is needed. Local officials should recommend that the funds be held until an applicant exhausts all sources of public disaster assistance, allowing the funds to be used for mitigation and other projects that cannot be funded elsewhere.

***Americorps*** - Americorps is the National Community Service Organization. It is a network of local, state, and national service programs that connects volunteers with nonprofits, public agencies, and faith-based and community organizations to help meet

our country's critical needs in education, public safety, health, and the environment. Through their service and the volunteers they mobilize, AmeriCorps members address critical needs in communities throughout America, including helping communities respond to disasters. Some states have trained Americorps members to help during flood-fight situations such as by filling and placing sandbags.

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## APPENDED TABLES

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## Appended Table 1 Hazard Event Ranking

*Each hazard may have multiple effects; for example, a hurricane causes high winds and inland flooding. Some hazards may have similar effects; for example, hurricanes and earthquakes may cause dam failure.*

Natural Hazards	Location	Frequency of Occurrence	Magnitude / Severity	Rank
	1 = small 2 = medium 3 = large	0 = unlikely 1 = possible 2 = likely 3 = highly likely	1 = limited 2 = significant 3 = critical 4 = catastrophic	
Winter Storms	3	3	2	8
Hurricanes	3	1	3	7
Summer Storms and Tornadoes	2	3	2	7
Earthquakes	3	1	2	6
Wildfires	1	2	1	4

### Location

1 = small	isolated to specific area during one event
2 = medium	multiple areas during one event
3 = large	significant portion of the town during one event

### Frequency of Occurrence

0 = unlikely	less than 1% probability in the next 100 years
1 = possible	between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely	between 10 and 100% probability in the next year; or at least one chance in next 10 years
3 = highly likely	near 100% probability in the next year

### Magnitude / Severity

1 = limited	injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant	injuries and / or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical	injuries and / or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

*Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA National Climatic Data Center*

**Appended Table 2  
Hazard Effect Ranking**

*Some effects may have a common cause; for example, a hurricane causes high winds and inland flooding.  
Some effects may have similar causes; for example, hurricanes and nor'easters both cause heavy winds.*

Natural Hazard Effects	Location	Frequency of Occurrence	Magnitude / Severity	Rank
	1 = small 2 = medium 3 = large	0 = unlikely 1 = possible 2 = likely 3 = highly likely	1 = limited 2 = significant 3 = critical 4 = catastrophic	
Blizzard	3	3	2	8
Nor'Easter Winds	3	3	2	8
Snow	3	3	2	8
Hurricane Winds	3	1	3	7
Ice	3	2	2	7
Shaking	3	1	2	6
Thunderstorm Winds	2	3	1	6
Tornado Winds	2	1	3	6
Falling Trees/Branches	1	3	1	5
Flooding from Dam Failure	1	1	3	5
Hail	2	2	1	5
Inland Flooding	1	2	2	5
Lightning	1	3	1	5
Fire/Heat	1	2	1	4
Flooding from Poor Drainage	1	2	1	4
Smoke	1	2	1	4

**Location**

1 = small	isolated to specific area during one event
2 = medium	multiple areas during one event
3 = large	significant portion of the town during one event

**Frequency of Occurrence**

0 = unlikely	less than 1% probability in the next 100 years
1 = possible	between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely	between 10 and 100% probability in the next year; or at least one chance in next 10 years
3 = highly likely	near 100% probability in the next year

**Magnitude / Severity**

1 = limited	injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant	injuries and / or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical	injuries and / or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic	multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

*Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA National Climatic Data Center*

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Minimum Lot Areas</b> Zone A: at least 80,000 sf of the 160,000 sf lot area shall exclude 100-year flood hazard areas, defined inland wetlands and watercourses, and steep slopes over 25%. Zone A: Buildings may not be placed in the streambelt zones of the main channels (but not the tributaries) of the Housatonic River and the Tenmile River. Zone B: the minimum lot area of 80,000 sf shall exclude 100-year flood hazard areas, defined inland wetlands and watercourses, and steep slopes over 25%.	331.3 <input type="checkbox"/> 331.5 <input type="checkbox"/> 332.3 <input type="checkbox"/>			
<b>Earth Material Operations</b> Earth material operations shall not affect natural drainage onto or from adjacent property.	358.1 <input type="checkbox"/>			
<b>Establishment of the Floodplain Management</b> A development permit shall be required in performance with the provisions of this ordinance prior to the commencement of any development activities.		Pg. 6 <input type="checkbox"/>		
<b>Permit Procedures</b> Application for a zoning permit shall be made to the Land Use Enforcement Officer on forms furnished by him or her prior to any development activities.		Pg. 6 <input type="checkbox"/>		
<b>Provisions for Flood Hazard Reduction</b> New construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure. New construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage. New construction and substantial improvements shall be constructed by methods and practices that minimize flood damage. Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding. New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.		1.1.1 <input type="checkbox"/> 1.1.2 <input type="checkbox"/> 1.1.3 <input type="checkbox"/> 1.1.4 <input type="checkbox"/> 1.1.5 <input type="checkbox"/>		

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Provisions for Flood Hazard Reduction (Continued)</b> <p>New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the system into flood waters.</p> <p>On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding.</p> <p>In any portion of a watercourse which is altered or re-located, the flood carrying capacity shall be maintained.</p> <p>A structure already in compliance with the provisions of this ordinance shall not be made non-compliant by any alteration, repair, reconstruction, or improvement to the structure.</p> <p>New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated at least to the base flood elevation.</p> <p>Fully enclosed areas below the base flood elevation (flood vents) or floodproofing is NOT allowed for non-residential structures.</p> <p>All new manufactured homes or those undergoing substantial improvement or repair shall be elevated so that the bottom of the lowest floor is at or above the base flood elevation.</p> <p>Manufactured homes shall be placed on a permanent foundation which itself is securely anchored so that it will resist flotation, lateral movement, and hydrostatic pressures.</p> <p>All manufactured homes shall be installed using methods and practices which minimize flood damage, and adequate access and drainage should be provided.</p> <p>No encroachments, including fill, new construction, substantial improvements, or other development in floodways unless certification by a registered professional engineer demonstrating that encroachments shall NOT result in ANY increase in flood levels during occurrence of the base flood discharge.</p> <p>Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.</p> <p>Any applicant to whom a variance is granted from the ordinance shall be given written notice that the structure will be permitted to be built with the lowest floor elevation below the base flood elevation, and that the cost of flood insurance will be commensurate with the increased risk resulting from the lowest floor elevation.</p>		<div>1.1.6</div> <div>1.1.7</div> <div>1.1.8</div> <div>1.1.9</div> <div>1.2.1a</div> <div>1.2.1a</div> <div>1.2.1b</div> <div>1.2.1b</div> <div>1.2.1b</div> <div>1.2.2</div> <div>1.2.3</div> <div>1.2.4</div>		

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Standards for Subdivision Proposals</b> All subdivision proposals shall be consistent with the need to minimize flood damage. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood hazards. In Zone A, base flood elevation data shall be provided for subdivision proposals and other proposed development which are five acres or fifty lots, whichever ever occurs first.		2.1 <input type="checkbox"/> 2.2 <input type="checkbox"/> 2.3 <input type="checkbox"/> 2.4 <input type="checkbox"/>		
<b>Equal Conveyance</b>  Within the floodplain, encroachments resulting from filling, new construction or substantial improvements involving an increase in footprint of the structure, shall be prohibited unless the applicant provides certification by a registered professional engineer demonstrating that such encroachments shall NOT result in ANY increase in flood levels. Work within the floodplain and the land adjacent to the floodplain, including work to provide compensatory storage, shall not be constructed in such a way as to cause an increase in flood stage or flood velocity.		Pg. 9 <input type="checkbox"/>		
<b>Compensatory Storage</b>  The water holding capacity of the floodplain shall not be reduced. Any reduction caused by filling, new construction or substantial improvements involving an increase in footprint to the structure, shall be compensated for by deepening and/or widening the floodplain. Storage shall be provided on-site unless easements have been gained from adjacent property owners; it shall be provided within the same hydraulic reach and a volume not previously used for storage; it shall be hydraulically comparable and incrementally equal to the theoretical volume of flood water at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory storage shall have an unrestricted hydraulic connection to the same waterway or water body. Compensatory storage can be provided off-site if approved by the municipality.		Pg. 9 <input type="checkbox"/> Pg. 9 <input type="checkbox"/>		

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Aboveground Storage Tanks</b> Above-ground storage tanks (oil, propane, etc.) which are located outside or inside of the structure must either be elevated above the base flood elevation on a concrete pad or be securely anchored with tie-down straps to prevent flotation or lateral movement, have the fill pipe extended above the base flood elevation, and have a screw fill cap that does not allow for the infiltration of flood water.		Pg. 9 & Pg. 10 <div></div>		
<b>Portion of Structure in Flood Zone</b> If any portion of a structure lies within the special flood hazard area, the entire structure is considered to be in the special flood hazard area. The entire structure must meet the requirements of the flood zone. The structure includes any attached additions, garages, decks, sunrooms, or any other structure attached to the main structure. Decks or porches that extend into the more restrictive flood zone will require the entire structure to meet the standards of the more restrictive zone.		Pg. 10 <div></div>		
<b>Structures in Two Flood Zones</b> If a structure lies within two or more flood zones, the construction standards of the most restrictive zone apply to the entire structure. The structure includes any attached additions, garages, decks, sunrooms, or any other structure attached to the main structure.		Pg. 10 <div></div>		
<b>No Structures Entirely or Partially Over Water</b> New construction, substantial improvements and repair to structures that have sustained substantial damage cannot be constructed or located entirely or partially over water unless it is a functionally dependent use or facility.		Pg. 10 <div></div>		
<b>Certification of Professional Engineer</b> Any subdivision plan must contain a written statement from a professional engineer licensed in the State of Connecticut either upon the final subdivision map or in a report appended thereto, certifying that in lots contiguous to brooks, rivers, bodies of water and other areas subject to flooding, adequate provisions have been made for drainage and flood control; ... and that if any portion of the proposed subdivision lies within a floodplain designated by state or federal or state regulation, the applicable portion of such regulation have been met.			3(d)(2) <div></div>	

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Storm Water Drainage</b>  A subdivision plan shall contain a system for storm water drainage in any location where development activity might otherwise create a condition of accelerated erosion, as defined by the Soil Erosion and Sediment Control Regulations of the Town of Sherman. No wetland or watercourse shall be altered or obstructed for this purpose without the approval of the Sherman Inland Wetlands & Watercourses Commission. In a subdivision plan, the Commission may require culverts and other storm drainage installations, and also easements necessary for the effective functioning of the system.			3(e) <div></div>	
<b>Utilities</b> All electric, telephone, cable television and other utilities lines and cables shall be placed underground and buried. Utility structures servicing a subdivision that require aboveground placement may be constructed only if approved by the Commission.			3(f) <div></div>	
<b>Roads</b>  All accessway culverts, underdrains, curtain drains, and storm sewers shall be of a size and type determined by a qualified professional engineer, but in no case shall culvert pipes be less than fifteen inches in diameter, and underdrains and curtain drains shall be no less than six inches in diameter. Pipe material shall be approved by the Board of Selectmen or their agent and installed in accordance with sound engineering practice. Sufficient pipe shall be installed within any subdivision to carry existing watercourses and to drain the proposed accessways.  No dead-end accessway shall be considered unless a turnaround approved by the Board of Selectmen is provided within a right of way of not less than one-hundred feet in diameter. The construction of all dead-end accessways shall conform in every detail to all provisions of this section that apply to through streets and roadways.			4(e)(12) <div></div> 4(e)(16) <div></div>	

***Appended Table 3***  
***Development Permit Checklist for Hazard Mitigation***  
***and Effective Emergency Management***

	Zoning Regulations	Revised Federal Flood Insurance Program Ordinance	Subdivision Regulations	Inland Wetland Regulations
<b>Requirements for Subdivision Plan</b> Subdivision plans must include lines showing the 100-year flood hazard area as shown on maps prepared by FEMA which are on file in the Town Clerk's office.  Where road construction is part of the proposed subdivision, subdivision plans must include road profiles drawn to the standards of the Board of Selectmen, and a drainage analysis map showing the tributary watershed area and downstream area affected by runoff. Drainage computations shall consider the entire watershed area.			6(a)(16) <input type="checkbox"/>  6(b) <input type="checkbox"/>	
<b>Standards and Criteria for Decision - Environmental Impact</b> The agency may consider the environmental impact of the proposed activity, including the effects on the inland wetland's and/or watercourse's capacity...to prevent flooding, ...to control sediment, to facilitate drainage...				10.3 (a) <input type="checkbox"/>
<b>Standards and Criteria for Decision - Public Health, Safety, and Use</b> The agency may consider the potential damage from erosion and flooding downstream of the activity site.				10.3 (e) <input type="checkbox"/>
<b>Standards and Criteria for Decision - Detailed Parameters</b>  The agency may consider the ability of the area in which the regulated activity occurs to continue to absorb, store, or purify water or to prevent flooding, and the projected effect on the water table and drainage patterns. The effect of any material to be removed or deposited on flood control, water supply and quality, and aquatic organisms. Changes in the volume, velocity, temperature, or course of a waterway and the resulting effects on plants, animals, and aquatic life. Importance of the area to the region with respect to water supply, water purification, flood control, natural habitat, and recreation. The function of the area as part of the natural drainage system for the watershed.				10.4 (a) <input type="checkbox"/> 10.4 (b) <input type="checkbox"/> 10.4 (f) <input type="checkbox"/> 10.4 (i) <input type="checkbox"/> 10.4 (m) <input type="checkbox"/>

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**APPENDIX A**  
**STAPLEE MATRIX**

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Strategies Listed by Primary Report Section for Sherman	Associated Report Sections							Category	Responsible Department <sup>1</sup>	Schedule	Federal Funding Potential (Unlikely, Possible, or Likely and Grant Program)	Weighted STAPLEE Criteria <sup>2</sup>																Total STAPLEE Score								
	Flooding	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Earthquakes	Dam Failure	Wildfires					Benefits								Costs																
												Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal									
ALL HAZARDS																																				
Dissemination of informational pamphlets regarding natural hazards to public locations	x	x	x	x	x	x	x	1,2,5	OEM	B	Unlikely	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Add pages to Town website dedicated to citizen education and preparation for natural hazard events	x	x	x	x	x	x	x	1,2,5	OEM	B	Unlikely	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Consider implementation of an enhanced emergency notification system such as CodeRED	x	x	x	x	x	x	x	1,2,5	First Selectman	C	N/A	1	1	1	1	1	0	0	6	0	0	0	0	0	0	-1	0	-2	4							
Post a list of Town sheltering facilities in public locations and on the Town's website	x	x	x	x	x	x	x	1, 5	OEM	B	N/A	1	0	1	1	1	1	0	6	0	0	0	0	0	0	0	0	6								
Advertise the location of emergency shelters online, in local municipal buildings, and use TV, newspapers and radio prior to hazard event	x	x	x	x	x	x	x	5	OEM	B	N/A	1	0	1	1	1	1	0	6	0	0	0	0	0	0	0	0	6								
Upgrade emergency communications as necessary to ensure adequate communication with all areas of Town and neighbors	x	x	x	x	x	x	x	2,3	OEM	B	Possible - CEDAP, IECGP	1	1	1	1	1	1	1	9	0	0	0	0	0	-1	0	0	-1	8							
Consider upgrading the unpaved portions of Jericho Road North to provide additional egress north from the Town Center	x	x	x	x	x	x	x	1	First Selectman	C	Unlikely	0	0	1	0	0	0	0	1	-1	-1	0	-1	-1	-1	0	-7	-6								
Encourage residents to purchase and use NOAA weather radio with an alarm feature	x	x	x	x	x	x	x	2,5	OEM	B	N/A	1	1	1	0	0	0	0	4	0	0	0	0	0	0	0	0	4								
Continue to review and update Emergency Operations Plan, at least once annually	x	x	x	x	x	x	x	1	OEM	A	N/A	1	0	0	1	1	1	0	5	0	0	0	0	0	0	0	0	5								
Review potential evacuation routes to ensure timely migration and post evacuation in public locations and on the Town's website	x	x	x	x	x	x	x	1, 5	OEM	B	N/A	1	0	1	1	1	1	0	6	0	0	0	0	0	0	0	0	6								
Consider modifying the Plan of Conservation and Development and Subdivision Regulations to encourage two modes of egress into new neighborhoods	x	x	x	x	x	x	x	1, 2	PZC	B	N/A	0	1	1	0	1	0	0	4	0	0	0	-1	-1	0	0	-2	2								
Continue reviewing subdivision applications to ensure proper access for emergency vehicles	x	x	x	x	x	x	x	1, 2	PZC	A	N/A	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Continue to encourage property owners to widen roads to facilitate emergency vehicle access	x	x	x	x	x	x	x	1, 2	LUC	A	N/A	1	1	1	0	0	0	0	4	0	0	-1	-1	-1	0	0	-3	1								
Continue to require that utilities be placed underground in new developments	x	x	x	x		x	x	1, 2	PZC	A	N/A	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Pursue funding to place utilities underground in existing developments	x	x	x	x		x	x	1, 2	LUC	B	Unlikely - HMA	1	1	1	0	0	0	0	4	0	0	0	-1	-1	-1	0	-4	0								
INLAND FLOODING																																				
Prevention, Property Protection & Natural Resource Protection																																				
Continue to regulate activities within SFHAs	x	x	x	x		x		1	PZC	A	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Consider requiring new buildings in flood prone areas to be protected to the highest recorded flood level regardless of SFHA	x	x	x	x		x		1, 2	PZC	B	N/A	0	1	1	0	0	0	0	3	0	0	0	-1	-1	0	0	-2	1								
Require that new buildings be designed and graded to shunt drainage away from the building	x	x	x	x		x		1, 2	PZC	B	N/A	0	1	1	1	0	0	0	4	0	0	0	0	-1	0	0	-1	3								
Require developers to support whether detention or retention of storm water is the best option for developments	x	x	x	x				1	PZC	B	N/A	1	1	1	1	0	1	0	7	0	0	0	0	-1	0	0	-1	6								
Compile a checklist for applicants that cross-references the bylaws, regulations, and codes related to flood damage prevention	x	x	x	x		x		1, 5	LUC	B	N/A	1	0	1	1	1	1	0	6	0	0	0	0	0	0	0	0	6								
Acquire open space properties within SFHAs and set aside as greenways, parks, or other non-developed use	x	x	x	x		x		2,3	First Selectman	A	Possible - HMA	1	1	1	1	1	1	1	9	0	0	0	0	0	-1	0	-2	7								
Selectively pursue conservation objectives listed in the Plan of Conservation & Development and other plans	x	x	x	x		x		3	First Selectman	A	N/A	1	0	0	1	1	1	1	6	0	0	0	0	0	0	0	0	6								
Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains	x	x	x	x	x	x	x	1, 3	PZC, IWC	A	N/A	1	1	0	1	1	1	1	8	0	0	0	0	0	0	0	0	8								
Provide outreach regarding flood barriers, dry flood proofing, and wet flood proofing techniques to private homeowners	x	x	x	x		x		2, 4, 5	LUC	B	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Structural Projects																																				
Pursue funding to repair the bridge on Old Greenwood's Road Extension over Tollgate Brook	x	x	x	x		x		4	First Selectman	B	Unlikely - HMA	0	0	1	1	1	1	0	5	0	0	0	0	0	-1	0	-2	3								
Monitor culverts and pursue/allocate funding when repairs are necessary	x	x	x	x		x		4	DPW	A	Unlikely	1	1	1	1	1	0	0	6	0	0	0	0	0	0	0	0	6								
Conduct engineering studies as needed to redefine bridges suspected of being undersized, and pursue funding to resize if necessary	x	x	x	x		x		1, 4	DPW	B, C	Unlikely	1	1	1	1	1	0	0	6	0	0	-1	0	0	0	0	-1	5								
Encourage the State DOT to perform more frequent catch basin cleanouts of Route 39	x	x	x	x		x		4	First Selectman	B	Unlikely	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Reevaluate the drainage computations for culverts on public dead-end roads and resize if necessary	x	x	x	x		x		1, 4	DPW	B, C	Unlikely - HMA	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Encourage private communities to reevaluate the drainage computations for their culverts	x	x	x	x		x		1, 4	First Selectman	B, C	Unlikely	1	1	1	1	1	0	0	6	0	0	0	0	0	0	0	0	6								
WIND DAMAGE RELATED TO HURRICANES, SUMMER STORMS, AND WINTER STORMS																																				
Continue tree limb inspections and maintenance, especially along evacuation routes, and outreach to private property owners		x	x	x	x			1,2	DPW	A	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Continue to require compliance with the Connecticut Building Code for Wind Speeds		x	x	x				1, 2	PZC, LUC	A	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Encourage the use of structural mitigation techniques in new structures to protect new buildings to a higher than required standard		x	x	x	x			1	PZC, LUC	B	Possible - HMA	1	1	1	1	0	0	0	5	0	0	0	0	0	0	0	0	5								
Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards		x	x	x	x			1, 5	LUC	B	Unlikely	1	0	1	1	1	1	0	6	0	0	0	0	0	0	0	0	6								
WINTER STORMS																																				
Continue to provide information on the dangers of cold-related hazards				x				5	OEM	A	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Consider prioritizing plowing routes and post the snow plowing prioritization in Town buildings each winter				x				1, 5	DPW	B	N/A	1	0	0	1	1	0	0	3	0	0	0	0	0	0	0	0	3								
Provide information for mitigating icing, insulating pipes, and retrofits for flat roofed buildings				x				5	LUC	B	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
EARTHQUAKES																																				
Consider preventing residential development in areas prone to collapse, such as below steep slopes, or liquefaction					x			1	PZC	B	N/A	1	1	1	0	0	0	1	5	0	0	0	-1	0	0	0	-1	4								
Continue to require adherence to the state building codes		x	x	x	x			1, 2	PZC	A	N/A	1	1	0	1	1	1	0	7	0	0	0	0	0	0	0	0	7								
Ensure that municipal departments and critical facilities have adequate backup equipment (i.e. generators) in case damage occurs	x	x	x	x	x	x	x	1	OEM	B	Unlikely - SCG, CEDAP	0	0	1	0	0	0	0	1	0	0	0	-1	0	-1	0	-3	-2								
DAM FAILURE																																				
Stay current on the evolution of EOPs and Dam Failure Analyses for significant hazard dams that can impact Sherman	x				x	x		1, 5	OEM	A	Unlikely	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1								
Consider implementing Town inspections of Class A, AA, BB, and unranked dams	x				x	x		2, 3	First Selectman	B	N/A	0	1	0	0	0	0	0	2	-1	-1	0	-1	-1	-1	0	-7	-5								
If an enhanced emergency notification system is acquired, include dam failure inundation areas in database	x				x	x		1, 5	OEM	C	Unlikely	1	1	1	1	1	1	0	8	0	0	0	0	0	0	0	0	8								
Have copies of the dam EOPs and Dam Failure Analyses on file at the Town Hall for public viewing					x			5	OEM	B	N/A	0	0	1	0	1	1	0	4	0	0	0	0	0	0	0	0	4								
Utilize the Flood and Erosion Control Board to oversee municipal dam maintenance and problems with flooding and erosion	x	x	x	x		x		1,2,3,4	First Selectman	B	N/A	0	1	1	1	1	1	1	8	0	0	0	0	0	0	0	0	8								

Strategies Listed by Primary Report Section for Sherman	Associated Report Sections							Category	Responsible Department <sup>1</sup>	Schedule	Federal Funding Potential (Unlikely, Possible, or Likely and Grant Program)	Weighted STAPLEE Criteria <sup>2</sup>																Total STAPLEE Score																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	Flooding	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Earthquakes	Dam Failure	Wildfires					Benefits								Costs																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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<sup>1</sup>Notes  
PZC = Planning Commission  
LUC = Land Use Coordinator  
DPW = Department of Public Works  
IWC = Inland Wetlands & Watercourses Commission  
OEM = Office of Emergency Management

<sup>2</sup>Notes  
Beneficial or favorable ranking = 1  
Neutral or Not Applicable ranking = 0  
Unfavorable ranking = -1  
  
Technical and Economic Factors have twice the weight of the remaining categories (i.e. their values are counted twice in each subtotal).

### Prioritization by Listing Benefits and Costs - Structural Projects

Action	Benefits (Pros)	Costs (Cons)	Priority
Pursue additional supplies of fire-fighting water	1) would provide fire protection to areas that don't currently have it	1) Tanks would likely be needed since these areas lack streams and ponds	1
	2) Federal grants can be applied for to implement the improvements	2) If ponds are constructed, there will be regulatory approvals needed	
		3) A town staff member would be required to oversee the project	
		4) May not qualify for grant funding due to small size of the town	
Pursue funding to repair the bridge on Old Greenwood Road Extension over Tollgate Brook	1) Protect three homes from being completely isolated following a severe flood event	1) Fairly expensive - 2010 cost estimate was \$50 - 60K	2
	2) New bridge will have appropriate scour protection measures to prevent undermining	2) Unlikely to qualify for federal funding due to limited reported flooding damages	
	3) Loss of roadway use following minor floods eliminated	3) A town staff member would be necessary to oversee the project	
	4) Federal grants can be applied for to implement the improvements	4) Project would divert town staff from other projects	
	5) Work could be performed by public works		

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**APPENDIX B**  
**DOCUMENTATION OF PLAN DEVELOPMENT**

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***APPENDIX B***  
***PREFACE***

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the town of Sherman as well as to identify areas that should be prioritized for hazard mitigation. Documentation of this process is provided within the following sets of meeting minutes and field reports.

## ***Meeting Minutes***

### **PRE-DISASTER NATURAL HAZARD MITIGATION PLAN FOR SHERMAN Initial Data Collection Meeting May 20, 2010**

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#### ***I. Welcome & Introductions***

The following individuals attended the data collection meeting:

- ☐ David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- ☐ Scott Bighinatti, Milone & MacBroom, Inc.
- ☐ David Hannon, Housatonic Valley Council of Elected Officials (HVCEO)
- ☐ Andrea O'Connor, Sherman First Selectwoman
- ☐ Ron Cooper, Sherman Land Use Enforcement Officer
- ☐ Don Borkowski, Supervisor, Sherman Department of Public Works
- ☐ Dave Raines, Director, Sherman Office of Emergency Management
- ☐ Christine Walsh, Sherman Volunteer Fire Department

#### ***II. Description and Need for Hazard Mitigation Plans / Disaster Mitigation Act of 2000***

Mr. Hannon from HVCEO described the background of the project, which was initiated by Ms. O'Connor's interest in ultimately applying for funding from FEMA grant programs. Mr. Murphy from MMI described the basis for the natural hazard planning process and possible outcomes. Sherman is responsible for a 25% cost share; Andrea noted that this money has been appropriated from the Town budget. HVCEO will provide assistance as needed for the project.

#### ***III. Project Scope and Schedule***

The project scope was described, including project initiation and data collection, the vulnerability assessment, public meetings, development of recommendations, and the FEMA Review and Plan adoption. An aggressive five-month schedule was discussed and selected instead of a longer 12-month schedule.

Ms. O'Connor assigned herself as the primary point of contact for the Town, and Mr. Hannon is the main point of contact for the HVCEO.

The informational public meeting was scheduled for June 11, 2010 at 7:00 PM at the Town Hall. The Friday night meeting will allow weekenders and potentially summer residents to attend. Someone else from the Board of Selectmen will host the public meeting, as Ms. O'Connor will be out of town. Ms. O'Connor will ensure that the press release appears in the two local papers and potentially papers in surrounding towns. The notice will appear in the Citizen News (weekly) and Sentinel (biweekly) papers. Ms. O'Connor will also mention it in her weekly column.

#### ***IV. Hazards to Address***

The Sherman plan will address flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failure, and wildfires. Landslides/rockslides/mass wasting was also discussed as a possible plan section, although depending on the nature of such occurrences this may be combined with another hazard (such as flooding).

HVCEO provided a CD of GIS information for the Town from December 2005. Although some of the parcel mapping may be out of date, it is believed that a significant amount of detailed spatial information is included. MMI can double-check the parcel data against the assessor's mapping if we need to discuss parcel specific data. George Blake at HVCEO is the GIS contact if we have any questions about the data.

#### ***Emergency Response Capabilities & Evacuation Routes***

- ☐ The Sherman Volunteer Fire Department has its own ambulance and medical response staff.
- ☐ There is no regional emergency/evacuation plan. The Town has an Emergency Operations Plan and Mr. Raines will provide a copy electronically. Main evacuation routes include Routes 37, 39, and 55.
- ☐ The biggest emergency response problem in Sherman is poor access to the private lake communities. Roads are narrow, often one way in and out, and have steep grades which impede access by modern fire-fighting and rescue equipment. Grades exceed 15% and widening is often impossible. Pavement has deteriorated in many locations and some roads are unpaved. MMI notes that this situation is similar to the problems addressed in the Bethlehem and Nantucket natural hazard mitigation plans. Some roads have deteriorated because there was no association set up to manage them when they were originally built, and private owners very rarely want to pool money for repairs.
- ☐ The Office of Emergency Management has provided education to the private communities about road and tree maintenance to help ensure adequate access.
- ☐ The Candlewood Lake Authority has a small seasonal police force that is overseen by DEP, but they provide security more than emergency services.
- ☐ The Sherman Volunteer Fire Department had a boat until last year when it was retired from use. The boat needs to be replaced, but getting a new fire truck and building the new Emergency Services Building have budgetary priority. Right now they are relying on mutual aid agreements from other Towns and from the lake communities if

they need boat access. The boat is important because during some emergencies, it can access the lake communities faster and easier than by land.

- ❑ The resident state trooper has a list of contacts for each of the private lake communities if there is a non-emergency issue, but during emergency situations the Office of Emergency Management assists the private communities. All-terrain vehicles (ATV's) have been acquired to assist with emergency access.
- ❑ Mr. Cooper can accompany us if we want to look at problem areas along private roads.

### ***Critical Facilities***

- ❑ A new Emergency Services Building is under construction adjacent to the Town Hall. It should open in late 2010. This building will also serve as the primary emergency shelter and will have a dedicated generator.
- ❑ The current emergency shelter is the Sherman School, which has a generator. It will be the backup shelter once the Emergency Services Building is completed.
- ❑ The Route 39 Highway Department garage is considered a critical facility as it holds Town vehicles and serves as the temporary fire house.
- ❑ The Town Hall is a critical facility due to its status as the current Emergency Operations Center. The Town has a portable generator that is an additional source of power in an emergency.
- ❑ The previous Town Hall is now the Senior Center and could be used as a shelter.
- ❑ The JCC building could potentially be used as a shelter during a large evacuation.
- ❑ The Holy Trinity Church and Sherman Church could also be used as shelters, but more likely would be used as supply distribution and food preparation facilities in the event of a long term emergency. The Holy Trinity Church is the shelter if students at Sherman School are evacuated.
- ❑ The Senior Center has a list containing the addresses of elderly and home-bound persons who need special assistance during an evacuation or emergency.
- ❑ No assisted living facilities are in town. Residents that require such assistance on a daily basis are scattered through the town.

***Zoning, Subdivision, Inland Wetlands Regulations and Other Plans***

- ☐ Regulations were downloaded from the Town website, except for Inland Wetlands and the new Flood Insurance Ordinance (which were acquired at the meeting).
- ☐ The town is just beginning to update the Plan of Conservation and Development.
- ☐ The Town has a Natural Resource Inventory which could help describe water resources and wildfire risk areas. A copy will be provided.
- ☐ The Candlewood Lake Management Plan is a watershed study which may have information relevant to the hazard mitigation plan.
- ☐ The "FirstLight" project has generated controversy regarding its FERC permit in Town and is especially important to residents surrounding Lake Candlewood. Additional information on this project is available on the Town website.

***Noted Flooding and/or Drainage Problem Areas***

- ☐ The private communities in Town received federal funding after Tropical Storm Floyd in 1999, though it may have been helped by congressman intervention. The Town described their status as "quasi-public" in regards to the funding vehicle.
- ☐ A major bridge on the state road washed out during Floyd. (*Route 37 or Route 39?*)
- ☐ Wagon Wheel Road was mentioned as a problem area several times. This bridge washed out in April 2007 when water breached the bridge and undermined the pavement.
- ☐ Many of the dead-end roads have undersized culverts at the intersection end, which presents a problem for emergency access during and after flooding. A list of these roads should be put into the Plan.
- ☐ Ms. O'Connor is very concerned about bridges failing due to flash flooding. A bridge review was done ten years ago. Three culvert replacements have been done recently.
- ☐ Bridge scour from spring floods is a problem in Sherman. If roads are undermined then people could be stranded on dead-end roads.
- ☐ Overtopping is a problem as well along other roads, particularly when culverts become blocked by debris.

- ❑ Saw Mill Road is a dead end that has a bridge that washes out. It has been repaired twice recently and the town is concerned they may have to do a complete rebuild at some point.
- ❑ MMI can return to meet with Mr. Cooper and Mr. Borkowski to discuss specific problem areas related to flooding, flash flooding, wind, winter storms, snow, ice, ice jams, earthquakes, landslides, etc. MMI left a map with Mr. Cooper and Mr. Borkowski for markups.
- ❑ The new FEMA maps will be effective in June 2010 as part of the MapMod program. The Town didn't believe any changes were necessary to the floodplain mapping, and minimal changes are expected once the new maps are effective. The majority of streams and ponds in Town will continue to be mapped as Zone A, while the area near the Housatonic River in the northern part of Town will be Zone AE with a 500-year floodplain.
- ❑ Route 37 overtops near Route 39 due to undersized culverts. *Stream name?*
- ❑ The Town has a paper copy of a watershed and sedimentation study for a cove that may be relevant to flooding and erosion issues.

#### ***Problem Areas for Wind Damage***

- ❑ The town rarely has tree problems. The Town has a Tree Warden and a formal tree maintenance program that addresses most potential problems. Live trees are sometimes an issue, but the Town cleans up downed branches quickly. CL&P reportedly doesn't do a great job with maintenance.
- ❑ There was a severe downburst a few years ago. The Town has a report related to it and will provide a copy.

#### ***Problems Due to Snow and Ice***

- ❑ The CT DOT plows Routes 37, 39, and 55. The Town plows the remaining Town roads, while the private communities hire contractors to plow private roadways.
- ❑ Town personnel described the Town as having microclimates. It can be snowing in the hills and raining in the valley in one part of Town while sunny in the other.
- ❑ Snow is elevation-dependent during storms. As the town has high elevations, it is susceptible to heavy snowfall during winter months. The Town received money from FEMA related to snow plowing operations for heavy storms in January 2005 and February 2006.

- ❑ There are no unusual icing problems in Town. There are many hills in Sherman which can make driving difficult during winter storms, especially on narrow, steeply sloped private roads. Fortunately, many of these roads have seasonal houses that are not occupied during the winter.
- ❑ Some winter storms knock out power, particularly when the storm is accompanied by heavy wind. There were a few notable power outages in the last few years, one was for two days.

### ***Dams***

- ❑ Pepper Pond Dam was cited by the DEP as having maintenance issues. It is a class B dam above Lake Mauweehoo.
- ❑ Rogers Pond Dam (Class B) experienced a breach a few years ago. Mr. Cooper described it as a full failure. DEP is reportedly litigating the owners.
- ❑ There are no Class C (high hazard) dams in Town. It is not believed that there are any upstream in New York or upstream along the Housatonic River.

### ***Wildfires and Fire Protection***

- ❑ The Town believes that there are weaknesses in its fire protection capability.
- ❑ The Town has a color-coded map of fire-risk areas. The location of dry hydrants and water sources (and when those sources have water) and lots of other information such as number of fire calls and types of apparatus are available on the Sherman Fire Department website.
- ❑ Storage tanks or dry hydrants for fire protection are required by ordinance in all new commercial and residential developments as per the subdivision regulations administered by the planning and zoning commission.
- ❑ The Sherman School and the new Emergency Services Building have fire protection tanks.
- ❑ Many private roads are narrow and steep such that access is difficult for modern fire trucks. ATV's and other smaller vehicles are able to access these areas.
- ❑ The Office of Emergency Management will compile a list of problem areas for wildfires and access to fire-fighting water.
- ❑ The levels in Candlewood Lake and other ponds are important to fire protection during the summer months.

### ***Development Trends***

- ❑ Sherman has approximately 4,100 residents.
- ❑ Sherman has many dead-end roads, and many of these roads are relatively long and/or private. Emergency services can be cut off by falling trees or washed out culverts during emergencies. At this time the Town doesn't have any way to regulate this problem.
- ❑ New private roads are regulated by the Town through the subdivision process, so emergency access is not an issue.
- ❑ The Town has approved two subdivisions since 2006. They have yet to be built, and one of them is for sale.
  - "Far View Farms" on the north end of town off Anderson Road (18 homes on 2-acre lots); and
  - "Chapel Hill Estates" (14 lots off Chapel Hill Road).
- ❑ Most new development is in the northern end of town, but the most concentrated development is around Lake Candlewood.
- ❑ The golf course near the Housatonic River has 62 lots approved but only 14 have been built so far.
- ❑ 400-acre "Timber Trails" property in the southern part of town could be developable, but is in watershed that feeds Quaker Brook which drains to the NYC water supply.

### ***VI. Acquisitions***

Inland Wetlands Regulations – July 2009  
GIS CD from HVCOG – December 2005  
Flood Insurance Ordinance – Effective June 2010

Text file of Press Release to the Sentinel - appeared May 28, 2010

Selections from Our Selectmen . . .

Andrea O'Connor, First Selectman

Sherman is on the fast track to complete a Pre-Disaster Natural Hazard Mitigation Plan. Once the plan is in place, the town will be qualified to apply for FEMA grants to address potential hazards identified in the plan.

This work is being funded with a substantial grant from FEMA to HVCEO, Sherman's regional planning organization, plus a 25% cost share of \$7,000 from the Capital Non-Recurring Fund as previously approved by Town Meeting. I had asked HVCEO to apply for this grant to assist Sherman in developing a Hazard Mitigation Plan after receiving numerous requests from FEMA for grant proposals to mitigate natural hazards, only to find that eligibility for these grants required that a FEMA-approved plan be in place. The combined funds will pay for consultants from Milone & MacBroom, Inc., a firm with extensive experience in developing such plans, to create Sherman's plan.

The Hazard Mitigation Plan will cover a broad variety of natural hazards, including areas susceptible to flooding and/or drainage problems, wind and water damage due to hurricanes and tropical storms and well as summer storms and tornadoes, snow and ice hazards, wildfires, and the like. All areas of town will be considered in developing the plan, including private communities and their critical infrastructure, such as roads and bridges. And all areas will be eligible for FEMA funding for hazard mitigation once the plan is in place.

It is critical, then, for those in our community who are aware of potential natural hazards to attend an informational meeting being held on Friday, June 11<sup>th</sup> at 7:00 p.m. at Mallory Town Hall. This meeting will provide an overview of the design of the plan and the process of data collection and analysis. Participants will be invited to contribute to plan development by identifying those hazards of which they are aware so these can be documented and analyzed for inclusion in the plan.

An initial data collection meeting on May 20<sup>th</sup> included Don Borkowski, Public Works Supervisor; Ron Cooper, Land Use Enforcement Officer; David Raines, Emergency Management Director; Christine Walsh, representing the Sherman Volunteer Fire Department; two representatives from Milone & MacBroom, Inc.; and myself. We brainstormed past and potential hazards and began the process of data collection that will contribute to the plan. At that meeting, I opted to set an aggressive five-month schedule for plan completion rather than a longer 12-month schedule. If the plan is approved by FEMA before the end of the year, Sherman would become eligible for FEMA grants targeted to Connecticut after the recent wind and flood damage that occurred along the coast, even though our town was not severely affected by this storm.

Pursuit of this Pre-Disaster Natural Hazard Mitigation Plan fits nicely into the Selectmen's efforts to engage in long-range planning for infrastructure maintenance. For example, I'm certain that the evaluation of bridges being completed by engineer Joe Wren of Indigo-Design will dovetail nicely with the plan, since washouts and overtopping of bridges are a major concern, especially those bridges on the town's many dead-end roads. Residents can easily be stranded if bridge failure undermines a road, as occurred when an April 2007 storm washed out a bridge on Wagon Wheel Road.

Residents are our best source of specific information regarding past and potential hazards, especially those who live in private communities where the town has no formal responsibility for infrastructure maintenance. I urge those with ideas and information to attend the meeting on June 11<sup>th</sup> so that the Hazard Mitigation Plan that emerges truly represents potential natural hazards throughout our town.

# SHERMAN THIS WEEK

## Sherman Community Calendar

May 26- 7:00pm- Public Safety Committee of the CLA Meeting, Candlewood Knolls Club House, New Fairfield.  
 May 27- 7:00pm- BOS Monthly Meeting, Mallory Town Hall  
 June 1- 7:00pm- ZBA Meeting, Mallory Town Hall  
 June 2- 7:00pm- BOE Regular Meeting, Sherman School Cafeteria  
 June 2- 7:30pm- Executive Committee of the CLA Meeting, CLA Office, 30 Bridge St., New Milford  
 June 3- 10:30am- HRRA Meeting, Brookfield Town Hall  
 June 3- 7:00pm- P&Z Monthly Meeting, Mallory Town Hall  
 June 4- 7:00pm- Emergency Services Facility Committee Meeting, Mallory Town Hall



The 43rd Annual  
 Sherman Memorial  
 Day Parade  
 Sun. May 30, 1pm  
 Begins at Judd's Corner  
 & Spring Lake Rd.

SHS Annual Barn Sale  
 Sat., May 29, 9am-4pm  
 Sun., May 30, 9am-12pm  
 At the old red barn  
 in the center of town.

Sherman Library  
 One Day Book Sale  
 Sat., May 29, 9am-4pm  
 See front page for details



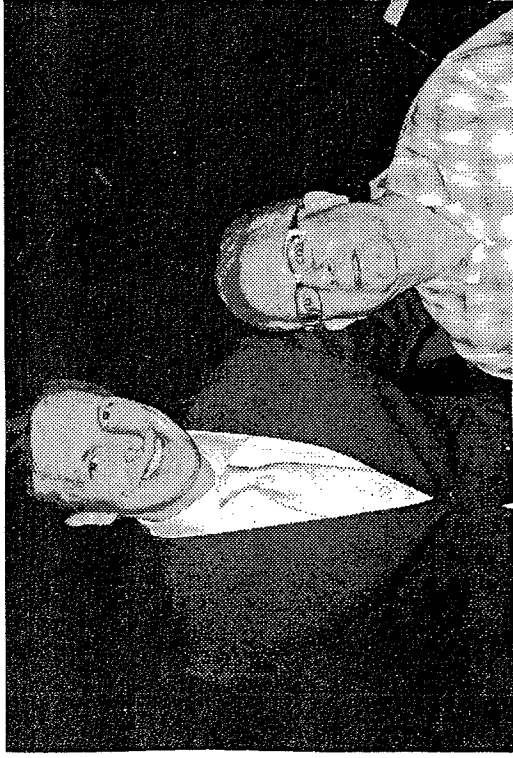
5th Annual Huntington's  
 Disease Benefit Dinner,  
 Saturday, June 5

The Maher family, of Sherman CT, is holding their "Fifth Annual, Huntington's Disease, A Family Story, Benefit Dinner." Saturday, June 5th, from 5:30 - 9:30 p.m. at the Bantam Fire Department, 92 Doyle Rd, Bantam. Tickets are \$30, and \$10 for Children under the age of 10. Tickets are available in advance. All funds raised are used for Huntington's disease research. In the past 4 years they've raised over \$75,000.

After Melinda Maher held a benefit dinner for her senior project at Shepaug Valley High School in 2006, her and her family chose to continue the event as an annually run family event. Her father, Fred Maher lost his battle August 3<sup>rd</sup>, 2008, after 14 years of fighting this disease.

Currently one in every 10,000 Americans have been diagnosed with HD, including another 5,000 children between the ages of 6 months and 18 years. Since HD is hereditary there are another 250,000 at risk of inheriting Huntington's disease. Community has thousands affected with this devastatingly fatal disease that presently has no cure.

To reserve tickets for the dinner, please call Melinda 203-241-9216, Charlotte 860-355-3382 or Eric 203-241-6869 or e-mail [curehd2006@aol.com](mailto:curehd2006@aol.com). For more, information visit the family's website: [www.curehd2006.com](http://www.curehd2006.com).



## Mark Weber Delegate To State Convention

Mark Weber of the DTC with Congressmen Chris Murphy who is running for reelection.



## Date is Set For Sherman Art Show At The JCC

Art Show Committee (L-R): Mary Jane Magoon, Susi Leiter, Marcella Lourd and Carol Faure. Opening Reception Friday July 30, July 31, and August 1. Save the Dates!

--- Carol Faure

## Upcoming Trips with The NF Senior Center

### That Still Have Available Seats:

Stop by the center for a fier at 33 Route 37; 203-312-5665

Newport Flower Show at Rosecliff Mansion, Driving Tour of Newport, and lunch at The Atlantic Club, Friday June 25th price \$75 per person.

"Jekyll & Hyde" at Westchester Broadway Theatre and luncheon, Friday October 1<sup>st</sup>, cost \$76 per person.

West Point Tour of grounds and buildings, Buffet Lunch at landmark Thayer Hotel, and cruise on the MV Commander, a nationally registered historic vessel of the Hudson Highlands. Thursday September 16<sup>th</sup>, cost \$73pp

Oktoberfest at the Platz Brauhaus, celebrate a traditional Old World Bavarian day of feasting, dancing, singing, and merriment in Pomona NY. Tuesday October 19<sup>th</sup>, cost \$57 pp



## TOGETHER, FOR SHERMAN

## ANDREA O'CONNOR, First Sectman

Everybody loves a parade, and Sherman's Memorial Day Parade, scheduled for this Sunday, May 30<sup>th</sup>, beginning at 1:00 p.m., is no exception. Marchers will assemble at Judd's Corner at the southern intersection of Spring Lake Road and Route 39 North, then proceed toward the center of Town, turning right in front of the School. Marching down Route 37, participants will pause as taps is played at the veteran's memorial in front of Old Town Hall, resuming their march down Saw Mill Road to Veterans Field for a brief commemorative ceremony.

It's exhilarating to see folks lined up along the parade route and at Veteran's Field to see Sherman show off its best. Just use caution at the firehouse building site, which is being tidied up for the occasion.

Memorial Day has been set aside to honor the nation's war dead—those gallant men and women who made the supreme sacrifice, giving their lives in defense of our nation's ideals. It is these heroes and heroines who made possible the freedoms we enjoy today, including the simple freedom of enjoying this parade.

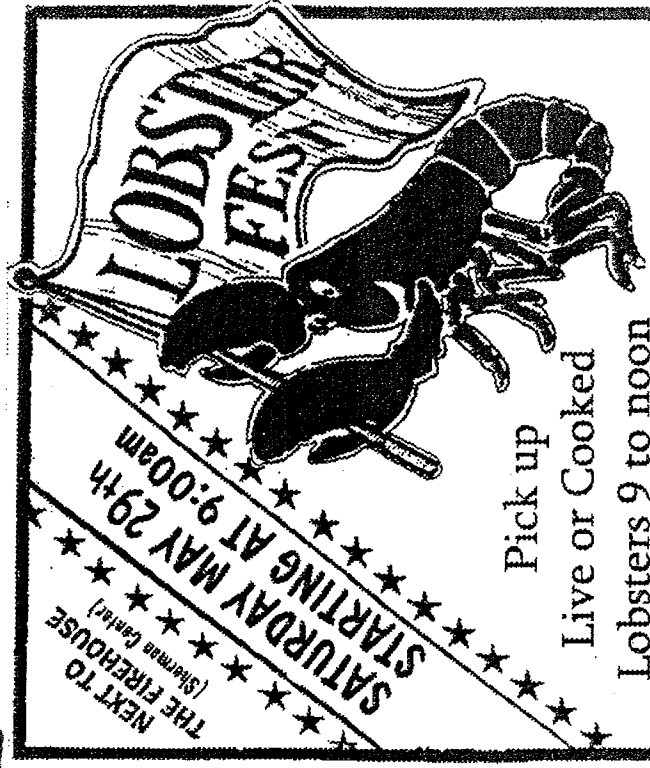
Memorial Day also kicks off the summer season, although the beach will be officially closed until the school year ends with graduation on June 18<sup>th</sup>. Use of the beach is at swimmers' own risk as no life guards will be on duty until school is out. We're working hard to have the Pavilion site cleaned up prior to the weekend, but those using the Town park area should use caution on this site until the building is officially open.

Work is also proceeding apace at Old Greenwoods bridge, which is finally moving along on schedule. Working conditions have been ideal, with low flow of water to contend with, and this project should be completed by fall—to everyone's great relief. I'll rest a lot easier once the old bridge is demolished after the new bridge comes on line.

Meanwhile, back at Town Hall, Sherman is on the fast track to complete a Pre-Disaster Natural Hazard Mitigation Plan. Once the plan is in place, the town will be qualified to apply for FEMA grants to address potential hazards identified in the plan. The plan is being developed with the assistance of Milone & MacBroom, Inc., a firm with extensive experience in developing such plans. Funding for this effort comes from a FEMA grant being administered by HVCEO, the Town's regional planning organization, and a 25% cost-share of \$7,000 from the Capital Non-Recurring Fund as previously approved by Town Meeting.

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☆ FOR MEMORIAL DAY ☆

TO RESERVE AHEAD CALL

860-354-3601 or 860-350-4043

(RESERVATIONS MUST BE PICKED UP BY 11:00AM)

Republicans Town Committee, Sherman CT, Bob Ostresky, Treasurer

## GIL'S AUTO & TRUCK REPAIR

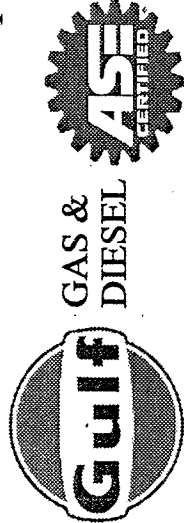
AMERICAN & FOREIGN REPAIRS • TRUCKS

Serving New Fairfield for 33 Years

Check Engine Light On? Come on Down.

Engine Diagnostics are our Specialty

Fuel Injection Service & Cleaning • AC Repairs • Brakes  
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7 STATE ROUTE 37

NEW FAIRFIELD, CT 06812

(203) 746-2018 (203) 746-9314

FAX (203) 746-5751

## *Sherman Town Events Calendar*

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*To submit an event for inclusion on this calendar, Please click [here](#).*

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### June, 2010

**Wednesday, June 02, 2010**

**07:00 PM**

**Sherman Board of Education Regular Monthly Meeting. Sherman School Cafeteria.II.**

**Thursday, June 03, 2010**

**10:30 AM**

**Regional Recycling Task Force Meeting,  
Brookfield Town Hall.**

**Thursday, June 03, 2010**

**07:00 PM**

**Sherman Planning and Zoning Commission  
Monthly Meeting, Mallory Town Hall.**

[Download: agenda](#)

**Thursday, June 03, 2010**

**07:00 PM**

**Israeli Scouts at the Jewish Community Center.  
Singing and dancing and fun for everyone! Free  
admission.**

**Friday, June 04, 2010**

**07:00 PM**

**Emergency Services Facility Committee. Mallory  
Town Hall.**

**Saturday, June 05, 2010**

**09:00 AM**

**Trails Day Hike starting at Evans Hill Road along  
the Herrick and Appalacian Trails. For more info,  
contact Naromi Land Trust at 860-354-0260**

**Saturday, June 05, 2010**

**08:00 PM**

**The Kent Singers at The Jewish Community  
Center. "How Can We Keep From Singing" a  
night of A Cappella. \$15 members, \$20**

nonmembers. 860-355-8050

**Monday, June 07, 2010**  
**06:00 PM**  
**SVFD Meeting, Mallory Town Hall.**

**Tuesday, June 08, 2010**  
**07:30 PM**  
**Sherman Park & Rec Commission Monthly Meeting, Mallory Town Hall.**

**Wednesday, June 09, 2010**  
**07:00 PM**  
**Conservation Commission Monthly Meeting, Mallory Town Hall.**  
 Download: [agenda](#)

**Friday, June 11, 2010**  
**07:00 PM**  
**Public Information Meeting to Develop a Pre-Disaster Natural Hazards Mitigation Plan.**  
**Mallory Town Hall**  
 Download: [invitation](#)

**Saturday, June 12, 2010**  
**10:00 AM**  
**Sherman Volunteer Appreciation Open House:**  
 all adult and student volunteers and their families are invited to stop at the library any time between 10 am and 2 pm for beverages and homebaked goodies served by the Library Board of Trustees and staff.

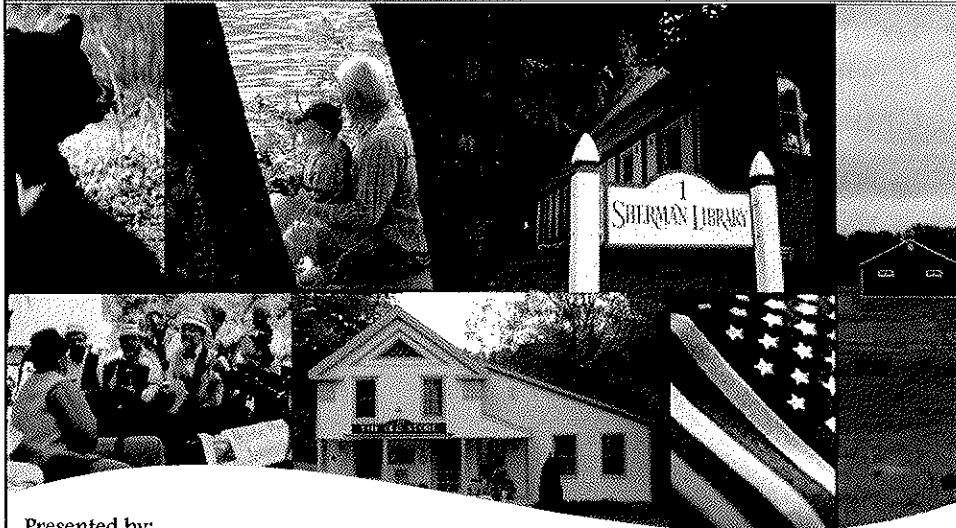
**Saturday, June 12, 2010**  
**07:30 PM**  
**"Senior Moments" Musical Comedy Night at the JCC. Music from the 40's, 50's, & 60's starring Jim Brownold and Sal Denise. \$15 advance reservations, \$20 at the door. 860-355-8050**

**Monday, June 14, 2010**  
**06:00 PM**  
**SVFD Meeting, Mallory Town Hall.**

**Monday, June 14, 2010**  
**06:00 PM**  
**Senior Housing Commission, Sherman School Conference Room.**

**Monday, June 14, 2010**  
**07:00 PM**

## Pre-Disaster Natural Hazard Mitigation Plan Sherman, Connecticut



Presented by:  
David Murphy, P.E. – Associate

June 11, 2010



MILONE & MACBROOM®

## History of Hazard Mitigation Planning



- Authority

- Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)



- Goal of Disaster Mitigation Act

- Encourage disaster preparedness
- Encourage hazard mitigation measures to reduce losses of life and property



MILONE & MACBROOM®

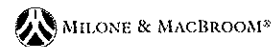


MILONE & MACBROOM®

## History of Hazard Mitigation Planning



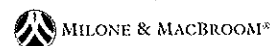
- Local municipalities must have a FEMA-approved Hazard Mitigation Plan in place to receive Federal Grant Funds for Hazard Mitigation Projects
  - PDM (Pre-Disaster Mitigation)
  - HMGP (Hazard Mitigation Grant Program)
  - FMA (Flood Mitigation Assistance)
  - RFC (Repetitive Flood Claims)
  - SRL (Severe Repetitive Loss)



## History of Hazard Mitigation Planning



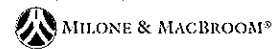
State	Description	Grant
Connecticut	Home elevations	\$641,025
Connecticut	Culvert replacement	\$500,000
Connecticut	Home acquisition	\$411,000
Connecticut	East Haven home elevation	\$75,206
Connecticut	Home elevation	\$64,575
Connecticut	Home elevation	\$56,700
Maine	Floodplain acquisition and structure removal	\$2,157,678
Massachusetts	Downtown flood mitigation/culvert replacement	\$3,000,000
Massachusetts	Pond flood hazard project	\$1,745,700
Massachusetts	Flood hazard mitigation project	\$1,079,925
Massachusetts	Culvert project	\$525,000
Massachusetts	Housing elevation and retrofit	\$473,640
Massachusetts	Housing elevation and retrofit	\$449,935
Massachusetts	Road mitigation project	\$186,348
Massachusetts	Flood mitigation project	\$145,503
New Hampshire	Water planning for firefighting	\$134,810
New Hampshire	Culvert project	\$112,500
New Hampshire	Box culvert project	\$102,000
New Hampshire	Culvert project	\$72,750
New Hampshire	Dry hydrants	\$15,251
New York	Beach road elevation	\$1,792,521
New York	Subdivision utilities; overhead to underground	\$300,767
New York	WWTP Floodwall construction	\$223,200
New York	Culvert project	\$122,664
Vermont	Fluvial erosion risk assessment	\$337,498
Vermont	Road mitigation project	\$140,441
Vermont	Foundation & erosion controls to a public building	\$99,188



## What is a Natural Hazard?



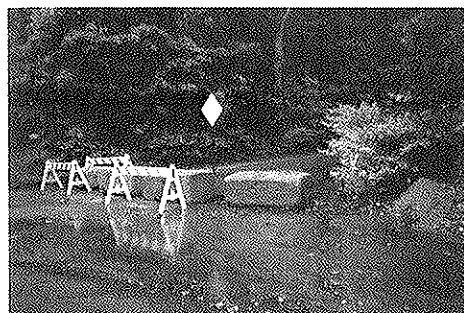
- An extreme natural event that poses a risk to people, infrastructure, and resources



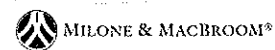
## What is Hazard Mitigation?



- *Pre-disaster* actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects



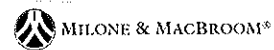
A Road Closure During / After a Large Scale Rainfall Event is a Type of Hazard Mitigation



## Long-Term Goals of Hazard Mitigation



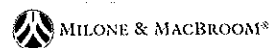
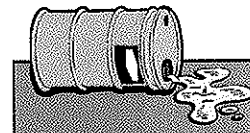
- Reduce loss of life and damage to property and infrastructure
- Reduce the cost to residents and businesses
- Educate residents and policy-makers about natural hazard risk and vulnerability
- Connect hazard mitigation planning to other community planning efforts
- Enhance and preserve natural resource systems in the community



## What a Hazard Mitigation Plan Does Not Address



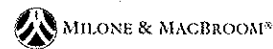
- Terrorism and Sabotage
- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



## Components of Hazard Mitigation Planning Process



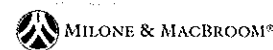
- Identify natural hazards that could occur in Sherman
- Evaluate the vulnerability of structures and populations and identify critical facilities and areas of concern
- Assess adequacy of mitigation measures currently in place such as regulations and emergency services
- Evaluate potential mitigation measures that could be undertaken to reduce risk and vulnerability
- Develop recommendations for future mitigation actions



## Sherman's Critical Facilities



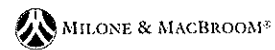
- The New Emergency Services Building
- Sherman School
- Highway Department
- Town Hall



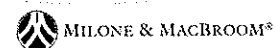
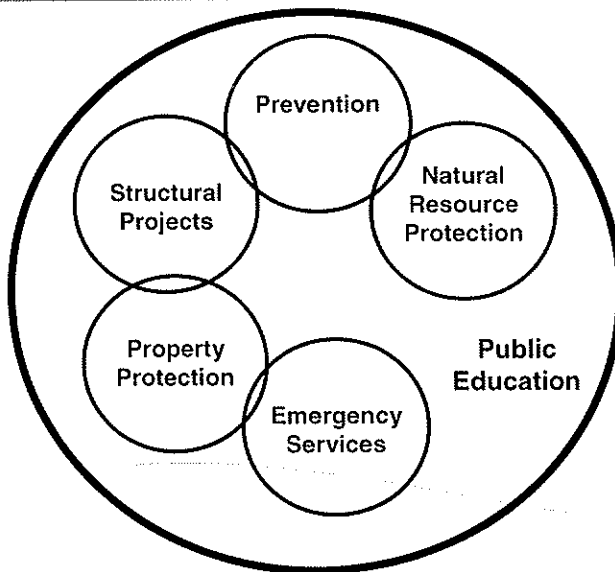
## Sherman's Critical Facilities



- Senior Center
- JCC Building
- Churches
- Key Roads and Evacuation Routes



## Potential Mitigation Categories



## Potential Mitigation Measures

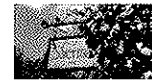


- Provide Emergency Notification System such as the CodeRED System
- Adopt local legislation that limits or regulates development in vulnerable areas
- Public education programs – dissemination of public safety information
- Construction of structural measures
- Replace undersized bridge and culverts
- Preserve critical land areas and natural systems
- Elevate or remove flood-prone buildings
- Replace overhead utilities with underground utilities
- Install dry hydrants

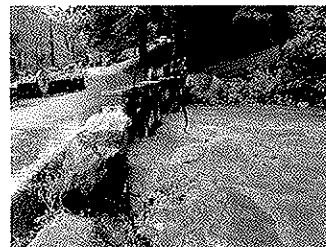


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## Primary Natural Hazards Facing Sherman



- Flooding
- Winter storms, nor'easters, heavy snow, blizzards, ice storms
- Hurricanes, tropical storms
- Summer storms, tornadoes, thunderstorms, lightning, hail
- Dam failure
- Wildfires
- Earthquakes



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## Hurricanes and Tropical Storms



- Winds
- Heavy rain / flooding



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## Summer Storms and Tornadoes



- Heavy wind / tornadoes / downbursts
- Lightning
- Heavy rain
- Hail



Tornado in KS



Fleeing in MN



Lightning over Boston



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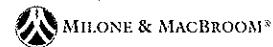
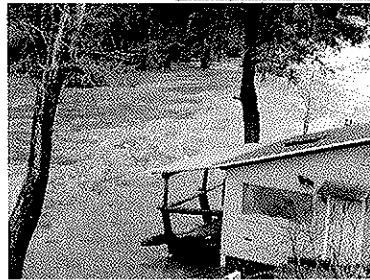
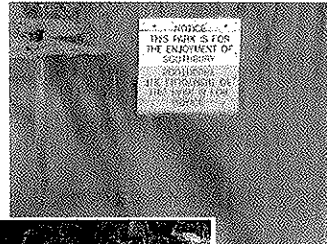


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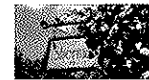
## Winter Storms and Nor'easters



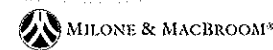
- Blizzards and nor'easters
- Heavy snow and drifts
- Freezing rain / ice



## Dam Failure



- Severe rains or earthquakes can cause failure
- Possibility of loss of life and millions of dollars in property damage



## Wildfires



- Fire
- Heat
- Smoke
- April is the month of risk in Connecticut



Photo courtesy of FEMA



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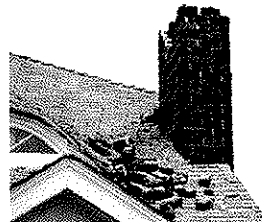
## Earthquakes



- Chester, CT experienced a small, 2.0 magnitude earthquake on March 11, 2008
- Can cause dam failure
  - Shaking
  - Liquefaction
  - Secondary (Slides/Slumps)



Photos courtesy of FEMA



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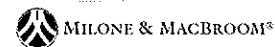
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## Area-Specific Problems



- Areas of Overbank Flooding and Bridge Damage

- Route 37 / Route 39 at Sawmill Brook
- Saw Mill Road at Sawmill Brook

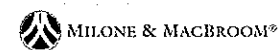
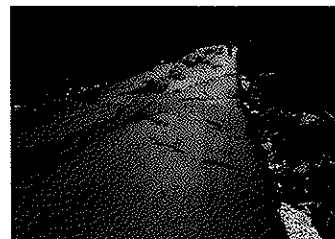


## Area-Specific Problems



- Areas of Overbank Flooding and Bridge Damage

- Wagon Wheel Road at Glen Brook
- Old Greenwood Road at Greenwood Brook
- Old Greenwood Road Extension at Tollgate Brook

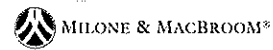


## Area-Specific Problems



- Areas of Roadway Washouts and Undersized Culverts

- Holiday Point Road
- Spring Lake Road
- Chimney Hill Road
- Anderson Road

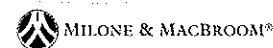


## Area-Specific Problems



- Areas of Roadway Washouts and Undersized Culverts

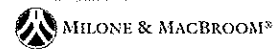
- Barlow Farm Road
- Briggs Hill Road
- Glenview Drive
- Other Dead-End Roads with Undersized Culverts near the Beginning



## Slides / Slumps



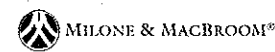
- Hubbell Mountain Road



## Next Steps



- Incorporate input from residents
- Rank hazard vulnerability
- Develop a response strategy
- Prepare the draft plan with recommendations for review by the Town and the public
- Adopt and implement the plan





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## *Meeting Minutes*

### **PRE-DISASTER NATURAL HAZARD MITIGATION PLAN FOR SHERMAN Public Information Meeting June 11, 2010**

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#### ***I. Welcome***

Selectman Ed Hayes opened the meeting at 7:05 PM. Mr. David Hannon from HVCEO explained the agency's role in the project and introduced Mr. David Murphy of Milone & MacBroom, Inc., the consultant selected for the project.

#### ***II. Power Point Presentation: Pre-Disaster Natural Hazard Mitigation Plan for Town of Sherman***

Mr. Murphy proceeded through the power point presentation.

#### ***III. Public Commentary***

Mr. Frank Zipp ([fzipp@aol.com](mailto:fzipp@aol.com), 914-906-3678) is part of the Candlewood Lake Estates Association. He provided information about his association. It is one of the largest in Sherman, with some of the land in New Milford, and bordering New Fairfield to the south. Green Pond is a significant feature. There have been concerns with the Green Pond Dam over the years. Only one very long road leads into the association. Recent and ongoing clearing and grading on the east side of the Sherman/New Milford boundary has reportedly changed drainage patterns and affecting runoff toward homes in the Candlewood Lake Estates Association. Mr. Zipp offered a tour of these areas.

Mr. Pat Raffaele ([seaside@snet.net](mailto:seaside@snet.net), 860-354-4054) is part of the Candlewood Echos Association. He provided information about drainage problems above his association. During a recent storm, a storm drain at Route 39 became clogged (this particular drain is across from the Candlewood Echos sign). Water ran overland into the association. A tour of this area may be worthwhile, although Mr. Raffaele does not need to be present.

Several members of the audience remarked that drainage system maintenance and cleanouts were not frequent enough in Sherman. The plan should address this issue.

Several members of the audience led a discussion about emergency response and utility repairs and maintenance. Because of the significant elevation differences in Sherman, winter weather is variable. Rain, ice, and snow could be affecting different areas at the same time, and response may be inappropriate based on what is observed in the center of town. Aging trees are a related problem. Wind and ice can bring down tree limbs and power lines. Everyone concurred that CL&P's response time is inadequate. The Fire Department had to monitor a downed line along Route 37 for eight hours during a recent

storm while waiting for CL&P. Coordination is important and needs to be improved. It was recommended that the plan somehow address coordination with CL&P.

Communications is another important issue. There are many "dead zones" in Sherman. It was recommended that the plan discuss this problem and recommend methods of improving communications, such as via radio.

*Passed recently as a separate ordinance*

## **REVISED FEDERAL FLOOD INSURANCE PROGRAM**

### **STATUTORY AUTHORIZATION**

**The Legislature of the State of Connecticut has in Title 7, Chapter 98, Section 7-148©(7)(A) and in Title 8, Chapter 124, Section 8-2 of the General Statutes delegated the responsibility to local governmental units to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry.**

**Therefore, the Town of Sherman, Connecticut, does amend the "Revised Federal Flood Insurance Program" ordinance enacted by Town Meeting of October 2, 1987 and ordains the following amended ordinance:**

### **FLOOD DAMAGE PREVENTION OBJECTIVES**

The objectives of this ordinance are:

1. To protect human life and health.
2. To minimize expenditure of public money for costly flood control projects.
3. To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public.
4. To minimize prolonged business interruptions.
5. To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains.
6. To help maintain a stable tax base by providing for the sound use and development of flood prone areas in such a manner as to minimize flood blight areas, and
7. To insure that potential home buyers are notified that property is in a flood area.

### **DEFINITIONS**

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

Area of special flood hazard means the land in the floodplain within a community subject to one (1) percent or greater chance of flooding in any given year. Areas of special flood hazard are determined utilizing the base flood elevations (BFE) provided on the flood profiles in the Flood Insurance Study (FIS) for a community. BFEs provided on Flood Insurance Rate Map (FIRM) are only approximate (rounded up or down) and should be verified with BFEs published in the FIS for a specific location. Areas of special flood hazard include, but are not necessarily limited to, the land shown as Zones A and AE on a FIRM.

Base flood means the flood having a one (1) percent chance of being equaled or exceeded in any given year, also referred to as the one hundred (100) year flood, as published by the Federal Emergency Management Agency (FEMA) as part of a Flood Insurance Study (FIS) and depicted on a Flood Insurance Rate Map (FIRM).

Base flood elevation (BFE) means the elevation of the crest of the base flood (100-year flood). The height in relation to mean sea level (NAVD of 1988) expected to be reached by the waters of the base flood at pertinent points in the flood plains of coastal and riverine areas.

Basement means any area of the building having its floor subgrade (below ground level) on all sides.

Building means see the definition for "Structure."

Cost means, as related to substantial improvements, the cost of any reconstruction, rehabilitation, addition, alteration, repair or other improvement of a structure shall be established by a detailed written contractor's estimate. The estimate shall include, but not be limited to: the cost of materials (interior finishing elements, structural elements, utility and service equipment); sales tax on materials, building equipment and fixtures, including heating and air conditioning and utility meters; labor; built-in appliances; demolition and site preparation; repairs made to damaged parts of the building worked on at the same time; contractor's overhead; contractor's profit; and grand total. Items to be excluded include: cost of plans and specifications, survey costs, permit fees, outside improvements such as septic systems, water supply wells, landscaping, sidewalks, fences, yard lights, irrigation systems, and detached structures such as garages, sheds, and gazebos.

Development means any man-made changes to improved or unimproved real estate, including but not limited to the construction of buildings or structures; the construction of additions, alterations or substantial improvements to buildings or structures; the placement of buildings or structures; mining, dredging, filling, grading, excavation or drilling operations or storage of equipment; the storage, deposition, or extraction of materials; and the installation, repair or removal of public or private sewage disposal systems or water supply facilities.

Existing manufactured home park or subdivision means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, as a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before the effective date, May 2, 1975, of the floodplain management ordinance adopted by the community.

Expansion to an existing manufactured home park or subdivision means the preparation of additional sites by the construction of facilities for servicing the lots on which manufacturing homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

Federal Emergency Management Agency (FEMA) means the federal agency that administers the National Flood Insurance Program (NFIP)

Finished living space means, as related to fully enclosed areas below the base flood elevation (BFE), a space that is, but is not limited to, heated and/or cooled, contains finished floors (tile,

linoleum, hardwood, etc.), has sheetrock walls that may or may not be painted or wall papered, and other amenities such as furniture, appliances, bathrooms, fireplaces and other items that are easily damaged by floodwaters and expensive to clean, repair or replace.

Flood or flooding means a general and temporary condition of partial or complete inundation of normally dry land areas from either the overflow of inland or tidal waters, or the unusual and rapid accumulation/runoff of surface waters from any source.

Flood Insurance Rate Map (FIRM) is the official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas (100-year floodplain) and the insurance risk premium zones applicable to a community.

Flood Insurance Study (FIS) is the official study of a community in which the Federal Emergency Management Agency (FEMA) has conducted an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations.

Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

Functionally dependent use or facility means a use or facility that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities. The term does not include seafood processing facilities, long-term storage, manufacturing, sales or service facilities.

Historic structure means any structure that is (a) Listed individually in the National Register of Historic Places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register; (b) Certified or preliminarily determined by the Secretary of the interior as contributing to the historic significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district; (c) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or (d) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either: (1) By an approved state program as determined by the Secretary of the interior or (2) Directly by the Secretary of the Interior in states without approved programs.

Lowest floor means the lowest floor of the lowest enclosed area (including basement).

Manufactured home means a structure, transportable in one (1) or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term also includes park trailers, travel trailers, recreational vehicles and other similar vehicles or transportable structures placed on a site for one hundred and eighty (180) consecutive days or longer and intended to be improved property.

Manufactured home park or subdivision means a parcel or contiguous parcels of land divided into two (2) or more manufactured home lots for rent or sale.

Market value means the market value of the structure and shall be determined by the appraised value of the structure prior to the start of the initial repair or improvement, or in the case of damage, the value of the structure prior to the damage occurring.

Mean sea level means, for purposes of the National Flood Insurance Program, the North American Vertical Datum (NAVD) of 1988 or other datum, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

New construction means structures for which the "start of construction" commenced on or after May 2, 1975, the effective date of the floodplain management regulations, and includes any subsequent improvements to such structures.

New manufactured home park or subdivision means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date, May 2, 1975, of the floodplain management regulation adopted by the community.

Recreational vehicle means a vehicle which is: (a) built on a single chassis; (b) four hundred (400) square feet or less when measured at the largest horizontal projection; (c) designed to be self-propelled or permanently towable by a light duty truck; and (d) designed primarily not for use as a permanent dwelling but as a temporary living quarters for recreational, camping, travel, or seasonal use.

Start of construction [for other than new construction or substantial improvements under the Coastal Barrier Resources Act (P.L. 97-348)] includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, or improvement was within 180 days of the permit date. The actual start means the first placement of permanent construction of a structure (including a manufactured home) on a site, such as the pouring of slabs or footings, installation of piles, construction of columns, or any work beyond the stage of excavation or placement of a manufactured home on a foundation. Permanent construction does not include land preparation such as clearing, grading and filling; nor does it include the installation of streets/and/or walkways; nor does it include excavation for a basement, footings, piers or foundations or the erection of temporary forms, nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

Structure means a walled and roofed building which is principally above ground, including a manufactured home, a gas or liquid storage tank, or other man-made facilities or infrastructures.

Substantial damage means damage of any origin sustained by a structure, whereby the cost of restoring the structure to its pre-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Substantial improvement means any combination of repairs, reconstruction, alteration, or improvements to a structure, taking place during a one (1) year period in which the cumulative cost equals or exceeds fifty percent of the market value of the structure. The market value of the structure should be 1) the appraised value of the structure prior to the start of the initial repair or improvement, or 2) in the case of damage, the value of the structure prior to the damage occurring. For the purposes of this definition, "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. The term does not, however, include any project for improvement of a structure required to comply with existing health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions.

Variance means a grant of relief by a community from the terms of the floodplain management ordinance that allows construction in a manner otherwise prohibited and where specific enforcement would result in unnecessary hardship.

Violation means failure of a structure or other development to be fully compliant with the community's floodplain management ordinance. A structure or other development without required permits, lowest floor elevation documentation, flood-proofing certificates or required floodway encroachment calculations is presumed to be in violation until such time as that documentation is provided.

Water surface elevation means the height, in relation to the North American Vertical Datum (NAVD) of 1988 (or other datum, where specified), of floods of various magnitudes and frequencies in the flood plains of coastal or riverine areas.

#### BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by the Federal Emergency Management Agency (FEMA) in its Flood Insurance Study (FIS) for Fairfield County, Connecticut, dated June 18, 2010, and accompanying Flood Insurance Rate Maps (FIRM), Dated June 18, 2010, and other supporting data applicable to the Town of Sherman, and any subsequent revisions thereto, are adopted by reference and declared to be a part of this ordinance. Since mapping is legally adopted by reference into this ordinance it must take precedence when more restrictive until such time as a map amendment or map revision is obtained from FEMA. The areas of special flood hazard include any area shown on the FIRM as Zones A and AE, including areas designated as a floodway on a FIRM. Areas of special flood hazard are determined utilizing the base flood elevations (BFE) provided on the flood profiles in the FIS for a community. BFEs provided on a FIRM are only approximate (rounded up or down) and should be verified with the BFEs published in the FIS for a specific location.

## ESTABLISHMENT OF THE FLOODPLAIN MANAGEMENT

A development permit shall be required in performance with the provisions of this ordinance prior to the commencement of any development activities.

## ADMINISTRATION: DESIGNATION OF THE ORDINANCE ADMINISTRATOR

The Land Use Enforcement Officer is hereby appointed to administer and implement the provisions of this ordinance.

## PERMIT PROCEDURES

Application for a zoning permit shall be made to the Land Use Enforcement Officer on forms furnished by him or her prior to any development activities.

## DUTIES AND RESPONSIBILITIES OF THE LUEO

Duties of the LUEO shall include, but not be limited to:

- a) Review all permit applications to determine whether proposed building sites will be reasonably safe from flooding.
- b) Advise permittee that additional Federal or State permits may be required, and if specific Federal or State permit requirements are known, require that copies of such permits be provided and maintained on file with the development permit. Such additional Federal and State permits may include, but are not limited to: Coastal Area Management Permit, Water Diversion, Dam Safety, Corps of Engineers 404.
- c) Notify adjacent communities and the Department of Environmental Protection, Water Resources Unit prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Emergency Management Agency.
- d) Assure that maintenance is provided within the altered or relocated portion of said watercourse so that the flood-carrying capacity is not diminished.
- e) Record the elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, in accordance with section 1.2.1 (a).
- f) When base flood elevation data or floodway data have **not** been provided, then the LUEO shall obtain, review and reasonably utilize any base flood elevation and floodway data available from a Federal, State or other source in order to administer the provisions of Section 5. When utilizing data other than that provided by the Federal Emergency Management Agency, the following standard applies: Select and adopt a regulatory floodway based on the principle that the area chosen for the regulatory floodway must be designed to carry the water of the base flood, without increasing the water surface elevation of that flood more than one foot at any one point.
- g) When base flood elevations have been determined within Zone AE on the community's Flood Insurance Rate Map but a regulatory floodway has not been designated, the LUEO must require that no new construction, substantial improvements, repair to structures which have sustained substantial damage or other development, including fill, shall be permitted which will increase the water surface elevation of the base flood more than one (1.0) foot at

any point within the community when all existing and anticipated development is considered cumulatively with the proposed development.

## Section 1. PROVISIONS FOR FLOOD HAZARD REDUCTION

### 1.1 GENERAL STANDARDS

In all areas of special flood hazard the following provisions are required:

- 1.1.1 New construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure;
- 1.1.2 New construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage;
- 1.1.3 New construction and substantial improvements shall be constructed by methods and practices that minimize flood damage;
- 1.1.4 Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding;
- 1.1.5 New and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
- 1.1.6 New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the system into flood waters;
- 1.1.7 On-site waste disposal systems shall be located and constructed to avoid impairment to them or contamination from them during flooding;
- 1.1.8 In any portion of a watercourse which is altered or re-located, the flood carrying capacity shall be maintained; and
- 1.1.9 A structure already in compliance with the provisions of this ordinance shall not be made non-compliant by any alteration, repair, reconstruction or improvement to the structure.

#### 1.2.1 (a) RESIDENTIAL CONSTRUCTION AND NON-RESIDENTIAL CONSTRUCTION

New construction or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated at least to the base flood elevation. The Town of Sherman does NOT allow fully enclosed areas below base flood elevation (flood vents) or floodproofing for non-residential structures.

#### 1.2.1 (b) MANUFACTURED HOMES

All manufactured homes to be newly placed, undergoing a substantial improvement or repaired as a result of substantial damage, shall be elevated so that the bottom of the lowest floor is at or above the base flood elevation (BFE). This includes manufactured homes located outside a manufactured home park or subdivision, in a new manufactured home park or subdivision, in an existing manufactured home park or subdivision, in an expansion to an existing manufactured home park or subdivision, or on a site in an existing park which a manufactured home has incurred substantial damage as a result of a flood. All manufactured homes shall be placed on a permanent foundation which itself is securely anchored and to which the structure is securely anchored so that it will resist flotation, lateral movement and hydrostatic pressures. Anchoring may include, but not be limited to, the use of over-the-top or frame ties to ground anchors. All manufactured homes shall be installed using methods and practices which minimize flood damage. Adequate access and drainage should be provided. Elevation construction standards include piling foundations placed no more than ten (10) feet apart, and reinforcement is provided for piers more than six (6) feet above ground level.

#### 1.2.1 (c) RECREATIONAL VEHICLES

Recreational vehicles placed on sites within an area of special flood hazard shall either be on the site for fewer than 180 consecutive days and be fully licensed and ready for highway use, or meet all the general standards of Section 1.1 and the elevation and anchoring requirement of a manufactured home in Section 1.2.1 (b). A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions.

#### 1.2.2 FLOODWAYS

Located within areas of special flood hazard established by FEMA are areas designated as floodways on the community Flood Insurance Rate Map. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles and has erosion potential, the following provisions shall apply: Prohibit encroachments, including fill, new construction, substantial improvements and other development unless certification (with supporting technical data) by a registered professional engineer is provided demonstrating, through hydrologic and hydraulic analyses performed in accordance with standard engineering practice, that encroachments shall not result in any **(0.00 feet)** increase in flood levels during occurrence of the base flood discharge.

#### 1.2.3 FLOODWAY PROHIBITION

Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

#### 1.2.4 NOTIFICATION FOR FLOODPLAIN VARIANCES

Any applicant to whom a variance is granted from the ordinance shall be given written notice that the structure will be permitted to be built with the lowest floor elevation below the base

flood elevation (BFE), and that the cost of flood insurance will be commensurate with the increased risk resulting from the lowest floor elevation.

## Section 2. STANDARDS FOR SUBDIVISION PROPOSALS

In all special flood hazard areas the following requirements shall apply:

- 2.1 All subdivision proposals shall be consistent with the need to minimize flood damage;
- 2.2 All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage;
- 2.3 All subdivision proposals shall have adequate drainage provided to reduce exposure to flood hazards; and
- 2.4 In Zone A, Base Flood Elevation data shall be provided for subdivision proposals and other proposed development which are five **(5)** acres or fifty **(50)** lots, whichever occurs first.

### EQUAL CONVEYANCE

Within the floodplain, except those areas which are tidally influenced, as designated on the Flood Insurance Rate Map (FIRM) for the community, encroachments resulting from filling, new construction or substantial improvements involving an increase in footprint of the structure, are prohibited unless the applicant provides certification by a registered professional engineer demonstrating, with supporting hydrologic and hydraulic analyses performed in accordance with standard engineering practice, that such encroachments shall not result in any (0.00 feet) increase in flood levels (base flood elevation). Work within the floodplain and the land adjacent to the floodplain, including work to provide compensatory storage shall not be constructed in such a way so as to cause an increase in flood stage or flood velocity.

### COMPENSATORY STORAGE

The water holding capacity of the floodplain, except those areas which are tidally influenced, shall not be reduced. Any reduction caused by filling, new construction or substantial improvements involving an increase in footprint to the structure, shall be compensated for by deepening and/or widening of the floodplain. Storage shall be provided on-site, unless easements have been gained from adjacent property owners; it shall be provided within the same hydraulic reach and a volume not previously used for storage; it shall be hydraulically comparable and incrementally equal to the theoretical volume of flood water at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Compensatory storage can be provided off-site if approved by the municipality.

### ABOVEGROUND STORAGE TANKS

Above-ground storage tanks (oil, propane, etc.) which are located outside or inside of the structure must either be elevated above the base flood elevation (BFE) on a concrete pad, or be securely anchored with tie-down straps to prevent flotation or lateral movement, have the top of the fill pipe extended above the BFE, and have a screw fill cap that does not allow for the infiltration of flood water.

#### PORTION OF STRUCTURE IN FLOOD ZONE

If any portion of a structure lies within the Special Flood Hazard Area (SFHA), the entire structure is considered to be in the SFHA. The entire structure must meet the construction requirements of the flood zone. The structure includes any attached additions, garages, decks, sunrooms, or any other structure attached to the main structure. Decks or porches that extend into a more restrictive flood zone will require the entire structure to meet the standards of the more restrictive zone.

#### STRUCTURES IN TWO FLOOD ZONES

If a structure lies within two or more flood zones, the construction standards of the most restrictive zone apply to the entire structure (i.e., V zone is more restrictive than A zone; structure must be built to the highest BFE). The structure includes any attached additions, garages, decks, sunrooms, or any other structure attached to the main structure. (Decks or porches that extend into a more restrictive zone will require the entire structure to meet the requirements of the more restrictive zone).

#### NO STRUCTURES ENTIRELY OR PARTIALLY OVER WATER

New construction, substantial improvements and repair to structures that have sustained substantial damage cannot be constructed or located entirely or partially over water unless it is a functionally dependent use or facility.

#### ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants or deed restrictions. However, where this ordinance and another conflict overlap, whichever imposes the more stringent restrictions shall prevail

#### WARNING AND DISCLAIMER OF LIABILITY

The degree of flood protection required by this ordinance is considered the minimum reasonable for regulatory purposes and is based on scientific and engineering consideration and research. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This ordinance does not imply or guarantee that land outside the Area of Special Flood Hazard or uses permitted in such areas will be free from flooding and flood damages. This ordinance shall not create liability on the part of the Town of Sherman or by any officer or employee thereof for any flood damages that result from reliance on this ordinance or any administrative decision lawfully made thereunder. The Town of Sherman, its officers and

employees shall assume no liability for another person's reliance on any maps, data or information provided by the Town of Sherman.

#### SEVERABILITY

If any section, subsection, paragraph, sentence, clause, or phrase of this ordinance should be declared invalid for any reason whatsoever, such decision shall not affect the remaining portions of this ordinance, which shall remain in full force and effect; and to this end the provisions of this ordinance are hereby declared to be severable.

#### PENALTIES FOR VIOLATION

Any violation of the provisions of this ordinance or failure to comply with any of its requirements, including violation of conditions and safeguards established in connection with grant of variances or special exceptions, shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall, upon conviction thereof, be fined a penalty of \$250.00 per day and in addition shall pay all costs and reasonable legal fees involved in the case. Nothing herein contained shall prevent the Town of Sherman from taking such lawful action as is necessary to prevent or remedy any violation.

Effective: June 3, 2010

Mr. Ron Cooper, Land Use Enforcement Officer of the Town of Sherman, escorted Scott Bighinatti of MMI on a tour of problem areas (**Sites A-T**) in the town. Streams in Sherman are reportedly high gradient and very flashy, and only a few areas will reportedly store flood waters for more than a day. Very few habitable structures can be impacted by overbank flooding. Most of the problems are infrastructure related, especially involving dead end roads with bridges near the access point. Houses beyond each bridge (for dead-end streets) were counted using aerial photographs prior to field reconnaissance.

The Town doesn't currently regulate the number of homes on new dead end streets. This is something Ron would like to see changed. Septic systems in the town are limited in capacity and performance by the soils, so large lot sizes are used.

Not all photographs taken during field investigations were included in these formal notes.

Later that day, Mr. Frank Zipp, President of the Candlewood Lake Estates Association, escorted Scott through CLEA to look at areas of concern (**Sites U-W**).

#### **Site A. Old Greenwood's Road Extension**



*Photo 1: Looking downstream from bridge*



*Photo 2: Upstream face of bridge*

This bridge over Tollgate Brook (Photos 1 and 2) is considered by the Town to be in poor/failing condition. It is at the beginning of a dead-end road with three houses beyond the bridge. The Town is considering this area as a potential application for HMGP funds.

## Site B. Timber Trails Association – Timber Lake Dam (Class B)



*Photo 3: Flash boards at dam*



*Photo 4: Warping flashboards*



*Photo 5: Abutment undermined*

The Timber Lake Dam (Photos 3, 4, and 5) is an earthen dam with concrete abutments and a concrete spillway. Two-inch by 12-inch boards are used to raise the level of the lake about 6 inches (normal pool elevation is 901 feet on the USGS topographic map). The downstream channel is cobbles, boulder, and ledge. The lake is about 10 acres in area. There is concern that if a storm causes the boards to break, it would have the effect of a minor dam failure downstream.

The bridge over the outlet stream and the damspillway (Quaker Brook) is part of Timber Lake Road North, a road that runs along the crest of the dam with two homes on the far side of the bridge. However, one of the homes has a private driveway back to Timber Lake Road east of Quaker Brook so there is still emergency access in this area. The bridge is constructed of steel I-beams and timbers. Failure of the weir boards probably wouldn't cause the bridge to wash out, but a dam failure would. The weir boards seem to be directing flow downwards beneath the boards leading to scour/undermining of the bottoms of the abutments.



*Photo 6: Quaker Brook downstream of Timber Lake Road*



*Photo 7: Quaker Brook upstream of Timber Lake Road*

Downstream on Timber Lake Road, the bridge over Quaker Brook is very high (Photos 6 and 7). The channel continues to be ledge and cobbles/boulders. The wingwalls appear to be in good/fair condition. A flash flood or dam failure could compromise the structural integrity of the wingwalls, which would isolate 10 homes (unless Timber Lake Road North was still accessible, but the top bridge is more likely to be damaged). There is a unpaved forest road running north to Coburn Road West, but it has a (suspected) poor private crossing over Quaker Brook and is on private land, so it is not considered to be accessible by emergency vehicles.

### **Site C. Quaker Brook at Route 37**

This crossing likely does not present a flooding problem. The stream banks are approximately 12 feet wide and the bed material is primarily boulders. The bridge is state-owned. The outlet flows into Valley Pond (elevation 723) and then into Deer Pond. The CT DEP lists the Deer Pond Dam as having recently breached. The dam was not approached in the field but from Route 37 it was difficult to see a dam structure.

### **Site D. Quaker Brook at Big Trail (Timber Trails Association)**



*Photos 8 and 9 – Downstream side of Big Trail bridge over Quaker Brook*

Approximately 60 homes are on the other side of this bridge, which is the only means of egress into this part of the association. Ron stated that the association wishes to remove this bridge and install a new one slightly downstream to remove the “crook” in the road. Also, this part of the community is reportedly served by a single bedrock well installed near Route 37. A review of MMI’s in-house GIS indicates that the Timber Trails Association has three systems served by the Aquarion Water Company – one around Timber Lake, one along Route 37, and one along Big Trail. This is the only Community Water System in the Town. Reportedly, the water company wants the road moved such that they can have control of the 200-foot sanitary radius of the well. The proposed road would likely connect to Route 37 in New Fairfield.

### **Site E. Unnamed Outlet Stream from Pepper Pond (< Class B) at Coote Hill**

The culvert under Coote Hill appears to have been damaged as areas of concrete have fallen from the side of the bridge. Six homes lie uphill beyond the culvert with Coote Hill being the only egress. The channel has a low gradient to the next lake, with Pepper Pond (elevation 717) being slightly higher in normal pool elevation than Lake Mauweehoo (elevation 711). The association doesn't have a sign up for the road which makes it difficult for emergency personnel (especially ambulances from other towns that are unfamiliar with the area) to find the street.

Ron believes that the State inspects the Pepper Pond Dam, which was listed as Class B by the DEP in 1996 but was not listed on the high hazard dam list (Class B dams and higher) in 2007. Pepper pond is reportedly spring fed.

### **Site F. Unnamed Stream from Lake Mauweehoo (< Class B) at Mauweehoo Hill**



*Photo 10 – Downstream side of Mauweehoo Hill bridge over unnamed tributary to Glen Brook*

The Lake Mauweehoo dam is reportedly in good condition, and the grass at the top of the dam appeared maintained. The dam has no debris gates, which Ron stated allows debris to pass the spillway such that clogs do not occur that could cause damage. The dam hasn't been an issue as far as Ron knows. It was ranked as Class BB in 1996 but was not included on the more recent list.

bridge, with this as the only egress.

Mauweehoo Hill is a town road with a large circular culvert. Ron can't remember any issues with the culvert. There are approximately 30 homes beyond this

### **Site G. Glen Brook at Glenview Drive**



*Photo 11 – Upstream face of Glenview Drive bridge*

This large box culvert was recently installed by the Town. It appears large enough to convey all the normal flows along Glen Brook and a significant amount of flood flow as well. Ron says there have been no problems with this bridge. Six houses lie beyond the bridge, with this as the only means of egress.

#### **Site H. Glen Brook at Wagon Wheel Road**



*Photo 12 – Downstream face of culvert*



*Photo 14 – Glen Brook upstream of Road*

The storms of April 2007 caused serious damage to this area. Glen Brook jumped its banks several hundred feet upstream of the bridge, creating a side channel that opened into the roadway about 40 feet downhill from the bridge. The water eroded out the sand and gravel base beneath the asphalt of Wagon Wheel Road for 700 feet down the hill (with an elevation drop of 40-50 feet), causing a cavity 18” in depth beneath the asphalt. Approximately eight homes were cut off, and the fire department had to use an all-terrain utility vehicle (“gator”) to get people out. The culverts were undersized for the remaining water, with water entering the roadway at the bridge on the downstream side and causing erosion. Ron has pictures of this event. A neighbor stated that the bridge also “washed out about ten years ago” – this was likely related to Tropical Storm Floyd in 1999.

#### **Site I. Barlow Farm Road**

The drainage in this area was overloaded in 2007(?) and sent stone into a neighbor’s yard. Ron sent us pictures of this event.

#### **Site J. Ledgewood Drive (unnamed tributary to Candlewood Lake)**

Ledgewood Drive is part of the Deer Run Shores Association. An unnamed stream passes beneath the private road through a cross culvert. Downstream, the stream passes beneath a driveway at the very end of the road just upstream of the lake. The channel near the driveway has been armored with riprap by the property owner, implying that fast velocities occur in this stream.

### Site K. Greenwoods Brook and Sawmill Brook near Route 37



*Photo (from Bing.com) – Downtown Area*

Sawmill Brook (a.k.a. Great Brook) and Greenwoods Brook come together in this area. The Route 37/Route 39 bridge washed out during Tropical Storm Floyd, and more recent flooding along Greenwoods Brook (April 2007?) damaged the bridge leading into Old Greenwoods Road, which is currently under repair. The white house (circled in red) just upstream and south of Great Brook was moved (after Tropical Storm Floyd) a little

ways away from the stream and elevated slightly, but may still be in Zone A. Ron stated that this building is a historic structure, and is the only structure he knows of that could still be flood prone.

### Site L. Sawmill Brook at Sawmill Road



*Photo 15 – Saw Mill Road Culvert*

This culvert experienced severe damage during Tropical Storm Floyd in 1999. The culvert was repaired but not resized. It is the first place Ron comes to check on when there is a flooding event. During the 1999 storm, flood waters tore up the nearby athletic fields and destroyed the surface of the tennis court. This area was where most of the Town's damage was – over \$60,000 dollars in repairs. Ron sent us a lot of pictures of this area from 1999. This road is the only means of egress to this area by land for approximately 15 homes, the Town beach, and the Town marina.

During an emergency, residents could exit by water via Allens Cove on Candlewood Lake. This stream has a large watershed and is prone to dead limbs falling into it which require occasional clearing.

### Site M. Holiday Point Association – Hillside Drive

An unnamed tributary to Candlewood Lake drains a wetland that runs parallel to Holiday Point Road. The roadway leading into Hillside Drive at the association entrance was

prone to overtopping during heavy rain (such as during the April 2007 storms), but that has been mitigated recently with a new catch basin and culvert under the road.

#### **Site N. Fox Run Retention Basin**



*Photo 18 – Fox Run retention basin*

This retention basin was built to control drainage from the Fox Run subdivision. The outlet stream runs downhill under Atchison Cove Road and Cedar Point Drive to enter into Candlewood Lake in what may be locally known as Atchison Cove. Atchinson Cove reportedly has siltation issues that intensified after the subdivision was built. The retention basin supposedly was built improperly such that it does not retain water at all because the invert of the outlet pipe is level with the bottom of the basin. It also has a 6” outlet control pipe for drawdown purposes. The

Holiday Point Association is suing the Town (for the cost of dredging the cove) on the basis of a private engineering study which calculated that 60% of the sediment load entering the cove was due to the retention basin. The Town has “shovel ready” plans in place for correcting the deficiency, but personnel time and budget constraints are keeping the project on the back burner. This project is also being considered by the Town for HMGP funds, although it is unlikely to qualify since it is ultimately a siltation issue (and an issue with potential litigation which FEMA is disinclined to get involved with in its grant programs).

#### **Site O. Jericho Road North**

A small wetland drains beneath the road to Morrissey Brook, but it is unlikely that the outlet stream will cause much damage to this unpaved road. This road is one of the few unpaved town roads. The nearby dam on Rogers Pond (Class B in 1996, not ranked in 2007) had a recent failure that reportedly completely drained the pond. The failure caused no damage and the dam was inspected by the DEP. The deficiencies have reportedly been corrected. Ron would like to see Jericho Road paved and connected through to its southern end, as the middle part has remained the same horse and buggy trail it was more than a century ago. Connecting the road through would allow a bypass within Sherman if Route 39 was ever closed north of Route 37. There are very few bypass roads in the Town.

**Site P. Beaver Creek Lane**

This road has twin cross culverts to pass Morrissey Brook. The biggest problem at this crossing is that the beavers in the area dam up the culverts.

**Site Q. Church Road near Babbling Brook Drive**

Ron may have sent us pictures of this area. The Town recently replaced the cross culvert here with an arch culvert of corrugated steel. In 2007 the entire area backed up and flooded, but no structures were damaged. The area downstream is land trust property.

**Site R. Farm Road**

The unnamed stream near the entrance to Farm Road overtops during heavy rains (reportedly up to a foot deep for severe storms). This road is the only access into a 22-house subdivision. The adjacent watershed isn't very large. There is an approximately 100-acre lot adjacent to the end of the road (north side) that the Town is going to be buying as open space.

**Site S. Clover Leaf Farm North and South**

A small unnamed tributary to Wimisink Brook passes beneath these two subdivision access roads close to the egress point off Anderson Road. The stream drains from nearby wetlands and could overtop the road during heavy rains. A small pipe conveys water beneath each road. If the roads overtopped or washed out, three houses on the south road and eight homes on the north road would be stranded.

**Site T. Evergreen Drive**

Beavers live in the nearby wetland, but the pipe that passes water is several feet below the level of the road. The street has a number of catch basins which convey flow downstream of the road. This road is near the Appalachian Trail.

#### **Site U. Candlewood Lake Estates – Green Pond Road at Association Gate**



*Photo 21 – Drainage on Green Pond Road*

The road leading into the association (over 100 homes are beyond the gate) is high gradient and has issues with drainage. The undersized pipes under the road are causing the asphalt to crack above the two cross culverts leading up the hill to Eagles Nest Drive. As a side note, the Boy Scout Reservation was sold off and is now Mill Pond Farm, a private association with one entrance on Green Pond Road at the CLEA gate and another at the end of Fox Run.

#### **Site V. Candlewood Lake Estates – Green Pond Dam and Vicinity**



*Photo 22 – Green Pond Outlet Stream*



*Photo 23 – Green Pond Dam (boulders visible)*

Green Pond may also be known as Emerald Lake. The water quality in the lake is reportedly excellent such that species highly sensitive to contamination have been seen in the pond. The pond reportedly may also have archeological value. The primary outlet stream appears to flow over a bedrock outcrop spillway and down through a rock-lined channel to Green Pond Road (Photo 22). The association recently replaced the pipe under this road with a 24-inch corrugated plastic culvert, as high outflows from the pond could cause the road to overtop. The dam itself appears to be an earthen or earthen and rock dam reinforced with boulders (Photo 23), but no spillway on the dam was present. A seepage stream believed to be from the dam joins to the outlet stream just above Green Pond Road.

## Site W. Candlewood Lake Estates – Development in New Milford



*Photo 24 – Gravel Road in new subdivision*

A 60-acre development is proposed in New Milford just over the Sherman Town Line from CLEA. It is adjacent to the end of a paper street (the north end of Old Forest Road) in CLEA. A lot of work has been done in prepping this subdivision for approvals, such as blasting to layout some gravel roads, clearing trees, staking out lots, test pits, etc. Much of this work was done several years ago, as much of the cleared area has grown back in with small saplings less than ten years old. The area is shown as cleared on the 2004 aerial mapping set, suggesting that this work

started prior to 2003. The clearing work increased the amount of silt in the runoff entering into Green Pond, sparking concern in the association. The subdivision work appears to currently be on hold, and siltation into Sherman has reportedly been reduced in recent years due to the reestablishment of vegetation. CLEA's concerns with the new development include (1) construction period runoff and siltation, (2) post-construction drainage and siltation, and (3) a possible connection between the new subdivision and the paper street, since roads have been cut almost adjacent to Old Forest Road. CLEA prefers to limit access points into the association for security purposes, which to them outweigh emergency access issues.

## Scott Bighinatti

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**From:** Ifkovic, Diane [Diane.Ifkovic@ct.gov]  
**Sent:** Sunday, August 08, 2010 4:53 PM  
**To:** Scott Bighinatti  
**Subject:** RE: Town of Sherman RLPs?

Hi Scott,

I think Dave Murphy asked me this same question awhile back, but I checked the system again to be safe. There are NO repetitive loss properties (RLPs) or severe repetitive loss properties (SRLPs) in Sherman.  
diane

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From: Scott Bighinatti [scottb@miloneandmacbroom.com]  
Sent: Friday, August 06, 2010 3:03 PM  
To: Ifkovic, Diane  
Subject: Town of Sherman RLPs?

Hi Diane,

I'm preparing the Natural Hazard Mitigation Plan for the Town of Sherman and I was wondering if there were any repetitive loss properties in the Town. The Town doesn't believe that there are, but I wanted to double check with you just in case there were any historical ones that just haven't been flooded in the past decade or so.

Thanks,

Scott J. Bighinatti  
Environmental Scientist

Milone & MacBroom, Inc.  
99 Realty Drive, Cheshire, Connecticut 06410  
203.271.1773 Ext. 204 / 203.272.9733 (Fax)  
[www.miloneandmacbroom.com](http://www.miloneandmacbroom.com)

Please consider the environment before printing this e-mail.

## **Storm Nicole Field Reconnaissance**

**David Murphy**

**October 1, 2010**

**For:**

***Danbury Natural Hazard Mitigation Plan – File 2667-18***

***New Fairfield Natural Hazard Mitigation Plan – File 2534-09***

***Sherman Natural Hazard Mitigation Plan – File 3101-04***

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Storm Nicole consisted of the remnants of a tropical storm combined with a low pressure system. Widespread and heavy rain stretched along the entire eastern United States. The heaviest rain occurred in Danbury, Sherman, and New Fairfield in the early morning of October 1, 2010, with rainfall continuing throughout the day. The field reconnaissance was timed to correspond to the end of the heavy rain, in mid-morning. The reconnaissance began in Sherman at 9 AM and continued through New Fairfield to Danbury, ending around 11:30 AM. Photos are only included in this document for the municipality of the respective plan.

### **Sherman**

Sherman was entered at Gaylordsville and traversed generally from north to south, including the following roads: *Anderson Road, Cloverleaf Farms North and South, Route 39, Taber Road, Spring Lake Road, Beaver Creek Lane, Farm Road, Holiday Point Road, Saw Mill Road, Route 37, Old Greenwoods Road, Old Greenwoods Road Extension, Barlow Farm Road, Wagon Wheel Road, Leach Hollow Road, Mauweehoo Hill Road, Timber Lake Road, and Big Trail.*

Target areas included those previously identified by Town officials, plus locations where streams are conveyed beneath roads in culverts. Although high flows were observed, flooding was not observed anywhere in the town except possibly at the north end of Spring Lake. Ten photographs were taken as described below:

1. A tributary to Morrissey (Naromi.)  
Brook flows from west to east and enters a culvert under Spring Lake Road at a very high gradient. This is an area that could easily be overtopped during more severe weather events.



2. A pond flows into a small stream at the edge of Holiday Point Road. This area could probably be overtopped with slightly more rainfall.



3. The new bridge at Old Greenwood Road is still under construction. The temporary culvert was handling all the water in Tollgate Brook.



4. Recent stormwater system improvements were noted along Barlow Farm Road. These catch basins and culverts intercept water flowing overland down the steep hill and convey it under the road.



5. Same as #4

6. The Glen Brook bridge at Wagon Wheel Road was functioning and was not overtopped.



7. Same as #6

8. The bridge/culvert over Glen Brook at Glen View Drive appears to be new and possibly oversized, and the elevation difference from stream to road would make it difficult to overtop.



9. In contrast, the culvert for the Glen Brook tributary at Mauweehoo Hill Road is small in comparison to the bridge at Glen View Drive, although flooding was not occurring.



10. Timber Trails Road is unpaved and was eroding during the storm. Although the road was not compromised, water flowing down the road was crossing and cascading down a steep bank where the photo was taken. This is a potentially unsafe situation for more severe storms.



### New Fairfield

New Fairfield was entered at its northwest corner (Route 37) and traversed generally from northwest to southeast, including the following roads: *Route 37, Bigelow Road, Ball Pond Road (Route 39), Barnum Road, Smoke Hill Drive, Old Farm Road, Williams Road, Indian Hill Road, Gillotti Road, the downtown area, and the Candlewood Corners area (Route 39 and Saw Mill Road).*

Target areas included those previously identified by Town officials: Bigelow Corners, East Lake Brook, and Candlewood Corners. High flows were observed, but flooding was not observed anywhere in the town. Eleven photographs were taken as described below:

1. Ball Pond Brook was high but completely conveyed by the culverts at Route 37.
2. Same as #1
3. A different stream crosses under Route 37 on the south side of the house at Bigelow Corners. This stream appears to be conveyed under the road through a different type of structure that was completely submerged. The water was almost at the edge of the road. A slightly more severe storm would have caused the stream to cross the road. The roadside is eroded and armored with riprap directly across the road, indicating that the stream does cross the road under severe weather conditions.
4. Different view of the other stream
5. Different view of the other stream

6. Different view of the other stream
7. East Lake Brook at Smoke Hill Drive
8. East Lake Brook at Smoke Hill Drive
9. East Lake Brook at Old Farm Road
10. East Lake Brook at Williams Road (at the RLP; no flooding observed)
11. East Lake Brook at Williams Road

Candlewood Corners was visited, but flooding was not occurring, even after all the rainfall. The small stream was flowing slightly and its culverts were easily handling all the water. Water was not flowing down the side of the road or onto the commercial properties. This area probably responds very quickly under intense rainfall events, but otherwise probably doesn't see much runoff or any flooding action.

### Danbury

Danbury was entered from New Fairfield (Route 37) and traversed generally from north to south, with all of the reconnaissance focused north of downtown, including the following roads: *Route 37, Padanarum Road, North Street, Thorpe Street, Barnum Street, Patch Street, Rowan Street, Oakland Avenue, Hayestown Avenue, Walnut Street, Tamarack Avenue, and Ford Avenue.*

Target areas included potential areas of flooding in the Kohanza/Padanarum Brook watershed. Scott Bighinatti was covering other areas in the City at the same time. Nine photographs were taken as described below:

1. An unnamed stream was flowing over the lower end of Padanarum Road at the

Route 37 intersection. This is not a mapped floodplain. The stream appears to flow from an area of condominiums and a small tavern or restaurant immediately to the north.

2. Close up of #1 above.
3. 19 North Street (RLP) and a small fire station located on top of Kohanza Brook; located in a mapped floodplain.
4. 25 Patch Street (RLP) on top of (or next to) the combined Kohanza/Padanarum Brook; located in a mapped floodplain.
5. Ford Avenue – homes in the Padanarum Brook floodplain.
6. 20 Tamarack Avenue (RLP) – this home is at the edge of the Padanarum Brook floodplain and it is not clear how it floods, although the home has a walk-out basement in the rear.
7. Homes at the east end of Walnut Street are in the Padanarum Brook floodplain; some appear to be elevated with garages below living space.
8. Same as #7.
9. Homes at the intersection of 2<sup>nd</sup> Street and Oakland Avenue in the Padanarum Brook floodplain; these appear to be elevated with garages below living space.

A few notable observations were as follows:

- The presence of the small fire house next to 19 North Street indicates that there may be small critical facilities in floodplains that we have not already noted. For example, this small fire house is not one of the five main fire stations that we already listed as critical facilities. Another example is the facility “Danbury Ambulance” on Walnut Street, which may be in the 500-year flood zone of Padanarum Brook.
  - The RLP listed at 60 Padanarum Road could not be located. “Ron Jonh’s Pit Stop” gas station and auto repair shop is located at 58 Padanarum Road and there is a house next door, but the house appears to be at a lower address toward 56 Padanarum Road (a shopping plaza). All of these properties are adjacent to the brook, which flows along the rear yards.
  - The newer construction at the east end of Walnut Street and the townhomes at the intersection of 2<sup>nd</sup> Street and Oakland Avenue all appear to have been built in floodplains (the brook is immediately behind all of these structures) but living space is above the garages. It is admirable that the living space is elevated, but valuable personal property is kept in garages, such as cars, and there may be utilities in the garages as well. It is alarming that these homes appear to be relatively new construction.
  - Nearby, at the north end of Oakland Avenue, the Oakland Glen Apartments are in the floodplain and are not elevated.
- The presence of the small fire house next to 19 North Street indicates that there may be small critical facilities in floodplains that we have not already noted. For example, this small fire house is not one of the five main fire stations that we already listed as critical facilities. Another example is the

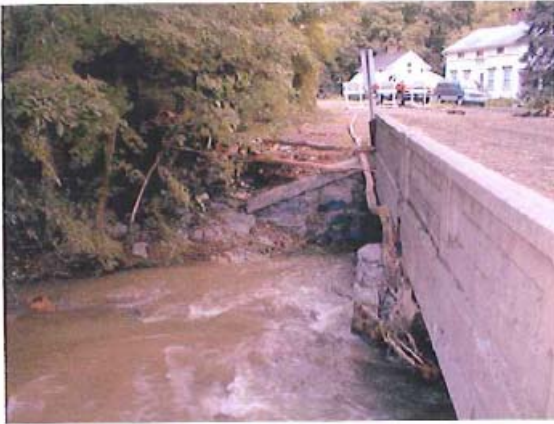
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**APPENDIX C**  
**PHOTOS OF SHERMAN STORM DAMAGE**

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***Tropical Storm Floyd – September 1999***

***Route 37/Route 39 Bridge – Sawmill Brook***



*Downstream Face of Route 37/Route 39 Bridge.*



*Debris on Roadway Surface*



*Southwest Abutment of Route 37/Route 39 Bridge, Looking Downstream*



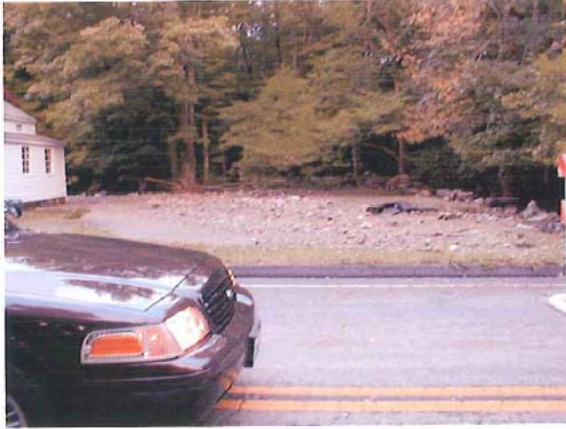
*Downstream Debris*



*Southwest Abutment of Route 37/Route 39 Bridge, Looking Upstream – Scour*



*Upstream Side of Bridge*



*Debris Northwest of Bridge*



*Looking South at Downstream Face*

***Sawmill Road Bridge – Sawmill Brook***



*Top of Culvert*



*Looking West at Downstream Face*



*Top of Culvert*



*Damage to Veterans Park*



*Damage to Veterans Park*



*Unidentified Bridge Reconstruction*

***Other Areas***



*Driveway at the Judd Property*



*Unidentified Bridge Reconstruction*

*September 23, 2003 Storm*



*Candlewood Lake*



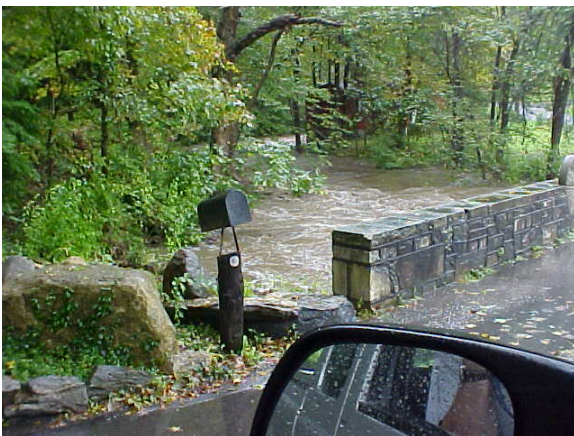
*Sawmill Brook at Sawmill Road – Downstream Face*



*Candlewood Lake*



*Sawmill Brook at Sawmill Road – Upstream Face*



*Sawmill Brook at Sawmill Road (Looking Upstream)*



*Farm Road*



*Farm Road*



*Church Road*

*April 2007 Storm*



*Anderson Road Detention Basin*



*Barlow Farm Road Washout*



*Chimney Hill Road Washout*



*Anderson Road West Washout*



*Holiday Point Road Drainage Failure*



*Holiday Point Road – Repaired*



*Lance Rogers Pond After Dam Failure*



*Lance Rogers Pond Dam Failure*



*Hubble Mountain Road Slump*



*Lance Rogers Pond Dam Failure*



*Lance Rogers Pond Dam Failure*



*Lance Rogers Pond Dam Failure*



*Spring Lake Road Driveway Washout*



*Spring Lake Road Washout*



*Wagon Wheel Road Looking Upstream*



*Wagon Wheel Road Several Hundred Feet  
Downstream of Bridge*



*Wagon Wheel Road Downhill of Bridge*



*Wagon Wheel Road Bridge*



*Road Base Debris Collecting Downhill of Bridge*



*Wagon Wheel Road Downhill of Bridge*



*Wagon Wheel Road Overflowing*



*Wagon Wheel Road Looking Uphill*



*Wagon Wheel Road Bridge*

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**APPENDIX D**  
**HAZUS-MH SOFTWARE OUTPUT**

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# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** UN-NAMED-1938-4

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

<b>Scenario Name:</b>	UN-NAMED-1938-4
<b>Type:</b>	Historic
<b>Max Peak Gust in Study Region:</b>	89 mph

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 4 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

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

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	95.41	1	3.79	0	0.58	0	0.21	0	0.01
Commercial	80	96.34	3	3.26	0	0.38	0	0.03	0	0.00
Education	3	96.75	0	3.11	0	0.14	0	0.00	0	0.00
Government	2	96.77	0	3.10	0	0.13	0	0.00	0	0.00
Industrial	41	96.56	1	3.18	0	0.22	0	0.04	0	0.00
Religion	7	96.70	0	3.15	0	0.14	0	0.01	0	0.00
Residential	1,565	95.16	76	4.62	4	0.22	0	0.00	0	0.00
<b>Total</b>	<b>1,712</b>		<b>81</b>		<b>4</b>		<b>0</b>		<b>0</b>	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	14	96.52	0	3.32	0	0.16	0	0.00	0	0.00
Masonry	113	95.23	5	4.25	1	0.46	0	0.05	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	68	96.69	2	3.00	0	0.28	0	0.02	0	0.00
Wood	1,520	95.23	73	4.57	3	0.19	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 6,106 tons of debris will be generated. Of the total amount, Brick/Wood comprises 2% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 6 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 1.6 million dollars, which represents 0.42 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 2 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 95% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	1,425.56	31.78	8.43	11.36	1,477.13
	Content	17.20	3.90	1.72	1.82	24.64
	Inventory	0.00	0.07	0.29	0.17	0.53
	<b>Subtotal</b>	<b>1,442.76</b>	<b>35.75</b>	<b>10.45</b>	<b>13.35</b>	<b>1,502.30</b>
<u>Business Interruption Loss</u>						
	Income	0.00	4.25	0.04	1.41	5.71
	Relocation	40.92	3.17	0.29	1.02	45.40
	Rental	13.40	1.97	0.04	0.09	15.50
	Wage	0.00	1.51	0.07	3.32	4.90
	<b>Subtotal</b>	<b>54.33</b>	<b>10.90</b>	<b>0.45</b>	<b>5.84</b>	<b>71.51</b>
<u>Total</u>						
	<b>Total</b>	<b>1,497.09</b>	<b>46.65</b>	<b>10.90</b>	<b>19.19</b>	<b>1,573.81</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 1000-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 114 buildings will be at least moderately damaged. This is over 6% of the total number of buildings in the region. There are an estimated 7 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

**Table 2: Expected Building Damage by Occupancy : 1000 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	10	66.47	3	21.77	1	7.56	1	3.67	0	0.53
Commercial	59	71.35	16	19.52	7	7.91	1	1.21	0	0.01
Education	2	72.81	1	19.19	0	7.21	0	0.79	0	0.00
Government	1	73.03	0	18.70	0	7.46	0	0.81	0	0.00
Industrial	30	72.12	8	18.59	3	7.76	1	1.43	0	0.09
Religion	5	71.92	1	21.17	0	6.28	0	0.63	0	0.00
Residential	1,108	67.36	437	26.57	85	5.18	8	0.49	7	0.41
<b>Total</b>	<b>1,216</b>		<b>467</b>		<b>97</b>		<b>10</b>		<b>7</b>	

**Table 3: Expected Building Damage by Building Type : 1000 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	11	72.07	3	18.68	1	8.42	0	0.83	0	0.00
Masonry	81	68.09	26	22.11	10	8.04	2	1.45	0	0.31
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	51	72.87	12	17.44	6	8.18	1	1.50	0	0.01
Wood	1,077	67.47	424	26.58	81	5.08	8	0.48	6	0.39

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	0
Police Stations	1	0	0	0
Schools	1	0	0	0

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 22,815 tons of debris will be generated. Of the total amount, Brick/Wood comprises 5% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 47 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 6 households to be displaced due to the hurricane. Of these, 1 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 11.3 million dollars, which represents 2.98 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 11 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 91% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	7,798.13	316.64	126.78	141.37	8,382.92
	Content	1,505.29	99.48	67.91	50.92	1,723.59
	Inventory	0.00	1.98	11.10	3.62	16.70
	<b>Subtotal</b>	<b>9,303.42</b>	<b>418.09</b>	<b>205.78</b>	<b>195.91</b>	<b>10,123.20</b>
<u>Business Interruption Loss</u>						
	Income	0.00	36.56	1.68	10.05	48.29
	Relocation	704.61	58.76	11.69	26.10	801.17
	Rental	207.38	34.54	1.02	1.74	244.67
	Wage	0.00	30.63	2.95	27.45	61.02
	<b>Subtotal</b>	<b>911.99</b>	<b>160.49</b>	<b>17.34</b>	<b>65.34</b>	<b>1,155.15</b>
<u>Total</u>						
	<b>Total</b>	<b>10,215.40</b>	<b>578.58</b>	<b>223.12</b>	<b>261.25</b>	<b>11,278.36</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 500-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

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<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
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Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 35 buildings will be at least moderately damaged. This is over 2% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

**Table 2: Expected Building Damage by Occupancy : 500 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	12	82.90	2	12.43	0	3.09	0	1.44	0	0.14
Commercial	72	86.34	9	10.81	2	2.56	0	0.29	0	0.00
Education	3	87.47	0	10.49	0	1.94	0	0.10	0	0.00
Government	2	87.63	0	10.28	0	1.99	0	0.10	0	0.00
Industrial	37	86.98	4	10.35	1	2.29	0	0.35	0	0.02
Religion	6	86.87	1	11.34	0	1.70	0	0.09	0	0.00
Residential	1,363	82.83	252	15.29	29	1.74	1	0.06	1	0.07
<b>Total</b>	<b>1,494</b>		<b>268</b>		<b>32</b>		<b>2</b>		<b>1</b>	

**Table 3: Expected Building Damage by Building Type : 500 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	13	87.03	2	10.55	0	2.32	0	0.09	0	0.00
Masonry	100	83.61	15	13.00	3	2.90	1	0.43	0	0.06
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	61	87.51	7	9.68	2	2.47	0	0.34	0	0.00
Wood	1,324	82.94	243	15.24	27	1.69	1	0.07	1	0.07

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	0
Police Stations	1	0	0	0
Schools	1	0	0	0

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 9,450 tons of debris will be generated. Of the total amount, Brick/Wood comprises 5% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 20 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 4.4 million dollars, which represents 1.16 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 4 million dollars. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 91% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	3,487.92	120.48	42.04	52.92	3,703.36
	Content	315.75	27.58	18.80	15.47	377.61
	Inventory	0.00	0.53	3.18	1.22	4.93
	<b>Subtotal</b>	<b>3,803.68</b>	<b>148.59</b>	<b>64.02</b>	<b>69.60</b>	<b>4,085.89</b>
<u>Business Interruption Loss</u>						
	Income	0.00	22.07	0.72	4.82	27.61
	Relocation	147.30	22.07	3.32	8.82	181.50
	Rental	42.76	13.73	0.35	0.59	57.44
	Wage	0.00	16.87	1.26	13.12	31.25
	<b>Subtotal</b>	<b>190.06</b>	<b>74.74</b>	<b>5.64</b>	<b>27.35</b>	<b>297.79</b>
<u>Total</u>						
	<b>Total</b>	<b>3,993.73</b>	<b>223.33</b>	<b>69.67</b>	<b>96.95</b>	<b>4,383.68</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 200-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

HAZUS estimates that about 4 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

**Table 2: Expected Building Damage by Occupancy : 200 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	14	95.11	1	4.02	0	0.62	0	0.24	0	0.01
Commercial	80	96.12	3	3.44	0	0.41	0	0.03	0	0.00
Education	3	96.56	0	3.28	0	0.16	0	0.00	0	0.00
Government	2	96.58	0	3.27	0	0.15	0	0.00	0	0.00
Industrial	40	96.37	1	3.35	0	0.24	0	0.04	0	0.00
Religion	7	96.50	0	3.34	0	0.15	0	0.01	0	0.00
Residential	1,560	94.83	81	4.94	4	0.23	0	0.00	0	0.00
<b>Total</b>	<b>1,706</b>		<b>87</b>		<b>4</b>		<b>0</b>		<b>0</b>	

**Table 3: Expected Building Damage by Building Type : 200 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	14	96.33	1	3.50	0	0.17	0	0.00	0	0.00
Masonry	113	94.95	5	4.50	1	0.50	0	0.06	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	68	96.51	2	3.16	0	0.30	0	0.03	0	0.00
Wood	1,515	94.90	78	4.88	3	0.21	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 6,118 tons of debris will be generated. Of the total amount, Brick/Wood comprises 2% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 6 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 1.6 million dollars, which represents 0.43 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 2 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 95% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	1,459.01	33.90	8.75	12.64	1,514.31
	Content	17.33	3.90	1.72	1.82	24.77
	Inventory	0.00	0.07	0.29	0.17	0.53
	<b>Subtotal</b>	<b>1,476.34</b>	<b>37.87</b>	<b>10.77</b>	<b>14.63</b>	<b>1,539.62</b>
<u>Business Interruption Loss</u>						
	Income	0.00	4.23	0.04	1.41	5.68
	Relocation	41.19	3.23	0.31	1.04	45.77
	Rental	13.51	1.97	0.04	0.09	15.61
	Wage	0.00	1.50	0.07	3.31	4.88
	<b>Subtotal</b>	<b>54.70</b>	<b>10.93</b>	<b>0.47</b>	<b>5.84</b>	<b>71.94</b>
<u>Total</u>						
	<b>Total</b>	<b>1,531.04</b>	<b>48.81</b>	<b>11.24</b>	<b>20.47</b>	<b>1,611.56</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 100-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

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

**Table 2: Expected Building Damage by Occupancy : 100 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	15	98.81	0	1.09	0	0.08	0	0.02	0	0.00
Commercial	82	98.82	1	1.11	0	0.07	0	0.00	0	0.00
Education	3	98.90	0	1.09	0	0.01	0	0.00	0	0.00
Government	2	98.87	0	1.12	0	0.01	0	0.00	0	0.00
Industrial	42	98.85	0	1.13	0	0.02	0	0.00	0	0.00
Religion	7	99.03	0	0.94	0	0.03	0	0.00	0	0.00
Residential	1,628	98.97	17	1.00	0	0.02	0	0.00	0	0.00
<b>Total</b>	<b>1,778</b>		<b>18</b>		<b>0</b>		<b>0</b>		<b>0</b>	

**Table 3: Expected Building Damage by Building Type : 100 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	98.74	0	1.26	0	0.00	0	0.00	0	0.00
Masonry	117	98.63	2	1.30	0	0.07	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	69	98.83	1	1.12	0	0.04	0	0.00	0	0.00
Wood	1,580	98.99	16	1.00	0	0.02	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 795 tons of debris will be generated. Of the total amount, Brick/Wood comprises 6% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 2 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 0.6 million dollars, which represents 0.17 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 1 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 98% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	628.55	10.04	2.48	3.41	644.48
	Content	0.24	0.00	0.00	0.00	0.24
	Inventory	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>628.79</b>	<b>10.04</b>	<b>2.48</b>	<b>3.41</b>	<b>644.72</b>
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.49	0.13	0.01	0.03	0.67
	Rental	0.11	0.00	0.00	0.00	0.11
	Wage	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.60</b>	<b>0.13</b>	<b>0.01</b>	<b>0.03</b>	<b>0.77</b>
<u>Total</u>						
	<b>Total</b>	<b>629.39</b>	<b>10.16</b>	<b>2.50</b>	<b>3.44</b>	<b>645.49</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 50-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

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

**Table 2: Expected Building Damage by Occupancy : 50 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	15	99.69	0	0.30	0	0.01	0	0.00	0	0.00
Commercial	83	99.60	0	0.40	0	0.01	0	0.00	0	0.00
Education	3	99.59	0	0.41	0	0.00	0	0.00	0	0.00
Government	2	99.57	0	0.43	0	0.00	0	0.00	0	0.00
Industrial	42	99.57	0	0.43	0	0.00	0	0.00	0	0.00
Religion	7	99.67	0	0.32	0	0.01	0	0.00	0	0.00
Residential	1,644	99.93	1	0.07	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,795</b>		<b>2</b>		<b>0</b>		<b>0</b>		<b>0</b>	

**Table 3: Expected Building Damage by Building Type : 50 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	99.52	0	0.48	0	0.00	0	0.00	0	0.00
Masonry	119	99.66	0	0.33	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	70	99.56	0	0.43	0	0.00	0	0.00	0	0.00
Wood	1,595	99.93	1	0.07	0	0.00	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 7 tons of debris will be generated. Of the total amount, Brick/Wood comprises 100% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 0.2 million dollars, which represents 0.04 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	165.33	2.64	1.07	0.73	169.78
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>165.33</b>	<b>2.64</b>	<b>1.07</b>	<b>0.73</b>	<b>169.78</b>
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.01	0.00	0.00	0.02
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.00</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.02</b>
<u>Total</u>						
	<b>Total</b>	<b>165.34</b>	<b>2.65</b>	<b>1.07</b>	<b>0.73</b>	<b>169.80</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 20-year Return Period

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

**Scenario Name:** Probabilistic

**Type:** Probabilistic

## Building Damage

### General Building Stock Damage

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

**Table 2: Expected Building Damage by Occupancy : 20 - year Event**

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	15	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	83	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	42	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	7	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	1,645	100.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,797</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>	

**Table 3: Expected Building Damage by Building Type : 20 - year Event**

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	119	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	70	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	1,596	100.00	0	0.00	0	0.00	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

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

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

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Category	Area	Residential	Commercial	Industrial	Others	Total
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	Building	0.00	0.00	0.00	0.00	0.00
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<u>Total</u>						
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## **Appendix A: County Listing for the Region**

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**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
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Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** Probabilistic 10-year Return Period

**Print Date:** Thursday, February 10, 2011

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## Building Damage

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Education	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00
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Residential	1,645	100.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,797</b>		<b>0</b>		<b>0</b>		<b>0</b>		<b>0</b>	

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Wood	1,596	100.00	0	0.00	0	0.00	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 0.0 million dollars, which represents 0.00 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

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	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<u>Total</u>						
	<b>Total</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Hurricane Event Report

**Region Name:** Sherman, CT

**Hurricane Scenario:** GLORIA

**Print Date:** Thursday, February 10, 2011

**Disclaimer:**

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

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

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## General Description of the Region

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

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

- Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,827 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 million dollars (2006 dollars). Approximately 92% of the buildings (and 88% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 1,797 buildings in the region which have an aggregate total replacement value of 379 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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

<b>Occupancy</b>	<b>Exposure (\$1000)</b>	<b>Percent of Tot</b>
Residential	331,887	87.5%
Commercial	26,394	7.0%
Industrial	10,735	2.8%
Agricultural	2,769	0.7%
Religious	4,330	1.1%
Government	438	0.1%
Education	2,532	0.7%
<b>Total</b>	<b>379,085</b>	<b>100.0%</b>

### Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 1 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

## Hurricane Scenario

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

<b>Scenario Name:</b>	GLORIA
<b>Type:</b>	Historic
<b>Max Peak Gust in Study Region:</b>	72 mph

## Building Damage

### General Building Stock Damage

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

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

Occupancy	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	15	99.51	0	0.47	0	0.02	0	0.00	0	0.00
Commercial	83	99.41	0	0.58	0	0.01	0	0.00	0	0.00
Education	3	99.43	0	0.57	0	0.00	0	0.00	0	0.00
Government	2	99.40	0	0.60	0	0.00	0	0.00	0	0.00
Industrial	42	99.40	0	0.59	0	0.00	0	0.00	0	0.00
Religion	7	99.54	0	0.45	0	0.01	0	0.00	0	0.00
Residential	1,641	99.77	4	0.23	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,792</b>		<b>5</b>		<b>0</b>		<b>0</b>		<b>0</b>	

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

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	15	99.32	0	0.68	0	0.00	0	0.00	0	0.00
Masonry	118	99.44	1	0.54	0	0.01	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	70	99.38	0	0.62	0	0.01	0	0.00	0	0.00
Wood	1,592	99.78	4	0.22	0	0.00	0	0.00	0	0.00

## **Essential Facility Damage**

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

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

Classification	Total	# Facilities		
		Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	1	0	0	1
Police Stations	1	0	0	1
Schools	1	0	0	1

## Induced Hurricane Damage

### **Debris Generation**

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

The model estimates that a total of 12 tons of debris will be generated. Of the total amount, Brick/Wood comprises 100% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

## Economic Loss

The total economic loss estimated for the hurricane is 0.3 million dollars, which represents 0.08 % of the total replacement value of the region's buildings.

### **Building-Related Losses**

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

The total property damage losses were 0 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 99% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

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

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Property Damage</u>						
	Building	297.39	2.64	1.07	0.73	301.84
	Content	0.02	0.00	0.00	0.00	0.02
	Inventory	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>297.41</b>	<b>2.64</b>	<b>1.07</b>	<b>0.73</b>	<b>301.85</b>
<u>Business Interruption Loss</u>						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.01	0.03	0.00	0.01	0.05
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.01</b>	<b>0.03</b>	<b>0.00</b>	<b>0.01</b>	<b>0.05</b>
<u>Total</u>						
	<b>Total</b>	<b>297.42</b>	<b>2.67</b>	<b>1.07</b>	<b>0.74</b>	<b>301.90</b>

## **Appendix A: County Listing for the Region**

Connecticut  
- Fairfield

**Appendix B: Regional Population and Building Value Data**

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	3,827	331,887	47,198	379,085
Total	3,827	331,887	47,198	379,085
Study Region Total	3,827	331,887	47,198	379,085

# HAZUS-MH: Earthquake Event Report

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**Region Name:** Sherman, CT

**Earthquake Scenario:** Portland 5.7

**Print Date:** February 10, 2011

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

**Disclaimer:**

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

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## General Description of the Region

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

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

Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region with a total population of 3,827 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 (millions of dollars). Approximately 92.00 % of the buildings (and 88.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 264 and 0 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 379 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 1 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 5 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 2 hazardous material sites, 0 military installations and 0 nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 264.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 4 bridges, 316 kilometers of pipes.

**Table 1: Transportation System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations/ # Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Highway</b>	Bridges	4	7.30
	Segments	4	257.40
	Tunnels	0	0.00
	Subtotal		<b>264.70</b>
<b>Railways</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Bus</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Ferry</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Port</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Airport</b>	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>264.70</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	3.20
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>3.20</b>
<b>Waste Water</b>	Distribution Lines	NA	1.90
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.90</b>
<b>Natural Gas</b>	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.30</b>
<b>Oil Systems</b>	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>0.00</b>
<b>Electrical Power</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Communication</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>6.30</b>

## Earthquake Scenario

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

<b>Scenario Name</b>	Portland 5.7
<b>Type of Earthquake</b>	Arbitrary
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	-72.60
<b>Latitude of Epicenter</b>	41.60
<b>Earthquake Magnitude</b>	5.70
<b>Depth (Km)</b>	10.00
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	CEUS Event

## Building Damage

### Building Damage

HAZUS estimates that about 4 buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	14	0.82	0	1.75	0	2.50	0	3.27	0	1.85
<b>Commercial</b>	80	4.51	2	10.34	1	17.80	0	23.91	0	17.79
<b>Education</b>	3	0.16	0	0.35	0	0.59	0	0.76	0	0.66
<b>Government</b>	2	0.11	0	0.22	0	0.35	0	0.42	0	0.25
<b>Industrial</b>	41	2.29	1	4.84	0	8.39	0	10.60	0	6.20
<b>Other Residential</b>	42	2.36	1	3.87	0	6.40	0	8.50	0	8.81
<b>Religion</b>	7	0.38	0	0.88	0	1.70	0	2.45	0	2.40
<b>Single Family</b>	1,582	89.36	17	77.76	3	62.27	0	50.10	0	62.03
<b>Total</b>	<b>1,771</b>		<b>22</b>		<b>4</b>		<b>0</b>		<b>0</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	1,580	89.21	15	66.44	1	31.38	0	0.00	0	0.00
<b>Steel</b>	68	3.82	1	6.42	0	9.63	0	9.52	0	0.00
<b>Concrete</b>	10	0.58	0	0.96	0	1.26	0	0.54	0	0.00
<b>Precast</b>	4	0.23	0	0.74	0	2.32	0	4.01	0	0.00
<b>RM</b>	14	0.82	0	1.53	0	3.85	0	5.14	0	0.00
<b>URM</b>	95	5.34	5	23.91	2	51.56	0	80.79	0	100.00
<b>MH</b>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,771</b>		<b>22</b>		<b>4</b>		<b>0</b>		<b>0</b>	

\*Note:

RM      Reinforced Masonry  
 URM    Unreinforced Masonry  
 MH      Manufactured Housing

## **Essential Facility Damage**

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

## Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	4	0	0	4	4
	Bridges	4	0	0	4	4
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	158	0	0
Waste Water	95	0	0
Natural Gas	63	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,434	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

### **Fire Following Earthquake**

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### **Debris Generation**

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

The model estimates that a total of 0.000 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 78.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

### **Casualties**

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
<b>2 AM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>2 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>5 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

## Economic Loss

The total economic loss estimated for the earthquake is 0.36 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

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

The total building-related losses were 0.36 (millions of dollars); 15 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 70 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

**Table 11: Building-Related Economic Loss Estimates**

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.00	0.00	0.01	0.00	0.00	0.01
	Capital-Related	0.00	0.00	0.01	0.00	0.00	0.01
	Rental	0.00	0.00	0.01	0.00	0.00	0.01
	Relocation	0.01	0.00	0.01	0.00	0.00	0.02
	<b>Subtotal</b>	<b>0.02</b>	<b>0.00</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.05</b>
<b>Capital Stock Losses</b>							
	Structural	0.04	0.00	0.01	0.00	0.00	0.05
	Non_Structural	0.15	0.00	0.02	0.01	0.01	0.19
	Content	0.05	0.00	0.01	0.00	0.00	0.06
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.23</b>	<b>0.00</b>	<b>0.04</b>	<b>0.02</b>	<b>0.02</b>	<b>0.30</b>
	<b>Total</b>	<b>0.25</b>	<b>0.00</b>	<b>0.07</b>	<b>0.02</b>	<b>0.02</b>	<b>0.36</b>

## Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	257.44	\$0.00	0.00
	Bridges	7.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Subtotal	<b>264.70</b>	<b>0.00</b>	
Railways	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
	<b>Total</b>	<b>264.70</b>	<b>0.00</b>	

**Table 13: Utility System Economic Losses**

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	3.20	\$0.00	0.01
	Subtotal	3.16	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.90	\$0.00	0.01
	Subtotal	1.90	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.30	\$0.00	0.01
	Subtotal	1.27	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	6.33	\$0.00	

**Table 14. Indirect Economic Impact with outside aid**  
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
<b>First Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	0.00
<b>Second Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Third Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Fourth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Fifth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01

## **Appendix A: County Listing for the Region**

Fairfield,CT

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut	Fairfield	3,827	331	47	379
Total State		3,827	331	47	379
Total Region		3,827	331	47	379

# HAZUS-MH: Earthquake Event Report

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**Region Name:** Sherman, CT

**Earthquake Scenario:** Haddam 5.7

**Print Date:** February 15, 2011

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

**Disclaimer:**

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

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## General Description of the Region

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

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

Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region with a total population of 3,827 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 (millions of dollars). Approximately 92.00 % of the buildings (and 88.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 264 and 0 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 379 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 1 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 5 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 2 hazardous material sites, 0 military installations and 0 nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 264.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 4 bridges, 316 kilometers of pipes.

**Table 1: Transportation System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations/ # Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Highway</b>	Bridges	4	7.30
	Segments	4	257.40
	Tunnels	0	0.00
	Subtotal		<b>264.70</b>
<b>Railways</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Bus</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Ferry</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Port</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Airport</b>	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>264.70</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	3.20
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>3.20</b>
<b>Waste Water</b>	Distribution Lines	NA	1.90
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.90</b>
<b>Natural Gas</b>	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.30</b>
<b>Oil Systems</b>	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>0.00</b>
<b>Electrical Power</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Communication</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>6.30</b>

## Earthquake Scenario

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

<b>Scenario Name</b>	Haddam 5.7
<b>Type of Earthquake</b>	Arbitrary
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	-72.55
<b>Latitude of Epicenter</b>	41.47
<b>Earthquake Magnitude</b>	5.70
<b>Depth (Km)</b>	10.00
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	CEUS Event

## Building Damage

### Building Damage

HAZUS estimates that about 3 buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	15	0.82	0	1.90	0	2.65	0	3.33	0	1.84
<b>Commercial</b>	80	4.52	2	11.07	1	18.61	0	24.00	0	17.71
<b>Education</b>	3	0.16	0	0.37	0	0.61	0	0.76	0	0.66
<b>Government</b>	2	0.11	0	0.23	0	0.36	0	0.42	0	0.25
<b>Industrial</b>	41	2.29	1	5.18	0	8.76	0	10.66	0	6.19
<b>Other Residential</b>	42	2.37	1	4.00	0	6.58	0	8.43	0	8.85
<b>Religion</b>	7	0.38	0	0.92	0	1.76	0	2.44	0	2.39
<b>Single Family</b>	1,586	89.34	14	76.33	2	60.66	0	49.98	0	62.12
<b>Total</b>	<b>1,775</b>		<b>19</b>		<b>3</b>		<b>0</b>		<b>0</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	1,583	89.17	12	64.25	1	28.27	0	0.00	0	0.00
<b>Steel</b>	68	3.82	1	6.92	0	10.18	0	9.80	0	0.00
<b>Concrete</b>	10	0.58	0	1.02	0	1.30	0	0.52	0	0.00
<b>Precast</b>	4	0.23	0	0.78	0	2.41	0	3.95	0	0.00
<b>RM</b>	15	0.82	0	1.61	0	3.91	0	5.12	0	0.00
<b>URM</b>	95	5.38	5	25.41	2	53.93	0	80.62	0	100.00
<b>MH</b>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,775</b>		<b>19</b>		<b>3</b>		<b>0</b>		<b>0</b>	

\*Note:

RM      Reinforced Masonry  
URM     Unreinforced Masonry  
MH      Manufactured Housing

## **Essential Facility Damage**

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

## Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	4	0	0	4	4
	Bridges	4	0	0	4	4
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	158	0	0
Waste Water	95	0	0
Natural Gas	63	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,434	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

### **Fire Following Earthquake**

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### **Debris Generation**

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

The model estimates that a total of 0.000 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 78.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

### **Casualties**

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
<b>2 AM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>2 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>5 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

## Economic Loss

The total economic loss estimated for the earthquake is 0.28 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

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

The total building-related losses were 0.28 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 69 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

**Table 11: Building-Related Economic Loss Estimates**

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.00	0.00	0.01	0.00	0.00	0.01
	Capital-Related	0.00	0.00	0.01	0.00	0.00	0.01
	Rental	0.00	0.00	0.01	0.00	0.00	0.01
	Relocation	0.01	0.00	0.01	0.00	0.00	0.02
	<b>Subtotal</b>	<b>0.01</b>	<b>0.00</b>	<b>0.03</b>	<b>0.00</b>	<b>0.00</b>	<b>0.05</b>
<b>Capital Stock Losses</b>							
	Structural	0.03	0.00	0.01	0.00	0.00	0.05
	Non_Structural	0.11	0.00	0.02	0.01	0.01	0.14
	Content	0.03	0.00	0.01	0.00	0.00	0.05
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	<b>Subtotal</b>	<b>0.18</b>	<b>0.00</b>	<b>0.03</b>	<b>0.01</b>	<b>0.01</b>	<b>0.23</b>
	<b>Total</b>	<b>0.19</b>	<b>0.00</b>	<b>0.06</b>	<b>0.01</b>	<b>0.02</b>	<b>0.28</b>

## Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	257.44	\$0.00	0.00
	Bridges	7.26	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Subtotal	<b>264.70</b>	<b>0.00</b>	
Railways	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
	<b>Total</b>	<b>264.70</b>	<b>0.00</b>	

**Table 13: Utility System Economic Losses**

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	3.20	\$0.00	0.01
	Subtotal	3.16	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.90	\$0.00	0.01
	Subtotal	1.90	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.30	\$0.00	0.01
	Subtotal	1.27	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	6.33	\$0.00	

**Table 14. Indirect Economic Impact with outside aid**  
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
<b>First Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	0.00
<b>Second Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	0.00
<b>Third Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Fourth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Fifth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01

## **Appendix A: County Listing for the Region**

Fairfield,CT

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut	Fairfield	3,827	331	47	379
Total State		3,827	331	47	379
Total Region		3,827	331	47	379

# HAZUS-MH: Earthquake Event Report

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**Region Name:** Sherman, CT

**Earthquake Scenario:** East Haddam 6.4

**Print Date:** February 10, 2011

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

**Disclaimer:**

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

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## General Description of the Region

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

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

Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region with a total population of 3,827 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 (millions of dollars). Approximately 92.00 % of the buildings (and 88.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 264 and 0 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 379 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 1 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 5 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 2 hazardous material sites, 0 military installations and 0 nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 264.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 4 bridges, 316 kilometers of pipes.

**Table 1: Transportation System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations/ # Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Highway</b>	Bridges	4	7.30
	Segments	4	257.40
	Tunnels	0	0.00
	Subtotal		<b>264.70</b>
<b>Railways</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Bus</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Ferry</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Port</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Airport</b>	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		<b>0.00</b>
		Total	<b>264.70</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	3.20
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>3.20</b>
<b>Waste Water</b>	Distribution Lines	NA	1.90
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.90</b>
<b>Natural Gas</b>	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.30</b>
<b>Oil Systems</b>	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>0.00</b>
<b>Electrical Power</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Communication</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>6.30</b>

## Earthquake Scenario

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

<b>Scenario Name</b>	East Haddam 6.4
<b>Type of Earthquake</b>	Arbitrary
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	-72.40
<b>Latitude of Epicenter</b>	41.50
<b>Earthquake Magnitude</b>	6.40
<b>Depth (Km)</b>	10.00
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	CEUS Event

## Building Damage

### Building Damage

HAZUS estimates that about 21 buildings will be at least moderately damaged. This is over 1.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	13	0.78	1	1.39	0	2.39	0	3.20	0	2.34
<b>Commercial</b>	72	4.29	7	7.77	3	16.17	0	21.06	0	21.25
<b>Education</b>	3	0.16	0	0.27	0	0.55	0	0.65	0	0.79
<b>Government</b>	2	0.10	0	0.18	0	0.38	0	0.41	0	0.41
<b>Industrial</b>	37	2.17	4	3.83	2	8.47	0	10.26	0	9.12
<b>Other Residential</b>	39	2.32	3	2.98	1	5.03	0	6.83	0	8.18
<b>Religion</b>	6	0.37	1	0.59	0	1.25	0	1.88	0	2.29
<b>Single Family</b>	1,512	89.80	76	83.00	13	65.75	1	55.72	0	55.62
<b>Total</b>	<b>1,684</b>		<b>91</b>		<b>19</b>		<b>2</b>		<b>0</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	1,514	89.92	72	78.52	9	47.41	0	20.45	0	0.00
<b>Steel</b>	61	3.62	6	6.05	3	13.51	0	13.36	0	8.87
<b>Concrete</b>	9	0.55	1	0.94	0	2.12	0	1.23	0	0.87
<b>Precast</b>	4	0.21	0	0.40	0	1.52	0	2.99	0	0.54
<b>RM</b>	13	0.80	1	0.95	1	2.95	0	4.46	0	0.00
<b>URM</b>	83	4.90	12	13.13	6	32.50	1	57.51	0	89.72
<b>MH</b>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,684</b>		<b>91</b>		<b>19</b>		<b>2</b>		<b>0</b>	

\*Note:

RM      Reinforced Masonry  
URM     Unreinforced Masonry  
MH      Manufactured Housing

## **Essential Facility Damage**

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

## Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	4	0	0	4	4
	Bridges	4	0	0	4	4
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	158	1	0
Waste Water	95	0	0
Natural Gas	63	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,434	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

### **Fire Following Earthquake**

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### **Debris Generation**

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

The model estimates that a total of 0.000 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 71.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

### **Casualties**

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
<b>2 AM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>2 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>5 PM</b>	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

## Economic Loss

The total economic loss estimated for the earthquake is 1.89 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

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

The total building-related losses were 1.88 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 70 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

**Table 11: Building-Related Economic Loss Estimates**

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.00	0.00	0.04	0.00	0.00	0.05
	Capital-Related	0.00	0.00	0.04	0.00	0.00	0.04
	Rental	0.02	0.00	0.03	0.00	0.00	0.05
	Relocation	0.06	0.00	0.04	0.01	0.01	0.12
	<b>Subtotal</b>	<b>0.08</b>	<b>0.01</b>	<b>0.14</b>	<b>0.01</b>	<b>0.02</b>	<b>0.26</b>
<b>Capital Stock Losses</b>							
	Structural	0.17	0.00	0.05	0.02	0.02	0.26
	Non_Structural	0.79	0.01	0.11	0.05	0.04	0.99
	Content	0.25	0.00	0.06	0.03	0.02	0.36
	Inventory	0.00	0.00	0.00	0.01	0.00	0.01
	<b>Subtotal</b>	<b>1.21</b>	<b>0.01</b>	<b>0.22</b>	<b>0.09</b>	<b>0.08</b>	<b>1.61</b>
	<b>Total</b>	<b>1.29</b>	<b>0.02</b>	<b>0.36</b>	<b>0.10</b>	<b>0.10</b>	<b>1.88</b>

## Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	257.44	\$0.00	0.00
	Bridges	7.26	\$0.00	0.05
	Tunnels	0.00	\$0.00	0.00
	Subtotal	<b>264.70</b>	<b>0.00</b>	
Railways	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
	<b>Total</b>	<b>264.70</b>	<b>0.00</b>	

**Table 13: Utility System Economic Losses**

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	3.20	\$0.00	0.13
	Subtotal	3.16	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.90	\$0.00	0.11
	Subtotal	1.90	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.30	\$0.00	0.06
	Subtotal	1.27	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	6.33	\$0.01	

**Table 14. Indirect Economic Impact with outside aid**  
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
<b>First Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Second Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.03
<b>Third Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.04
<b>Fourth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.04
<b>Fifth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.04
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.04

## **Appendix A: County Listing for the Region**

Fairfield,CT

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut	Fairfield	3,827	331	47	379
Total State		3,827	331	47	379
Total Region		3,827	331	47	379

# HAZUS-MH: Earthquake Event Report

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**Region Name:** Sherman, CT

**Earthquake Scenario:** Stamford 5.7

**Print Date:** February 10, 2011

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

**Disclaimer:**

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

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## General Description of the Region

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

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

Connecticut

Note:

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

The geographical size of the region is 23.32 square miles and contains 1 census tracts. There are over 1 thousand households in the region with a total population of 3,827 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 379 (millions of dollars). Approximately 92.00 % of the buildings (and 88.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 264 and 0 (millions of dollars) , respectively.

## Building and Lifeline Inventory

### **Building Inventory**

HAZUS estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 379 (millions of dollars) . Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 89% of the building inventory. The remaining percentage is distributed between the other general building types.

### **Critical Facility Inventory**

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 0 hospitals in the region with a total bed capacity of 0 beds. There are 1 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 5 dams identified within the region. Of these, 0 of the dams are classified as 'high hazard'. The inventory also includes 2 hazardous material sites, 0 military installations and 0 nuclear power plants.

### **Transportation and Utility Lifeline Inventory**

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 1 and 2.

The total value of the lifeline inventory is over 264.00 (millions of dollars). This inventory includes over 38 kilometers of highways, 4 bridges, 316 kilometers of pipes.

**Table 1: Transportation System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations/ # Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Highway</b>	Bridges	4	7.30
	Segments	4	257.40
	Tunnels	0	0.00
	Subtotal		<b>264.70</b>
<b>Railways</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Light Rail</b>	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		<b>0.00</b>
<b>Bus</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Ferry</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Port</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Airport</b>	Facilities	0	0.00
	Runways	0	0.00
	Subtotal		<b>0.00</b>
		Total	<b>264.70</b>

**Table 2: Utility System Lifeline Inventory**

<b>System</b>	<b>Component</b>	<b># Locations / Segments</b>	<b>Replacement value (millions of dollars)</b>
<b>Potable Water</b>	Distribution Lines	NA	3.20
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>3.20</b>
<b>Waste Water</b>	Distribution Lines	NA	1.90
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.90</b>
<b>Natural Gas</b>	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>1.30</b>
<b>Oil Systems</b>	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		<b>0.00</b>
<b>Electrical Power</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
<b>Communication</b>	Facilities	0	0.00
	Subtotal		<b>0.00</b>
		<b>Total</b>	<b>6.30</b>

## Earthquake Scenario

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

<b>Scenario Name</b>	Stamford 5.7
<b>Type of Earthquake</b>	Arbitrary
<b>Fault Name</b>	NA
<b>Historical Epicenter ID #</b>	NA
<b>Probabilistic Return Period</b>	NA
<b>Longitude of Epicenter</b>	-73.60
<b>Latitude of Epicenter</b>	41.15
<b>Earthquake Magnitude</b>	5.70
<b>Depth (Km)</b>	10.00
<b>Rupture Length (Km)</b>	NA
<b>Rupture Orientation (degrees)</b>	NA
<b>Attenuation Function</b>	CEUS Event

## Building Damage

### Building Damage

HAZUS estimates that about 13 buildings will be at least moderately damaged. This is over 1.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 below summarizes the expected damage by general building type.

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Agriculture</b>	14	0.80	1	1.40	0	2.31	0	2.76	0	2.02
<b>Commercial</b>	76	4.41	5	7.82	2	15.76	0	19.46	0	18.94
<b>Education</b>	3	0.16	0	0.26	0	0.53	0	0.61	0	0.69
<b>Government</b>	2	0.11	0	0.17	0	0.33	0	0.35	0	0.29
<b>Industrial</b>	39	2.25	2	3.68	1	7.72	0	8.94	0	7.04
<b>Other Residential</b>	40	2.34	2	3.19	1	5.56	0	7.03	0	8.61
<b>Religion</b>	6	0.37	0	0.65	0	1.40	0	1.94	0	2.38
<b>Single Family</b>	1,542	89.56	51	82.83	8	66.39	1	58.92	0	60.03
<b>Total</b>	<b>1,721</b>		<b>62</b>		<b>12</b>		<b>1</b>		<b>0</b>	

**Table 4: Expected Building Damage by Building Type (All Design Levels)**

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
<b>Wood</b>	1,542	89.60	48	76.70	5	43.34	0	21.27	0	0.00
<b>Steel</b>	65	3.77	3	5.15	1	10.12	0	9.27	0	2.13
<b>Concrete</b>	10	0.57	1	0.83	0	1.53	0	0.67	0	0.48
<b>Precast</b>	4	0.22	0	0.48	0	1.83	0	3.08	0	0.57
<b>RM</b>	14	0.80	1	1.10	0	3.43	0	4.45	0	0.00
<b>URM</b>	87	5.04	10	15.74	5	39.75	1	61.25	0	96.82
<b>MH</b>	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
<b>Total</b>	<b>1,721</b>		<b>62</b>		<b>12</b>		<b>1</b>		<b>0</b>	

\*Note:

RM      Reinforced Masonry  
URM     Unreinforced Masonry  
MH      Manufactured Housing

## **Essential Facility Damage**

Before the earthquake, the region had 0 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (0.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 0.00% of the beds will be back in service. By 30 days, 0.00% will be operational.

**Table 5: Expected Damage to Essential Facilities**

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	0	0	0	0
Schools	1	0	0	1
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

## Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

**Table 6: Expected Damage to the Transportation Systems**

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	4	0	0	4	4
	Bridges	4	0	0	4	4
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	158	0	0
Waste Water	95	0	0
Natural Gas	63	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,434	0	0	0	0	0
Electric Power		0	0	0	0	0

## Induced Earthquake Damage

### **Fire Following Earthquake**

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

### **Debris Generation**

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

The model estimates that a total of 0.000 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 74.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

## Social Impact

### **Shelter Requirement**

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,827) will seek temporary shelter in public shelters.

### **Casualties**

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	0	0	0	0

## Economic Loss

The total economic loss estimated for the earthquake is 1.43 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

### Building-Related Losses

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

The total building-related losses were 1.43 (millions of dollars); 11 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 72 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

**Table 11: Building-Related Economic Loss Estimates**

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
<b>Income Losses</b>							
	Wage	0.00	0.00	0.02	0.00	0.00	0.03
	Capital-Related	0.00	0.00	0.02	0.00	0.00	0.03
	Rental	0.01	0.00	0.02	0.00	0.00	0.03
	Relocation	0.04	0.00	0.02	0.00	0.01	0.07
	<b>Subtotal</b>	<b>0.05</b>	<b>0.01</b>	<b>0.08</b>	<b>0.01</b>	<b>0.01</b>	<b>0.16</b>
<b>Capital Stock Losses</b>							
	Structural	0.11	0.00	0.03	0.01	0.01	0.16
	Non_Structural	0.61	0.01	0.08	0.04	0.03	0.77
	Content	0.24	0.00	0.05	0.02	0.02	0.33
	Inventory	0.00	0.00	0.00	0.00	0.00	0.01
	<b>Subtotal</b>	<b>0.96</b>	<b>0.01</b>	<b>0.16</b>	<b>0.07</b>	<b>0.06</b>	<b>1.27</b>
	<b>Total</b>	<b>1.02</b>	<b>0.02</b>	<b>0.24</b>	<b>0.08</b>	<b>0.07</b>	<b>1.43</b>

## Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 14 presents the results of the region for the given earthquake.

**Table 12: Transportation System Economic Losses**  
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	257.44	\$0.00	0.00
	Bridges	7.26	\$0.00	0.01
	Tunnels	0.00	\$0.00	0.00
	Subtotal	<b>264.70</b>	<b>0.00</b>	
Railways	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
Airport	Facilities	0.00	\$0.00	0.00
	Runways	0.00	\$0.00	0.00
	Subtotal	<b>0.00</b>	<b>0.00</b>	
	<b>Total</b>	<b>264.70</b>	<b>0.00</b>	

**Table 13: Utility System Economic Losses**

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	3.20	\$0.00	0.04
	Subtotal	3.16	\$0.00	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.90	\$0.00	0.03
	Subtotal	1.90	\$0.00	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Lines	1.30	\$0.00	0.02
	Subtotal	1.27	\$0.00	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
	Total	6.33	\$0.00	

**Table 14. Indirect Economic Impact with outside aid**  
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
<b>First Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
<b>Second Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.02
<b>Third Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.03
<b>Fourth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.03
<b>Fifth Year</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.03
<b>Years 6 to 15</b>			
	Employment Impact	0	0.00
	Income Impact	0	-0.03

## **Appendix A: County Listing for the Region**

Fairfield,CT

**Appendix B: Regional Population and Building Value Data**

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut	Fairfield	3,827	331	47	379
Total State		3,827	331	47	379
Total Region		3,827	331	47	379

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**APPENDIX E**  
**RECORD OF MUNICIPAL ADOPTION**

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