TOWN OF OXFORD
NATURAL HAZARD MITIGATION PLAN UPDATE, 2014

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MMI #1452-11

Prepared for the:

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Mr. Bill Johnson, Planning and Zoning Commission
Mr. Samuel Gold, Council of Governments of the Central Naugatuck Valley

The consulting firm of Milone & MacBroom, Inc. (MMI) prepared the subject plan update, building upon the initial work completed by DELTA Environmental Services, Inc. in 2006. Since that time there have been many changes regarding planning requirements for local natural hazard mitigation plans. Thus, this plan has been significantly reformatted and updated from the original plan. The following individuals at MMI may be contacted prior to plan update adoption with questions or comments regarding the plan update using the contact information on the title page or the electronic mail addresses below:

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EXECUTIVE SUMMARY

Town of Oxford, Connecticut Natural Hazard Mitigation Plan Update

The primary purpose of a Natural Hazard Mitigation Plan (the 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. Oxford first developed a Plan in 2006.

Oxford has vulnerability to an array of natural hazards including inland flooding; high winds associated with hurricanes, summer storms, tornadoes, and winter storms; hail and lighting during summer storms; ice and snow during winter storms; earthquakes; dam failure; and wildfires. This 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).

Recent disasters have revealed that while local sheltering capacity is adequate, the existing emergency operations center is inadequately sized. Oxford is an important regional supply distribution point such that improvements are regionally important. In addition, an improved location for storing emergency food supplies and equipment is needed. Existing capabilities to mitigate and respond to natural hazards are considered generally effective for the current level of funding allotted.

Floods are likely to occur every year from a variety of natural hazards, although damaging floods have a lower chance of occurrence. Flooding along the Housatonic River and the Little River are of greatest concern to the community. A variety of actions including improved regulations, completion of mitigation projects, and joining FEMA's Community Rating System are recommended to improve Oxford's understanding of, and response to, flooding events. FEMA's HAZUS-MH loss estimation software was used to determine potential damages from a 1% annual chance event; such an event could cause more than $8 million in damages along the Housatonic River in Oxford.

Regarding other hazards, damaging winds are less likely to occur each year but upon occurrence will impact the entirety of Oxford. A recreation of the 1938 Hurricane in HAZUS-MH suggests that a repeat event would cause more than $14 million in damages to the community. Winter storms are also a major concern in the community. Suggested actions include improving tree-trimming capabilities and communications with the local electric utility. Earthquakes are a relatively minor concern. However, the worst-case scenario earthquake is expected to cause approximately $17 million in damages to Oxford based on HAZUS-MH modeling.

The final two hazards evaluated include dam failure and wildfire. Many dams exist in Oxford, with the Stevenson Dam being the most prominent. One suggestion from residents is for the Town to coordinate releases from dams in advance of a major storm event. Oxford is considered to be a low-risk area for wildfires with the exception of State Forest lands located throughout the community.

Suggested actions for mitigating each hazard are summarized in Section 10 and ranked on the basis of a STAPLEE analysis. The Emergency Management Director is the Local Coordinator of this plan and is responsible for implementing suggested actions and performing an annual review of the Plan and each suggested action. The Plan needs to be updated again within five years of its approval date by FEMA.

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LIST OF ACRONYMS

AEL	Annualized Earthquake Losses
ARC	American Red Cross
ASFPM	Association of State Floodplain Managers
BCA	Benefit Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BOCA	Building Officials and Code Administrators
CLEAR	Center for Land Use Education and Research (University of Connecticut)
CM	Centimeter
CRS	Community Rating System
DEEP	Department of Energy & Environmental Protection
DEMHS	Department of Emergency Management and Homeland Security
DFA	Dam Failure Analysis
DMA	Disaster Mitigation Act
DOT	Department of Transportation
DPW	Department of Public Works
EAP	Emergency Action Plan
ECC	Emergency Communications Center
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HURDAT	Hurricane Database (NOAA's)
HURISK	Hurricane Center Risk Analysis Program
ICC	International Code Council
IPCC	Intergovernmental Panel on Climate Change
KM	Kilometer
KT	Knot
LID	Low Impact Development
LOMC	Letter of Map Change
MM	Millimeter
MMI	Milone & MacBroom, Inc.
MPH	Miles per Hour
NAI	No Adverse Impact
NCDC	National Climatic Data Center
NESIS	Northeast Snowfall Impact Scale
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act

LIST OF ACRONYMS (Continued)

NOAA	The National Oceanic and Atmospheric Administration
OPM	Office of Policy and Management
POCD	Plan of Conservation and Development
PDM	Pre-Disaster Mitigation
RFC	Repetitive Flood Claims
RLP	Repetitive Loss Property
SCCOG	Southeastern Connecticut Council of Governments
SFHA	Special Flood Hazard Area
SLOSH	Sea, Lake and Overland Surges from Hurricanes
SRL	Severe Repetitive Loss
SSURGO	Soil Survey Geographic
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
TNC	The Nature Conservancy
USD	United States Dollars
USDA	United States Department of Agriculture
USGS	United States Geological Survey

LIST OF PLAN UPDATES

The previous HMP has been revised and updated in several ways to be compatible with new planning requirements as well as to present hazard information in a straightforward manner. General formatting updates to the HMP are presented below:

Section 1 – Introduction and Implementation – This section has been updated from the previous HMP to include information about existing grant programs, coordination with neighboring communities, and current information regarding the current planning process and progress monitoring. The suggested actions from the previous HMP are presented in this section along with a discussion of whether or not the action was completed, is still valid, or is no longer applicable. Section VI (Implementation, Monitoring, and Evaluation) of the previous HMP has been incorporated into this section and updated for the current plan.

Section 2 – Community Profile – This section updates the information from Section I-B (Setting) of the previous HMP and includes additional information regarding geology, climate, and demographics. It further provides a review of existing plans, regulations, and emergency services.

Sections 3 through 9 – Individual Hazards – Flooding (including from dam failure) and winter storms were the primary hazards evaluated in the previous HMP (Section II and Section III), and most of the information in the previous HMP for these hazards has been retained and updated. Section IV of the previous HMP discussed earthquakes and wind damage, while wildfires were given lesser mention as a potential hazard. This HMP update incorporates this information and introduces chapters for each individual hazard that provide a full assessment based on that in the previous HMP as well as currently available data. HAZUS-MH, FEMA's loss estimation software, is utilized to calculate potential damages from flooding, wind, and earthquake events.

In addition, the updated HMP addresses several data deficiencies of the previous plan. The data in this plan update represent the best available data for each hazard at a scale appropriate for local planning. In particular, this plan includes the following information that was not available or not required in 2006:

- *HAZUS-MH* Level 1 Analysis and results for flooding, wind events, and earthquakes;

- Information pertinent to specific recent hazard events, including Tropical Storm Irene, Winter Storm Alfred, the March 2010 flooding, and the winter 2010-2011 snowfall. The previous plan did not include specific information regarding recent disasters and therefore did not discuss any specific consequences;

- Additional detail regarding less frequent hazards such as earthquakes, dam failure, and wildfires; and

- Updated information regarding each hazard including more discussion regarding repetitive loss properties and challenges related to increasing magnitude and frequency of rainfall.

Section 10 – Suggested Actions – Section V of the previous HMP discussed the generation of Plan recommendations and the prioritization of projects, and Appendix A of the previous HMP presented a general list of potential mitigation measures for hazards. The previous HMP utilized a generalized prioritization scheme (high, medium, or low priority) based on several criteria, a method that is no longer approvable by FEMA. This plan update utilizes the STAPLEE method (described in Section 10) to prioritize suggested actions based on a numerical score.

Section 11 – Resources and References – Appendix F of the previous HMP included a list of technical and financial resources; this list has been updated and included in Section 11 along with a list of works consulted for this HMP update.

1.0 INTRODUCTION & IMPLEMENTATION

1.1 Background and Purpose

The goal of emergency management activities is to prevent loss of life and property. The four phases of emergency management include Mitigation, Preparedness, Response and Recovery. Mitigation differs from the remaining three phases in that hazard mitigation is performed with the goal to eliminate or reduce the need to respond. The term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. In the context of disasters, pre-disaster hazard mitigation is commonly defined as any sustained action that reduces or eliminates long-term risk to people, property, and resources from hazards and their effects.

The primary purpose of a hazard mitigation plan (HMP) 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 the identified hazards. Public safety and property loss reduction are the driving forces behind this plan. However, careful consideration also must be given to the preservation of history, culture and the natural environment of the region.

This HMP update was prepared specifically to identify hazards and potential mitigation measures in Oxford, Connecticut. Oxford's previous HMP was approved by the Federal Emergency Management Agency (FEMA) in late 2006 and is on file at the FEMA Region I office. The HMP expired in late 2011. 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. While an update of the previous HMP, this HMP has been reformatted to be consistent with current FEMA planning requirements.

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 FEMA-approved mitigation plan in order to be eligible to apply for and receive Hazard Mitigation Assistance (HMA) grants.

The HMA "umbrella" contains several competitive grant programs deigned to mitigate the impacts of natural hazards. This HMP update 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) and Flood Management Assistance (FMA) programs. These programs are briefly described below.

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. The "5% Initiative" is a subprogram that provides the opportunity to fun mitigation actions that are consistent with the goals and objectives of the State and local mitigation plans and meet all HMGP requirements, but for which it may be difficult to conduct a standard benefit-cost analysis (Section 1.5) to prove cost-effectiveness.

<u>Pre-Disaster Mitigation (PDM) Program</u>

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 HMPs 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 subject plan update was funded through the PDM program.

<u>Flood Mitigation Assistance (FMA) Program</u>

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.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL) programs and made the following significant changes to the FMA program:

- The definitions of repetitive loss and severe repetitive loss properties have been modified;
- Cost-share requirements have changed to allow more Federal funds for properties with repetitive flood claims and severe repetitive loss properties; and
- There is no longer a limit on in-kind contributions for the non-Federal cost share.

The NFIP provides the funding for the FMA program. The PDM and FMA programs are subject to the availability of appropriation funding, as well as any program-specific directive or restriction made with respect to such funds.

Effective August 15 2013, acquisitions and elevations will be considered cost-effective if the project costs are less than $276,000 and $175,000, respectively. Structures must be located in Special Flood Hazard Areas (the area of the 1% annual chance flood). The benefit-cost analysis (BCA) will not be required.

One potentially important change to the PDM, HMGP, and FMA programs is that "green open space and riparian area benefits can now be included in the project benefit cost ratio (BCR) once the project BCR reaches 0.75 or greater." The inclusion of environmental benefits in the project BCR is limited to acquisition-related activities.

Table 1-1 presents potential mitigation project and planning activities allowed under each FEMA grant program described above as outlined in the most recent HMA Unified Guidance document.

Table 1-1
Eligible Mitigation Project Activities by Program

Eligible Activities	HMGP	PDM	FMA
Property Acquisition and Structure Demolition or Relocation	X	X	X
Structure Elevation	X	X	X
Mitigation Reconstruction			X
Dry Floodproofing of Historic Residential Structures	X	X	X
Dry Floodproofing of Non-residential Structures	X	X	X
Minor Localized Flood Reduction Projects	X	X	X
Structural Retrofitting of Existing Buildings	X	X	
Non-structural Retrofitting of Existing Buildings and Facilities	X	X	X
Safe Room Construction	X	X	
Wind Retrofit for One- and Two-Family Residences	X	X	
Infrastructure Retrofit	X	X	X
Soil Stabilization	X	X	X
Wildfire Mitigation	X	X	
Post-Disaster Code Enforcement	X		
Generators	X	X	
5% Initiative Projects	X		
Advance Assistance	X		

Source: Table 3 – HMA Unified Guidance document

Many of the suggested actions developed in this plan fall within the above list of eligible activities.

1.2 Hazard Mitigation Goals

The primary goal of this hazard mitigation plan update is to ***prevent or minimize 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.

The previous HMP identified two goals, three policies, and seven objectives that guided the Oxford Hazard Mitigation Committee in the development of the original HMP. These goals, policies, and objectives continue to be valid, and have been summarized into the bullets below.

Updating, adopting, and implementing this HMP 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 continue to be available if the HMP is in place and approved. Like many communities, Oxford has a limited budget for mitigation activities. Some potential mitigation activities are expensive and cannot be performed without outside assistance and grant funding.

- ***Identify mitigation initiatives to be implemented if and when funding becomes available.*** This HMP will update the current list of suggested mitigation actions, 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 development in Oxford through inter-municipal coordination as well as interdepartmental coordination within Oxford.

- ***Improve the mechanisms for pre-disaster 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. Like many communities, Oxford has historically focused on hazard preparation and response rather than mitigation.

- ***Improve the ability to implement post-***

<u>Local Plan Development Process</u>

Local governments in Connecticut are the primary decision makers for land use, utilizing land use and planning documents to make decisions along with management measures, zoning, and other regulatory tools. Development of a HMP at the community level is therefore vital if the community is to effectively address natural hazards. While communities cannot prevent disasters from occurring, they can lessen the impacts and associated damages from such disasters. Effective planning improves a community's ability to respond to natural disasters and documents local knowledge on the most efficient and effective ways to reduce losses. The benefits of effective planning include reduced social, economic, and emotional disruption; better access to funding sources for natural hazard mitigation projects; and improve the community's ability to implement recovery projects.

disaster 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 region's ability to implement and maintain mitigation strategies. It is a preventive pre-disaster measure that is less costly than most structural projects.

- ***Complement future Community Rating System (CRS) efforts.*** Implementation of certain mitigation measures may increase a community's rating with the NFIP program and thus the benefits that it derives from FEMA. The Town of Oxford does not participate in the CRS but is interested in joining in the near future.

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. The 2006 HMP determined that the most significant natural hazards in the Town of Oxford are flooding (from hurricanes, tropical depressions, nor'easters, and heavy thunderstorms) and winter storms. Dam failure, earthquakes, and wind damage (from hurricanes and tornadoes) were also hazards of concern. Other hazards, including wildfire, drought, landslides, and extreme heat were considered but not deemed to be of significance.

Each hazard was reviewed in full to bring the updated plan into concurrence with the State of Connecticut HMP and other local HMPs in Connecticut. Based on a review of the 2006 HMP and other HMPs, the list of hazards has been reorganized and expanded to include the following:

- Flooding;
- Hurricanes and Tropical Storms;
- Summer Storms (including lightning, hail, and heavy winds) and Tornadoes;
- Winter Storms;
- Earthquakes;
- Dam Failure; and
- 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, Tables 1-2, 1-3, and 1-4 on the following pages provide summaries of the hazard events and hazard effects that impact Oxford and include criteria for characterizing the locations impacted by the hazard, the frequency of occurrence of the hazard, and the magnitude or severity of the hazards.

TABLE 1-2
Effects of Natural Hazards

Effects	Natural Hazard					
	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Wildfires	Earthquakes	Dam Failure
Inland Flooding	X	X				X
Flooding from Poor Drainage	X	X				
Wind	X	X	X			
Falling Trees/Branches	X	X	X			
Lightning	X	X				
Hail		X				
Snow			X			
Blizzard			X			
Ice			X			
Fire/Heat				X		
Smoke				X		
Shaking					X	
Dam Failure					X	X
Power Failure	X	X	X	X	X	

Table 1-3
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	0	2	5
Wildfires	1	1	1	3

Location

1 = small	isolated to specific area during one event
2 = medium	mulitple 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 ilnesses 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

Table 1-4
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**	
Snow	3	3	2	8
Flooding from Poor Drainage	3	3	1	7
Nor'Easter Winds	3	2	2	7
Blizzard	3	2	2	7
Hurricane Winds	3	1	3	7
Riverine & Floodplain Flooding	2	2	2	6
Flooding from Dam Failure	1	1	4	6
Ice	2	2	2	6
Thunderstorm and Tornado Winds	2	2	2	6
Shaking	3	0	2	5
Lightning	1	3	1	5
Falling Trees/Branches	2	2	1	5
Hail	1	2	1	4
Fire/Heat	1	1	1	3
Smoke	1	1	1	3

Location

1 = small	isolated to specific area during one event
2 = medium	mulitple 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 ilnesses 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

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

This HMP update begins with a discussion of the planning process, a review of the suggested actions from the previous HMP, and a discussion of the program for implementing, monitoring, and updating the plan. Next, a general discussion of Oxford's community profile, including the physical setting, demographics, development trends, governmental structure, and sheltering capacity is provided. The next several chapters of this HMP are each dedicated to a particular hazard event through six subsections. These include *Setting*; *Hazard Assessment*; *Typical Mitigation Measures, Strategies, and Alternatives; Historic Record; Existing Programs, Policies, and Mitigation Measures*; and *Vulnerabilities and Risk Assessment* and are described below.

- ***Setting*** addresses the general areas that are at risk from the hazard.

- ***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.

- ***Typical Mitigation Measures, Strategies, and Alternatives*** identifies typical mitigation alternatives, including those that may not be cost effective or are inappropriate for the community.

- ***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 community has undertaken in the past or is currently undertaking to mitigate the given hazard.

- ***Vulnerabilities and Risk Assessment*** focuses on the specific areas of the community 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. Recommended courses of action are identified in **bold** and summarized in Section 10.

This HMP update concludes with a discussion prioritizing the various suggested actions and a discussion of technical and financial resources.

1.4 Documentation of the Planning Process

The Town of Oxford is a member of the Council of Governments of the Central Naugatuck Valley (COGCNV), the regional planning body responsible for Oxford and 12 other member municipalities: Beacon Falls, Bethlehem, Cheshire, Middlebury, Naugatuck, Prospect, Southbury, Thomaston, Waterbury, Watertown, Wolcott, and Woodbury. All 13 communities have single-jurisdiction HMPs that are being updated through three separate grants. The subject HMP is being updated as part of a grant shared with Watertown and Woodbury.

The 2006 HMP was developed through a series of meetings, the completion of written questionnaires, personnel interviews, and workshops. The First Selectman was chosen to provide oversight of the plan development process and maximize local involvement. Department heads and chief elected officials received notices of all meetings and were encouraged to attend. Following the first meeting, a written questionnaire regarding potential hazard mitigation issues and opportunities in Oxford was distributed to all community officials.

Meeting notices and agendas were also sent to area media and to the Town Clerk's office for posting prior to each meeting. All meetings were held open to the public at the Oxford Town Hall. Verbal reports on progress were given at monthly meetings of the COGCNV which are routinely attended and covered by local newspapers. Attendance by other interested groups, agencies, and organizations was also encouraged at the individual community meetings. Two public meetings were held prior to plan adoption to specifically solicit input from the community.

Chief Scott Pelletier of the Town of Oxford coordinated the development of both the original HMP and this HMP update. Because this plan is an update of the original plan, the timeline was somewhat compressed and the number of meetings was held to a minimum. The data collection, evaluation, and outreach program is discussed herein, with the following being a list of meetings that were held as well as other efforts to develop the update:

- ***A data collection meeting with Oxford on July 24, 2013.*** Necessary documentation was collected, and problem areas within Oxford were discussed.

- ***A public information meeting was held September 25, 2013 at 7:00 p.m.*** The mitigation planning process was presented and public comments solicited. Notice of the meeting was posted to the town's web site and in the Town Hall on September 12, 2013.

- ***An internet-based survey was made available to residents from August 15, 2013 through September 13, 2013.*** The survey was designed to draw additional information from residents. An article with a link to the survey was posted to the Oxford Patch website on August 15, 2013 and to the Voices newspaper (online and in print) on August 28, 2013.

Residents, business owners, and other stakeholders of Oxford, neighboring communities, and local and regional entities were invited to attend the public information meeting and to participate in the survey via press release, a local weekly newspaper and website (VoicesNews.com) and via the Town's website as noted above. Copies of these announcements are included in Appendix A. Summaries of the outcomes of the meeting and survey are provided below.

The public information meeting on September 25, 2013 was held during the Board of Selectman regular meeting. Scott Halstead, the WPCA Agent, made a comment after the hearing that he has some concerns with sewer pumping stations. He stated that some stations that are located in low areas may be subject to flooding. This is a potential vulnerability that is discussed in Section 3.6.2.

<u>*Internet-Based Survey*</u>

A public survey was developed using surveymonkey.com and made available to residents from August 15 through September 13, 2013. The survey was co-hosted by the towns of Woodbury and Watertown as part of the coordinated planning effort shared by the three towns. One of the first questions in the survey invited participants to identify their town (Oxford, Watertown, or Woodbury). Six people from Oxford participated in the survey. Of the six participants, only four completed the survey. The other two did not record or save any responses. The four residents are located on Griswold Road, Wildflower Drive, Roosevelt Drive, and Old Church Road.

Participants were asked which recent events, if any, have generated awareness of natural hazards. Table 1-5 summarizes the responses.

Table 1-5
Contributors of Awareness of Natural Hazards

Events	Number of Participants Selecting
Winter Storm Nemo in February 2013	3
“Superstorm" Sandy in October 2012	4
"Winter Storm" Alfred in October 2011	3
Hurricane/Tropical Storm Irene in August 2011	2
The Virginia earthquake in August 2011	0
The Springfield, Massachusetts tornado of June 2011	2
The snowstorms of January 2011 that caused buildings to collapse	0
Write-in Responses: Flooding of 2011 (Housatonic River)	1

The next question asked responders to rate hazards on a scale of 1 (low threat) to 3 (high threat) in Oxford. Responses are presented in Table 1-6.

Table 1-6
Potential Hazard Threat Based on Survey Response

Hazard	Number of Participants Selecting		
	Low Threat	Moderate Threat	High Threat
Flooding	3	1	
Hurricanes and Tropical Storms	1	3	
Tornadoes	4		
Severe Thunderstorms (including hail or downbursts)	2		2
Winter Storms (including snow or ice) and Blizzards	1		3
Earthquakes	4		
Wildfires and Brush Fires	2	2	
Sinkholes or Subsidence	3	1	
Dam Failure (could be caused by other hazards)	3	1	

The follow-up question asks which hazards have impacted the participant’s home or business. Table 1-7 summarizes these results.

Table 1-7
Impact to Responder's Home or Business

Hazard	Number of Participants Selecting
Flooding	1
Hurricanes and Tropical Storms	3
Tornadoes	--
Severe Thunderstorms (including hail or downbursts)	1
Winter Storms (including snow or ice) and Blizzards	4
Earthquakes	--
Wildfires and Brush Fires	--
Sinkholes or Subsidence	--
Dam Failure (could be caused by other hazards)	--

When asked if any specific areas of Oxford were vulnerable to any of the above hazards, one participant entered "Towantic Brook and dam on Towantic Pond" and the other entered "Little River flooded Route 67 after hurricane."

The next question asked what are the most important things that the community can do to help its residents or organization be prepared for a disaster, and become more resilient over time. Responses are presented in Table 1-8.

Table 1-8
Most Important Community Mitigation Measures Based on Survey Response

Actions	Number of Participants Selecting
Provide outreach and education to residents, businesses, and organizations to help them understand risks and be prepared	3
Provide technical assistance to residents, businesses, and organizations to help them reduce losses from hazards and disasters	1
Conduct projects in the community, such as drainage and flood control projects, to mitigate for hazards and minimize impacts from disasters	3
Make it easier for residents, businesses, and organizations to take their own actions to mitigate for hazards and become more resilient to disasters	1
Improve warning and response systems to improve disaster management	1
Enact and enforce regulations, codes, and ordinances such as zoning regulations and building codes	--

Participants offered the following additional comments regarding what the town could do:

- "Do a better job controlling runoff into ponds & streams, and removing dead/dying trees from town rights of way"
- "Coordinate water release at dams before storms"

When asked if the responder has taken any actions to reduce the risk or vulnerability to his or her family, home, or organization, responses were as presented in Table 1-9.

Table 1-9
Personal Mitigation Measures Taken Based on Survey Response

Actions	Number of Participants Selecting
Elevated my home or business to reduce flood damage	--
Floodproofed my business to reduce flood damage	--
Installed storm shutters or structural/roof braces to reduce wind damage	--
Taken measures to reduce snow build-up on roofs	1
Cut back or removed vegetation from my overhead utility lines or roof	2
Replaced my overhead utility lines with underground lines	--
Managed vegetation to reduce risk of wildfire reaching my home or business	1
Developed a disaster plan for my family, home, or business	1
Maintain a disaster supply kit for my family, home, or business	1
I have not taken any of these actions	1
Write-in Responses:	
Installed generator or standby power supply	2

When asked "If you could choose one action that could be taken in your town to reduce vulnerability to hazards and the disasters associated with these hazards, what would it be," participant answered with the following:

- Reduce vulnerability of Chestnut Tree Hill Rd to being closed & loss of power due to falling trees
- Improve snow removal processes
- Attention to vegetation above power lines

None of the participants provided additional contact information for follow-up.

In addition to the public outreach described above, the 13 COGCNV municipalities participated in a regional newspaper story about the plan update process and the need to remain eligible for potential hazard mitigation grants. The story, "Ready for Nature's Nastiness," was printed in the September 28, 2013 edition of the Waterbury Republican American, which maintains readership in all 13 COGCNV communities. A copy is included in Appendix A. The article noted that all of the municipalities were in various stages of the planning process. Potential mitigation projects in several of the towns were described. The article ended with a statement that residents and business owners can send ideas and comments for the plans to the COGCNV at the email address comments@cogcnv.org.

Additional opportunities for the public to review this plan update were implemented in advance of the public hearing to adopt this plan following receiving conditional approval from FEMA. The draft plan update that sent for FEMA review was posted on the Town (http://www.oxford-ct.org/) website and the COGCNV website (http://www.cogcnv.org/) to provide opportunities for public review and comment. The public and interested parties were notified of the opportunity to review the Plan via the two websites. No comments were received.

1.5 Coordination with Neighboring Communities

Oxford has coordinated with neighboring municipalities both within and without the COGCNV planning area in the past relative to hazard mitigation and emergency preparedness and will continue to do so. Table 1-10 presents a list of the communities that lie adjacent to Oxford.

Table 1-10
Municipalities Adjacent to Oxford

City / Town	Hazard Mitigation Plan Status
Borough of Naugatuck	Single Jurisdiction Plan (2009)
Town of Beacon Falls	Single Jurisdiction Plan (2009)
Town of Middlebury	Single Jurisdiction Plan (2009)
Town of Monroe	Multi-Jurisdiction Plan (2007)
Town of Newtown	No Plan
Town of Seymour	Multi-Jurisdiction Plan (2013)
Town of Shelton	Multi-Jurisdiction Plan (2013)
Town of Southbury	Single Jurisdiction Plan (2009)

Input from neighboring communities was sought during the development of the 2006 HMP through outreach to the chief elected officials of those communities. Specific outreach was provided to the communities of Shelton and Monroe regarding flooding along the Housatonic River downstream of the Stevenson Dam.

Adjacent communities were given ample opportunity to review and comment on this HMP update. Each surrounding community was individually invited via written correspondence to participate in the planning process (refer to Appendix A for copies of the letters and written responses). One response was received:

- A representative of the Newtown Land Use Agency responded via telephone to state that there are many potential flood-related projects that Newtown and Oxford could collaborate on along the Housatonic River. In particular, improved communications between both communities and First Light should be pursued regarding emergency response along the Housatonic River at Lake Zoar.

1.6 Summary of Previous Suggested Actions and Plan Implementation

Section V of the 2006 HMP provided a list of suggested mitigation actions that are reprinted below in Table 1-11. Potential actions were assigned priorities and responsible departments. Each action item has been reviewed by Town of Oxford personnel and marked as *completed*, *deferred*, or *deleted* with the reasoning for this decision. Deferred and amended actions are carried forward to the current list of potential mitigation actions presented in Section 10 of this HMP update, while completed mitigation actions are discussed as capabilities where appropriate.

Table 1-11
Summary of Previous Suggested Actions

Project	Priority	Responsible Department	Comment	Status
Improve emergency communications system between police, fire, EMS, and public works.	High	Emergency Management	The communications system has been updated.	Completed
Complete licensing of repeater/voting receiver communication system with FCC.	High	Emergency Management	This system is in place.	Completed
Evaluate the hazard-resistant nature of all critical facilities.	High	Emergency Management	This is performed annually and is a capability.	Completed
Review town roadway system to identify critical risks such as long cul-de-sacs and evaluate alternative access.	Medium	Planning Department	This is performed annually and is a capability.	Completed
Maintain emergency personnel training as well as maintaining and updating emergency equipment.	Medium	Emergency Management	This is done as needed and is a capability.	Completed
Develop a plan to evaluate standby power supplies at critical facilities and then pursue installation of generators.	Medium	Emergency Management	This has been completed and evaluations continue annually.	Completed
Improve system of notifying residents of flooding and controlled releases on the Housatonic River.	High	Selectman's Office & Emergency Management	This has been completed with the institution of the CodeRED emergency notification system.	Completed
Pursue funding to mitigation flood hazards at properties in Under the Rocks Park (elevations, acquisitions, levees).	High	Selectman's Office	This is in progress and should continue to be a suggested action	Deferred
Pursue funding and complete public works projects to mitigate flood hazards in the vicinity of the Little River	High	Department of Public Works	No progress to date. Deferred to plan update	Deferred
Evaluate potential flood mitigation projects; conduct engineering study to prioritize culvert and small bridge replacement projects.	High	Department of Public Works	No progress to date. Deferred to plan update	Deferred
Develop a Flood Audit Program.	Medium	Planning Department	Floodprone properties are well known. Completing audits will be too expensive.	Deleted
Evaluate the potential of obtaining flood hazard area to preserve as open space.	Medium	Planning Department	Town has a wish list for open space. Acquisitions occur as land is available.	Deferred
Evaluate and consider burying power lines underground.	Low	Planning Department	Considered too expensive for existing utilities.	Deleted
Review plans for snow removal to assure critical facilities are given priority.	Medium	Department of Public Works	This has been completed and routes are reviewed annually.	Completed
Review communication with CL&P to assure efficient response to downed lines.	Medium	Department of Public Works	This is ongoing and should be included in plan update.	Deferred

Section VI of the previous HMP outlined the proposed implementation, monitoring, and evaluation of the HMP. Oxford was to be responsible for implementation of hazard mitigation actions utilizing its own budgetary resources to the extent available to implement recommended mitigation actions. Oxford was further expected to work with the COGCNV to identify and pursue funding resources. The First Selectman's Office was to administer and implement the plan, with projects involving structural actions being the responsibility of the Public Works Department, actions involving local regulations being the responsibility of the Planning and Zoning Department, and actions involving emergency communications being the responsibility of the Emergency Management Director.

Section VI of the previous HMP further noted that the COGCNV would convene the Hazard Mitigation Committee to meet on or before the fifth anniversary of the adoption of the HMP to review the implementation process as well as the goals, objectives, and actions outlined in the HMP. The First Selectman was identified as the Local Coordinator in charge of implementing and monitoring the progress of the plan. An annual review was to take place to review each element or objective of the plan, discuss accomplishments of the previous year, and provide recommendations for new projects or revised objectives.

However, the recent economic downturn left Oxford with little funding to perform mitigation projects. The local budget was reduced often eliminating potential funding for costly mitigation actions. Staff hours were also reduced such that staff needed to concentrate on day to day activities which left little or no time to attempt to implement mitigation projects. In addition, no specific method was presented in the previous plan to track the initiation, status, and completion of mitigation activities, so this type of information was not formally recorded in most instances.

Overall, the presentation of mitigation actions in the previous HMP was very helpful in guiding mitigation planning. Local officials expressed that the HMP was useful in identifying their jurisdiction's vulnerability to natural hazards. As noted in Table 1-11, Oxford was still able to perform some low- and moderate-cost mitigation actions during the economic downturn despite the time and budget constraints. However, the implementation and monitoring language was in two separate sections and called for an implementation review immediately prior to the next planning process. These facts led to the recommended review not actually occurring.

This HMP update presents an *annual* implementation strategy for Oxford, identifies a local coordinator who will be responsible for the implementation and progress monitoring of the HMP, and provides a specific list of items to be followed in order to properly implement, monitor, and eventually update the HMP. This information is required under current planning guidelines and is presented in Section 1.7, Section 1.8, and Section 1.9.

1.7 Implementation Strategy and Schedule

The Town of Oxford will be responsible for ensuring adoption of this HMP. Oxford understands that HMP update will be considered current for five years from the date FEMA issues final approval of the plan. A matrix in Section 10 of this HMP update presents deferred actions from the previous HMP as well as new mitigation actions to consider. An implementation strategy and schedule is also identified for each action, detailing the responsible department and anticipated time frame for completing the mitigation action if funding is available.

A sample adoption worksheet is presented in Appendix B. The final record of adoption will also be located in this appendix. Upon adoption at the local level, this HMP will be made available to all community departments as a planning tool to be used in conjunction with existing documents and regulations. It is expected that revisions to other community plans and regulations such as the Plan of Conservation and Development, department annual budgets, and Zoning and Subdivision Regulations may reference this plan and its updates. **The Local Coordinator (Emergency Management Director) will be responsible for ensuring that the actions identified are incorporated into local planning activities within five years from the date of adoption or when other plans are updated, whichever is sooner.**

Table 1-12 cross-references those plans and regulations that may be most important for updating relative to the HMP, and provides a summary of how those plans and regulations were updated based on the information within, and recommendations of, the previous HMP.

Table 1-12
Plans and Regulations to be Potentially Updated

Regulation or Plan	Revisions Based on Initial HMP	Status Relative to HMP Update	Responsible Party
Emergency Operations Plan (Annual)	Vulnerable areas of the community were specified in the plan.	The next revision of this plan will incorporate elements of the HMP.	Emergency Management Director
Plan of Conservation and Development (2007)	Many of the general strategies and concerns of the previous HMP were incorporated into the plan.	The POCD update is underway and will incorporate elements of the HMP Update.	Planning and Zoning Commission
Long Range Plan (2009)	Many of the general strategies and concerns of the previous HMP were incorporated into the plan.	The next major revision of this plan will incorporate elements of the HMP.	Office of the First Selectman
Planning & Zoning Regulations / Flood Plain Management Ordinance	These regulations were not specifically updated as a result of recommendations of the previous HMP.	Several recommendations of HMP Update to be incorporated.	Planning and Zoning Commission
Subdivision Regulations	These regulations were not specifically updated as a result of recommendations of the previous HMP.	Several recommendations of HMP Update to be incorporated.	Planning and Zoning Commission
Inland Wetland Regulations	These regulations were not specifically updated as a result of recommendations of the previous HMP.	No changes needed at present time.	Not applicable

The First Selectman will be responsible for assigning appropriate Town officials to update portions of the plans and regulations in Table 1-12 if it is determined that such updates are appropriate. Should a general revision be too cumbersome or cost prohibitive, simple addendums to these documents will be added that include the provisions of this HMP within the five-year timeframe. The Plan of Conservation and Development is most likely to benefit from the inclusion of mitigation-related goals and recommendations, as it already includes discussion of important demographic information pertinent to long-range planning.

The Planning and Zoning Commission is listed multiple times in Table 1-12 and on the implementation table (Table 10-1). This commission has demonstrated relatively rapid action in the past as a result of receiving recommendations from a plan. The Town of Oxford anticipates that the commission will continue to be able to actively implement certain recommendations of this HMP in a reasonable timeframe.

Finally, the Local Coordinator (Emergency Management Director) will be responsible for ensuring that 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 herein. This will primarily include the annual budget and capital improvement project lists maintained by the Department of Public Works.

1.8 Progress Monitoring and Participation

The following instructions shall be followed by the Local Coordinator. The Local Coordinator will be responsible for monitoring the successful implementation of this HMP update, and will provide the linkage between the multiple departments involved in hazard mitigation at the local level relative to communication and participation. As the plans will be adopted by the local government, coordination is expected to be able to occur without significant barriers.

Site reconnaissance for Specific Suggested Actions – The Local Coordinator, with the assistance of appropriate department personnel, will annually perform reconnaissance-level inspections of sites that are subject to specific actions. This will ensure that the suggested actions remain viable and appropriate. Examples include home acquisitions or elevations, structural projects such as culvert replacements, roadway elevations, and water main extensions for increased fire suppression capabilities. The worksheets in Appendix C will be filled out for specific project-related actions as appropriate. These worksheets are taken from the *Local Mitigation Planning Handbook.*

The local coordinator will be responsible for obtaining a current list of repetitive loss properties (RLPs) in the community each year. This list is available from the State Hazard Mitigation Officer or NFIP Coordinator. The RLPs shall be subject to a windshield survey at least once every two years to ensure that the list is reasonably accurate relative to addresses and other basic information. Some of the reconnaissance-level inspections could occur incidentally during events such as flooding when response is underway.

Annual Reporting and Meeting – The Local Coordinator will be responsible for having an annual meeting to review the plan. Matters to be reviewed on an annual basis include the goals and objectives of the HMP, hazards or disasters that occurred during the preceding year, mitigation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and suggested actions for new projects and revised activities. Results of site reconnaissance efforts will be reviewed also. A meeting should be conducted in July or August of each year, at least two months before the annual application cycle for grants under the HMA program[1]. This will enable a list of possible projects to be circulated to applicable local

[1] PDM and FMA applications are typically due to the State in October of any given year.

departments to review and provide sufficient time to develop a grant application. The Local Coordinator shall prepare and maintain documentation and minutes of this annual review meeting.

Post-Disaster Reporting and Metering – Subsequent to federally-declared disasters in the State of Connecticut for New Haven County, a meeting shall be conducted by the Local Coordinator with representatives of appropriate departments to develop a list of possible projects for developing an HMGP application. The Local Coordinator shall prepare a report of the recent events and ongoing or recent mitigation activities for discussion and review at the HMGP meeting. Public outreach may be solicited for HMGP applications at a *separate* public meeting.

Continued Public Involvement – Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the HMP. Public input can be solicited through community meetings, presentations on local cable access channels, and input to web-based information gathering tools. Public comment on changes to the HMP may be sought through posting of public notices and notifications posted on local websites and the COGCNV website.

1.9 Updating the Plan

Updates to this HMP will be coordinated by the Local Coordinator with the assistance of the COGCNV. The Town of Oxford understands that this HMP will be considered current for a period of five years from the date of approval with the expiration date reported by FEMA via the approval letter. The Local Coordinator will be responsible for compiling the funding required to update the HMP in a timely manner such that the current plan will not expire while the plan update is being developed. This will ensure that the opportunity to apply for funding is available should an untimely disaster occur.

Table 1-13 presents a schedule to guide the preparation for the plan update and then the actual update of the plan. The schedule assumes that the current version of this plan will be adopted in Spring 2014 and will therefore expire in Spring 2019.

Table 1-13
Schedule for Hazard Mitigation Plan Update

Month and Year	Tasks
July or August 2014	Annual meeting to review plan content and progress
July or August 2015	Annual meeting to review plan content and progress
July or August 2016	Annual meeting to review plan content and progress
June 2017	Ensure that funding for the plan update is included in the fiscal year 2017-2018 budget
July or August 2017	Annual meeting to review plan content and progress
January 2018	Secure consultant to begin updating the plan, or begin updating in-house (Local Coordinator)
July or August 2018	Annual meeting to review plan content and progress
November 2018	Forward draft updated plan to CT DEMHS for review
Winter 2018-2019	Process edits from CT DEMHS and FEMA and obtain the Approval Pending Adoption (APA)
Spring 2019	Adopt updated plan

To update the Plan, the Local Coordinator will coordinate the appropriate group of local officials consisting of representatives of many of the same departments solicited for input to this HMP. In addition, local business leaders, community and neighborhood group leaders, relevant private and nonprofit interest groups, and the neighboring municipalities will be solicited for representation. These communities were outlined in Table 1-10.

The project action worksheets prepared by the Local Coordinator and annual reports described in Section 1.8 above for Oxford will be reviewed. In addition, the following questions will be asked:

- Do the mitigation goals and objectives still reflect the concerns of local residents, business owners, and officials?
- Have local conditions changed so that findings of the risk and vulnerability assessments should be updated?
- Are new sources of information available that will improve the risk assessment?
- If risks and vulnerabilities have changed, do the mitigation goals and objectives still reflect the risk assessment?
- What hazards have caused damage locally since the last edition of the HMP was developed? Were these anticipated and evaluated in the HMP or should these hazards be added to the plan?
- Are current personnel and financial resources at the local level sufficient for implementing mitigation actions?
- For each mitigation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles?
- For each mitigation action that has been completed, was the action effective in reducing risk?
- What mitigation actions should be added to the plan and proposed for implementation?
- If any proposed mitigation actions should be deleted from the plan, what is the rationale?

Future HMP updates may include deleting suggested actions as projects are completed, adding suggested actions as new hazard effects arise, or modifying hazard vulnerabilities as land use changes. For instance, with reference to Table 1-11, several suggested actions were removed from the HMP while preparing this update because they are capabilities, they were successfully completed, or they were subsumed by more specific actions.

2.0 COMMUNITY PROFILE

2.1 Physical Setting

The Town of Oxford was incorporated as a town in 1798. It is located in western New Haven County in southern Connecticut approximately 18 miles north of Bridgeport and 16 miles northwest of New Haven. It is located in the western portion of the COGCNV region. It is bordered to the north by the Town of Middlebury, to the east by the Borough of Naugatuck and the Town of Beacon Falls, to the south by the Towns of Seymour and Monroe and the City of Shelton, and to the west by the Towns of Newtown and Southbury. Refer to Figures 2-1 and 2-2 for maps showing the regional location of Oxford within the COGCNV region. The varying terrain and land uses in the community results in vulnerability to an array of natural hazards.

2.2 Existing Land Use

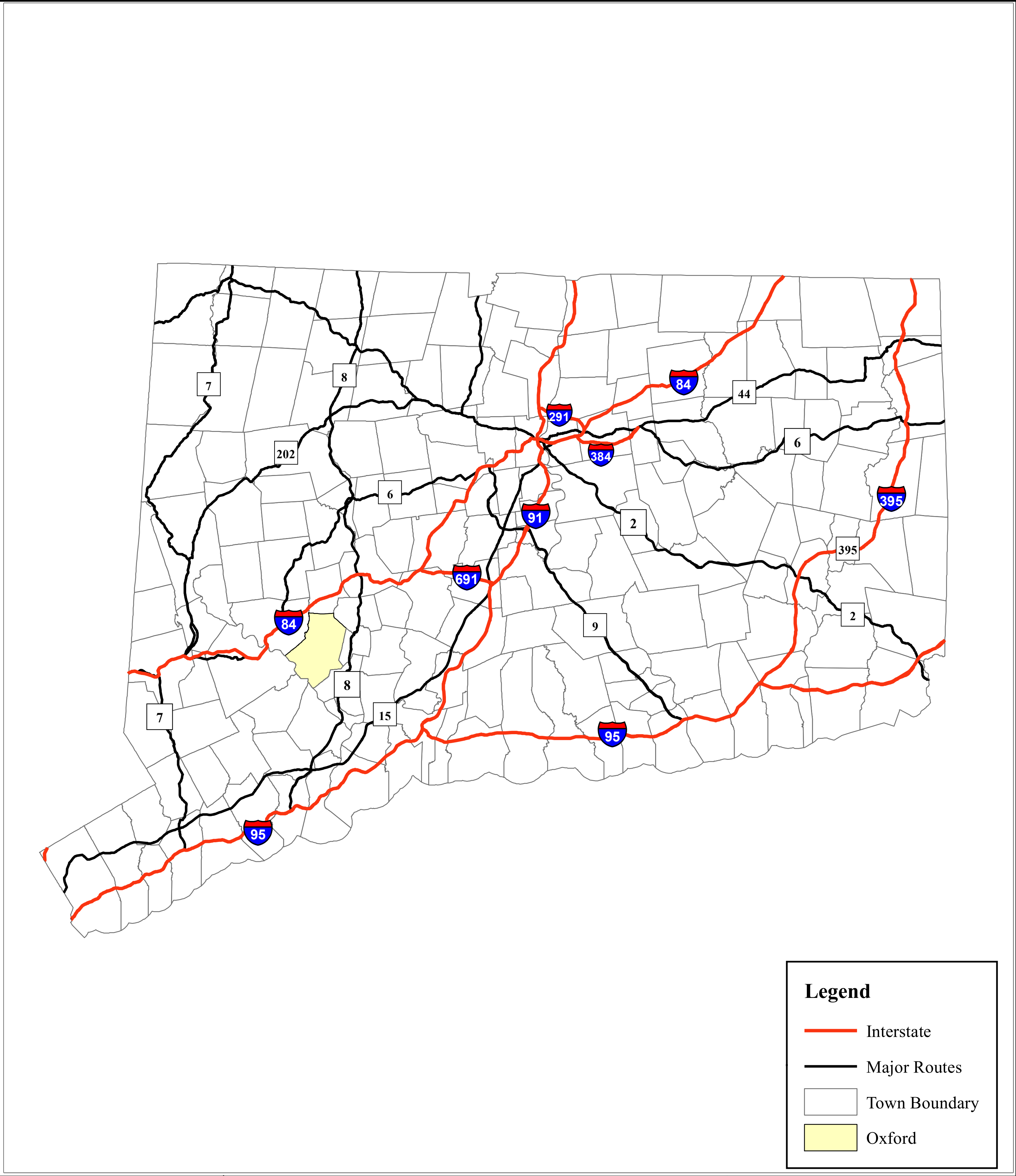
The land area of Oxford is approximately 32.6 square miles with an additional 0.8 square miles of water. Oxford is slowly transitioning from a rural community to a suburban community associated with the nearby cities of New Haven, Waterbury, Danbury, and Bridgeport. The majority of development is concentrated in the vicinity of State Routes 34, 42, 67, and 188. Access to major highways is available along these route to Interstate 84 in Southbury and Route 8 in Beacon Falls, Seymour, and Derby. State parks and forests in Oxford include Kettletown State Park, Southford Falls State Park, and the Naugatuck State Forest.

Table 2-1 summarizes 2006 land cover data which was derived from satellite imagery. Areas shown as turf and grass are maintained grasses such as residential and commercial lawns or golf courses. Development is generally spread throughout the community and not particularly concentrated in any one area. According to this data, about 73% of Oxford is forested and approximately 15% is developed.

Table 2-1
2006 Land Cover by Area

Land Cover	Area (acres)	Percent of Community
Deciduous Forest	13,340	64.2%
Developed	3,089	14.5%
Turf & Grass	1,211	5.7%
Coniferous Forest	1,123	5.3%
Agricultural Field	783	3.7%
Forested Wetland	549	2.6%
Water	491	2.3%
Other Grasses	367	1.7%
Barren	197	0.9%
Utility (Forest)	154	0.7%
Non-Forested Wetland	29	0.1%
Tidal Wetland	0	0.0%
Total	**21,333**	**100%**

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



SOURCE(S):
"Town boundary",
"Interstates", CT DEEP

Figure 2-1: Oxford Location Map

LOCATION:
Oxford, CT

Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2_1.mxd

Map By: JDW
MMI#: 1452-11
Original: 07/18/2013
Revision: 8/6/2013
Scale: 1 inch = 14 miles

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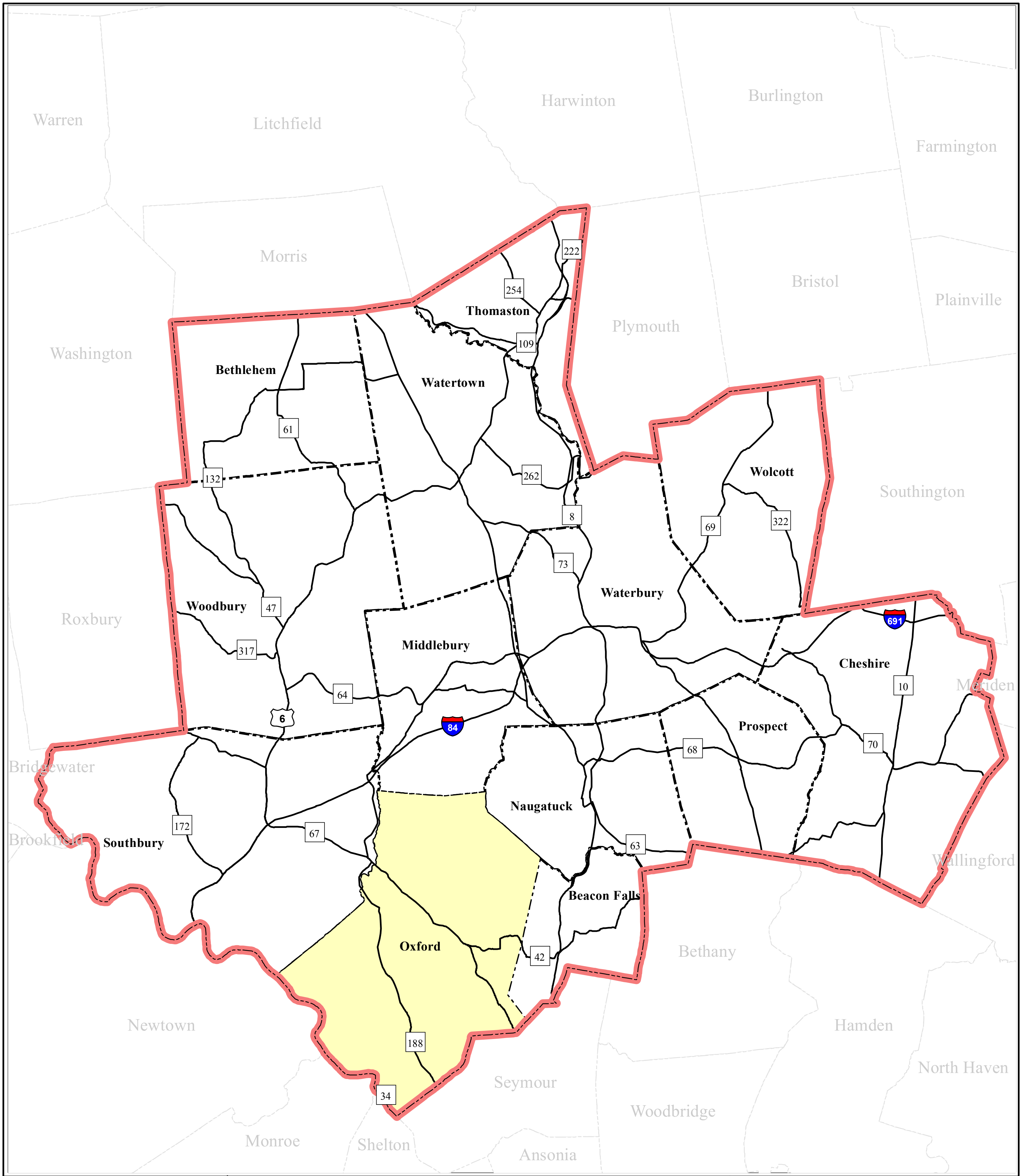

SOURCE(S):
"Town Boundary", "State Routes", CT DEEP

Figure 2-2: Oxford in the CNVR

LOCATION: **Oxford, CT**

N

Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2_2.mxd

Map By: JDW
MMI#: 1452-11
Original: 8/5/2013
Revision: 8/6/2013
Scale: 1 inch = 3.25 miles

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Refer to Figure 2-3 for a generalized land use map of the Town of Oxford. According to the draft Revised Zoning Map (2010), general residential zoning (Residential A) is located in the western, northern, and northeastern portions of Oxford, with the Residential Community Golf District zoning located in the northeastern portion of town. Industrial zoning and corporate business park zoning is located in the northern and northwestern portions of town, respectively. The Oxford Airport dominates much of the industrially-zoned area. The office professional district is located along Route 67 in the northwestern and central portion of town, and commercial zoning is located along Route 67 in the central and southeastern portions of town.

2.3 Geology

Geology is important to the occurrence and relative effects of natural hazards such as floods and earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in Oxford. Geologic information discussed in the following section was acquired in GIS format from the United States Geological Survey and the Connecticut DEEP.

Oxford is underlain by relatively hard metamorphic and igneous bedrock including a variety of gneiss, schist, and granite (Figure 2-4). The bedrock formations trend generally north to south. While no mapped fault lines underlie Oxford, a high angle fault from the Jurassic period is mapped trending southwest to northeast through Newtown and Southbury, and a second high angle fault from this period is mapped trending southwest to northeast through Ansonia and Seymour. These faults are believed to be inactive.

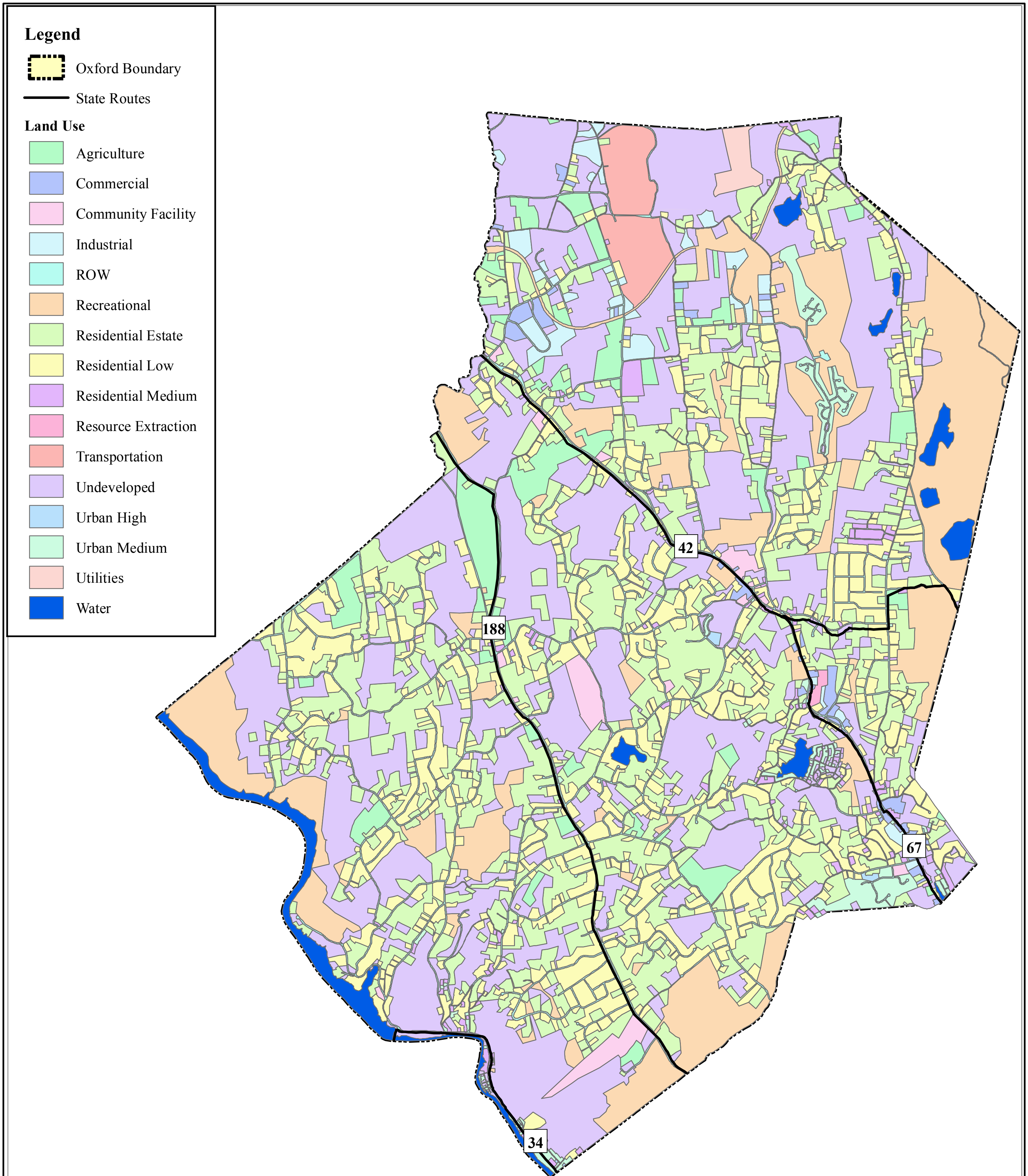
Continental ice sheets moved across Connecticut at least twice in the late Pleistocene. As a result, Oxford's surficial geology is characteristic of the depositional environments that occurred during glacial and postglacial periods. Refer to Figure 2-5 for a depiction of surficial geology.

Oxford is covered primarily by glacial till. Tills contain an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. The deposits are generally less than 50 feet thick, although deeper deposits of till are scattered across the hillier sections of Oxford. Stratified glacial meltwater deposits are related to the various water bodies in town, particularly the Housatonic River, Eightmile Brook, Little River, Fourmile Brook, and Towantic Brook. These deposits primarily contain stratified sands and gravels.

Stratified Glacial Meltwater Deposits

The amount of stratified glacial meltwater deposits present in a community 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. Oftentimes these deposits are associated with public water supply aquifers or with wetland areas that provide significant floodplain storage. However, the smaller glacial till watercourses throughout Oxford can also cause flooding.

The amount of stratified glacial meltwater deposits also has bearing on the relative intensity of earthquakes.



SOURCE(S):
"Town Boundary", "State Routes", CT DEEP, "Land Use", COGCNV

Figure 2-3: Oxford Generalized Land Use

LOCATION:
Oxford, CT

Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2_3.mxd

Map By: JDW
MMI#: 1452-11
Original: 07/23/2013
Revision: 7/25/2013
Scale: 1 inch = 1 mile

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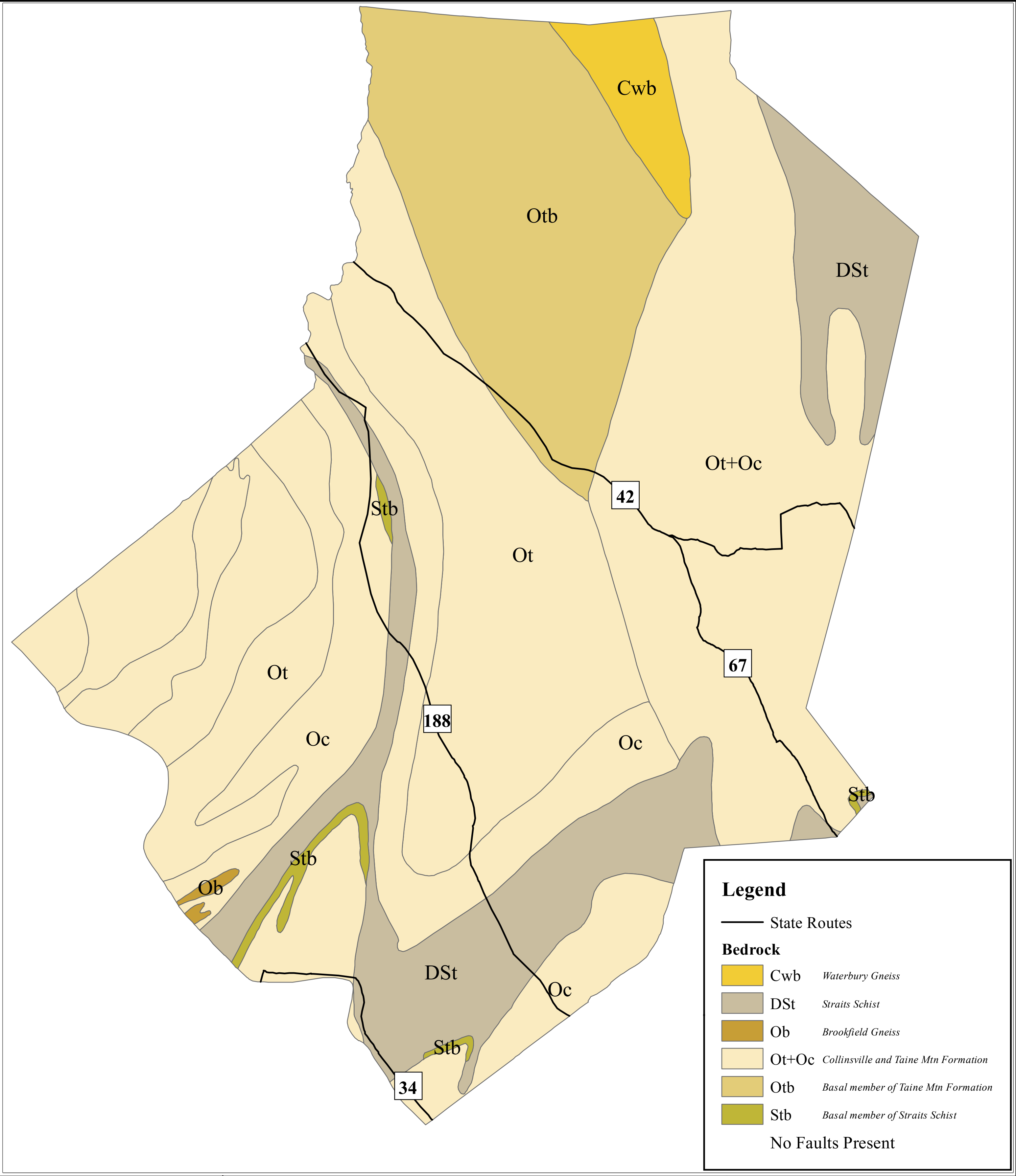

SOURCE(S):
"Town Boundary", "Bedrock",
CT DEEP

Figure 2-4: Oxford Bedrock Geology

LOCATION:
Oxford, CT

Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2_4.mxd

Map By: JDW
MMI#: 1452-11
Original: 07/18/2013
Revision: 8/6/2013
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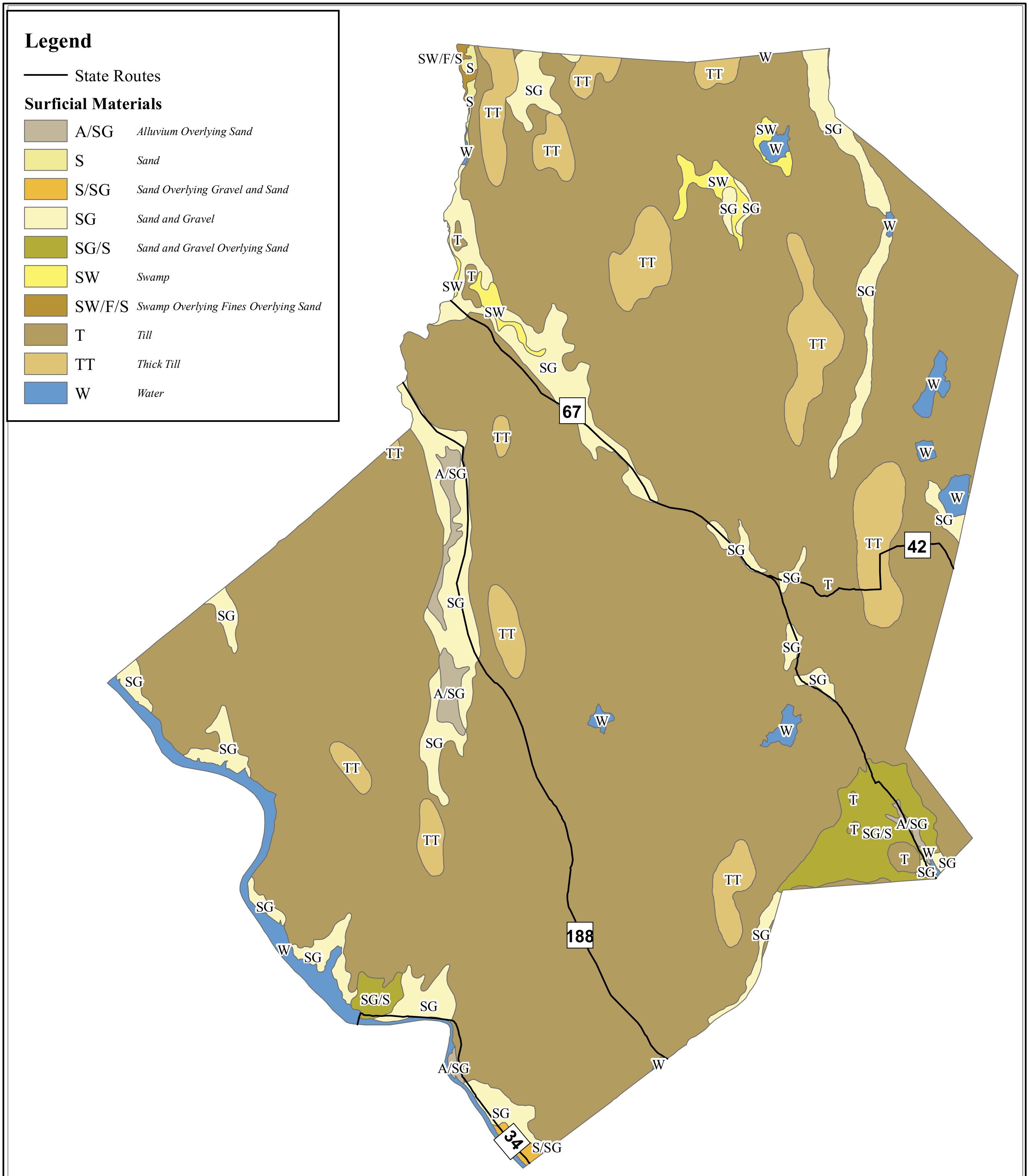

SOURCE(S):
"State Road", "Town Boundary", "Surfical Materials", CT DEEP

Figure 2-5: Oxford Surficial Geology

LOCATION:

Oxford, CT

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Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2_5.mxd

Map By: JDW
MMI#: 1452-11
Original: 07/18/2013
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2.4 Climate

Oxford has an agreeable climate characterized by moderate but distinct seasons. The mean annual temperature is 46.5 degrees Fahrenheit based on temperature data compiled by the National Climatic Data Center (NCDC) from 1971-2000. Summer high temperatures typically rise in the mid-80s and winter temperatures typically dip into the mid-teens as measured in Fahrenheit. Extreme conditions raise summer temperatures to near 100 degrees and winter temperatures to below zero. Median snowfall is 39.8 inches per year. Mean annual precipitation is 50.6 inches, with at least four inches of precipitation occurring in most months.

> ***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.***

By comparison, average annual statewide precipitation based on more than 100 years of record is less at 45 inches. Average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19th century (Miller et. al., 1997; NCDC, 2005). Likewise, annual precipitation in Oxford has increased over time.

Like many communities in the United States, Oxford experienced a population boom following World War II. This population increase led to concurrent increases in impervious surfaces and the amount of drainage infrastructure. Many post-war storm drainage systems and 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 in Connecticut for many years.

This engineering standard was based on the premise that extreme rainfall series do not change through time such that the older analyses reflect current conditions. Recent regional and state-specific analyses have shown that this is not the case as the frequency of two-inch rainfall events has increased and storms once considered a 1% annual chance event are now likely to occur twice as often. As such, the Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes (http://precip.eas.cornell.edu/) for engineering design. The availability of updated data has numerous implications for natural hazard mitigation as will be discussed in Section 3.

2.5 Drainage Basins and Hydrology

Oxford is part of both the Naugatuck River Valley and the Housatonic River Valley. The topography of the community is characterized by higher elevations that slope towards the two river valleys. Peaks in the northern part of the community reach elevations nearing 900 feet above sea level, while the majority of the community lies at elevations between 200 and 700 feet above sea level. Oxford is characterized by several substantial north-south trending ridges including Hull's Hill, the Mount Pisgah Ridge, Bowers Hill, Fivemile Hill, Jacks Hill, Towantic Hill, and Hunters Mountain along with many small parallel and orthogonally oriented valleys.

Oxford is divided among six sub-regional watersheds as shown on Figure 2-6. The drainage basins on the eastern side of the community drain into the Naugatuck River and then to the Housatonic River, with areas on the western side of Oxford draining to the Housatonic River.

Jack's Brook, Towantic Brook, and Riggs Street Brook all drain to the Little River and then to the Naugatuck River, while Eightmile Brook and its tributaries, Fourmile Brook, and Fivemile Brook flow to the Housatonic River. All of the water that passes through Oxford eventually empties into Long Island Sound via the Housatonic River.

Several large impoundments exist in Oxford. The largest of these is Lake Zoar, a backwater area formed along the Housatonic River by the Stevenson Dam. Other large impoundments include Towantic Pond, Chanko Pond, the four Seymour Reservoirs, Swan Lake, and Nichols Pond.

2.6 Population and Demographic Setting

According to the 2000 U.S. Census, the Town of Oxford had a population of 9,821. Oxford had a population of 12,683 in 2010 according to the U.S. Census, an increase of 29.1%. The overall population density of Oxford is 380 persons per square mile. Oxford ranks seventh out of the 13 COGCNV municipalities in Connecticut in terms of population, and eleventh in terms of population density. The COGCNV predicts strong population growth for Oxford of approximately nine percent for each five-year period through 2025.

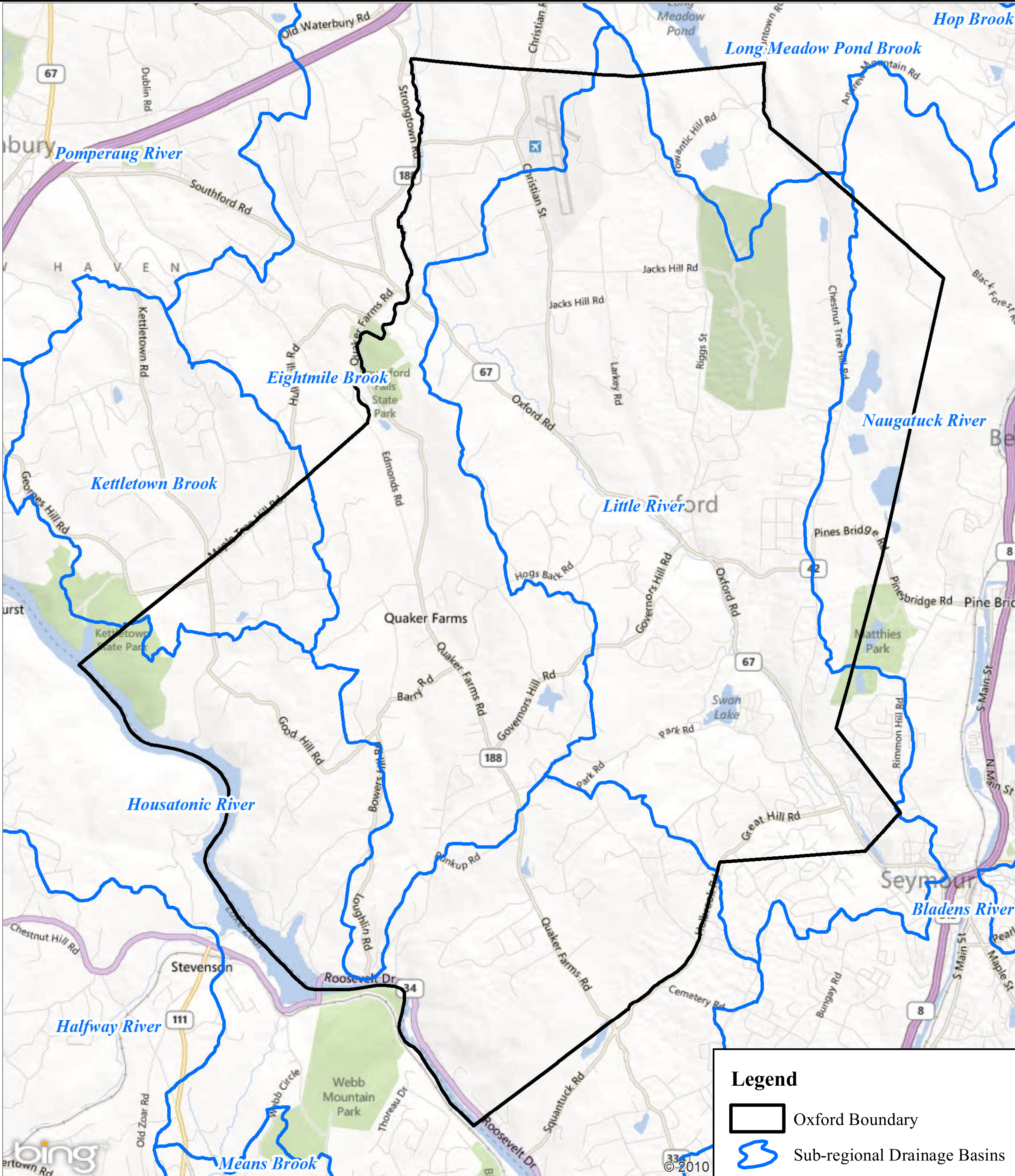
Oxford has significant populations of people who are linguistically isolated, elderly, and/or disabled. According to data collected by the U.S. Census Bureau for the period around 2010, 13.5% of the population is aged 65 or over, 2.5% speak English "less than very well", and 11.2% have a disability.

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.

2.7 Development Trends

Development in Oxford has been spread throughout the community without a centralized downtown. Residential development is scattered across the town and Oxford continues to be predominantly residential in nature although many small businesses and industries are located throughout the community. Recent years have seen the development of large age-restricted subdivisions such as Oxford Greens (600 homes situated around a golf course) off Riggs Street that is still in construction. This development will have generators and underground utilities. In particular, this major development was a concern for emergency officials as the hilltop location of the development makes it vulnerable to wind damage and winter storm effects. The large increase in the number of homes also increases the community's level of vulnerability to earthquakes, wildfires, and other natural hazards.

The vast majority of homes in Oxford are detached single-family homes (accounting for 94% of all residential structures). The majority of homes in Oxford (82%) were built before 1990, but only 16% were built before 1950 indicating a relatively recent housing stock. Oxford had 3,044 total housing units in 2004 and 4,411 units in 2011. The community issued 1,249 building permits for new construction between 1990 and 2004. Permits for the years 2006 through 2011 were only issued for single family homes (a total of 90, 83, 72, 29, 41, and 13 permits per year, respectively). The recent economic downturn generally slowed housing development in Oxford from 2007 through 2011. Newer buildings are constructed to more recent building codes and are considered to be less vulnerable to natural hazards than older buildings.



SOURCE(S):
"Town Boundary" CT DEEP
"Subbasins" CT DEEP
"Microsoft Virtual Earth Roads" Bing

Figure 2-6: Sub-Regional Drainage Basins

LOCATION:
Oxford, CT

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Oxford Natural Hazard Mitigation Plan

MXD: Y:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2-6.mxd

Map By: scottb
MMI#: 1452-11
Original: 07/26/2013
Revision: 9/19/2013
Scale: 1 inch = 5,280 feet

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The major roadways that serve Oxford include Routes 34, 42, 67, and 188. Each connects with either Interstate 84 or Route 8, which are located immediately north and east of Oxford, respectively. Most development has occurred along major arterial roadways and associated collector roads. The Waterbury-Oxford Airport, which supports small private planes, is located along the northern border near Middlebury. There are no railroads in Oxford – the only former line was removed and is now part of the Larkin State Park Trail (a walking trail).

Many new developments are currently in the works with some redevelopment occurring. Three other age-restricted housing developments are in the works, and affordable housing projects and a new shopping center are also proposed. As with all development projects, these projects are expected to increase the overall vulnerability of the community to natural hazards, although these projects are expected to be generally free from flooding. Many of the new projects are being designed and approved in phases since builders are hesitant to commit to a full build-out with the recent economic downturn. Redevelopment projects are mainly occurring in the area along the Housatonic River. Many older structures exist in this area that predate most building codes and the National Flood Insurance Program (NFIP). Redevelopment is expected to improve the resiliency of these structures to natural hazards, particularly where building elevations are proposed within the 1% annual chance floodplain. Oxford allows redevelopment to occur within the original footprint of the building; a historical problem in the community has been that expansions have occurred without permits.

A small industrial park is located on Willenbrock Road and several small shopping centers are situated along Route 67. No major expansions of commercial or industrial areas are currently proposed. Oxford has retained a significant area of agricultural land but some has been repurposed. The existing industrial area and larger residential developments are connected to public water and sewer.

In general, Oxford encourages future residential and non-residential development that can be supported by existing infrastructure. Should new or expanded infrastructure be required, such expansion is to be paid by the developer whenever possible. The 2007 Oxford Plan of Conservation and Development (PoCD) calls for future development to be consistent with and enhance the existing character of the town while avoiding adverse impacts to the environment (particularly in sensitive areas).

Public water supply is provided by the Heritage Village Water Company in the northern and central portion of Oxford and by the Aquarion Water Company in small areas of the southeastern and southwestern sections of Oxford. Major expansion of the public water system are not currently anticipated, although the PoCD suggests expanding sewers along Route 67 in order to encourage more intensive commercial development. Sewage is directed into Borough of Naugatuck or the Town of Seymour sewer system for treatment.

A build-out analysis in the 2007 PoCD estimates a maximum town population of 20,004 based on existing zoning and accounting for undevelopable areas. A total of 2,050 residential development lots including 400 building lots that are part of approved subdivisions could be developed. Planners in Oxford and at the COGCNV do not expect this full build-out to occur for several decades.

2.8 Governmental Structure

The Town of Oxford is governed by a Selectman-Town Meeting form of government. The Board of Selectmen or other commissions draft legislation for the electors of the community to vote upon, and enact such legislation when approved. The First Selectman serves as the chief executive managing day-to-day affairs, while the two remaining selectman are part-time.

In addition to the Board of Selectman, 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 following:

- The Building Department reviews plans to ensure conformance with all applicable codes and inspects work for final approval.
- The Conservation Commission is Oxford's Inland Wetlands Agency and reviews applications with wetland impacts.
- The Emergency Services Department coordinates emergency response activities and planning and oversees the local ambulance, fire, and police services.
- The Town Engineer position is contracted to a local engineering firm. The Town engineer reviews applications for a variety of requirements including compliance with Oxford's flood protection regulations.
- The Fire Department is the primary responder to emergency situations caused by natural hazards.
- The Fire Marshal reviews zoning and subdivision applications for fire protection safety concerns.
- The Grant Writer applies for and administers a variety of project grants including those for mitigation activities.
- The Planning and Zoning Commission reviews and approves zoning and subdivision applications and drafts regulation changes for Town Meeting approval. The Zoning Enforcement Officer and staff of the Planning and Zoning Department review applications for minor improvements and enforce zoning and wetland regulations. The Zoning Board of Appeals reviews requests for variances and handles appeals for rejected applications.
- The Police Department provides traffic control and assistance staffing shelters.
- The Public Works Department provides investigation assistance, cleanup, and repair support following disasters, and is relied upon to provide access to areas during storm events. They maintain and construct culverts, bridges, and roads on public land. Complaints related to town maintenance issues are routed to the Public Works Director and are investigated and remediated as necessary. Oxford has a Tree Warden that identifies dangerous trees and directs the Public Works Department to hire contractors to perform trimming and removal when necessary.

2.9 Review of Existing Plans and Public Information

Emergency Operations Plan

Oxford has an Emergency Operations Plan (EOP) that is updated and certified annually. This document provides general and specific procedures to be instituted by the First Selectman and/or designees during an emergency, including natural hazard events such as hurricanes and nor'easters. Therefore, the EOP is an action plan for providing emergency services prior to, during, and following a severe natural hazard event. The EOP is considered to be effective for providing a framework for emergency response within the Town of Oxford.

Plan of Conservation and Development

The 2007 PoCD is a broad planning document that provides guidelines for evaluating future land-use decisions. This document was updated following the adoption of the previous HMP and includes many goals, policies, and recommendations related to hazard mitigation planning, including:

- Continue to require that residential development includes the preservation of open space;
- Ensure that residential development can be safely accommodated by existing road systems;
- Allowing for controlled expansion of sewers to encourage commercial growth;
- Promote the use of conservation subdivisions to permit residential development while protecting sensitive environmental areas (such subdivisions could protect up to 40% of the land as open space);
- Continue to include methods to protect the slopes and hillsides of Oxford in residential development;
- Continue use of the Minimum Buildable Land concept within the *Zoning and Subdivision Regulations* to determine lot size;
- Continue to protect inland wetland areas from development that impairs their ability to store floodwater, to control erosion, to recharge and purify surface and groundwater and to support wildlife;
- Continue to utilize a range of methods of open space preservation including acquisition, imposition of conservation easements, dedication of open space for subdivisions, utilization of public-private partnerships for open space preservation, and other appropriate methods;
- Many roads require improvement to facilitate construction of new developments and to improve emergency access;
- Continue to provide and maintain public infrastructure facilities such as roads, sewers, and storm drainage, where needed, in all areas throughout the town to prevent physical deterioration;
- Additional emergency medical services will be needed to serve the increasing population aged 55 and over such as a new ambulance station; and
- The need for an additional fire station in northern Oxford should be evaluated to serve the growing industrial and residential sectors in that area;

The 2007 PoCD suggested revising the zoning regulations to encourage conservation subdivisions instead of traditional subdivisions. Such subdivision layouts could result in as much as 40% of the land being preserved as open space. This will preserve open space, enhance buffers between suburban and agricultural land uses, and help protect environmentally sensitive lands.

The 2007 PoCD is considered effective for informing and assisting in decision making by the Planning & Zoning Commission. While many of the goals, policies, and recommendations of the plan have not become specific regulations, the framework provided by the PoCD assists local commissions and officials in providing recommendations to developers to improve their designs prior to approval. This HMP Update is expected to further refine the goals, policies, and recommendations of the next PoCD update.

Long Range Plan

Oxford prepared a Long Range Plan in 2009. Many of the goals, policies, and strategies from the 2007 PoCD were included in the plan. The Plan also included the following additional strategies relative to hazard mitigation:

- Plan for an ultimate population of approximately 20,000 to provide for a superior quality of life for present and future Oxford residents;

The Long Range Plan also discussed a number of major construction and structural needs in the community that are of interest for hazard mitigation, including replacement of the roof at Great Oak School and the windows at Center School.

The Long Range Plan has been effective at providing local officials guidance related to the timing of a variety of capital projects. Any revisions to the Long Range Plan will benefit from the information in this HMP Update, particularly with regard to major construction and structural needs around the community to prevent damage from natural hazard events.

2.10 Review of Existing Regulations

Oxford has *Zoning Regulations* and *Subdivision Regulations* that regulate development, and *Inland Wetland Regulations* that regulate activities near wetlands. While regulations have not been updated to specifically address hazard mitigation, the DEEP's model regulations were used to update the regulations as necessary. Very few developments are permitted to impact wetlands or be built in FEMA Special Flood Hazard Areas (SFHA).

Zoning Regulations

One of the stated purposes of the Oxford *Zoning Regulations* (as revised through August 18, 2011) is to secure safety from fire, panic, flood, and other dangers. Development density is limited by requirements for large lot sizes (1.5-acres, two acres, or 2.75-acres for residential lots).

- Article 3, Section 20 requires that land with slopes in excess of 35% are not to be disturbed from their natural state for residential developments.
- Article 3, Section 23 prohibits new residential uses and places of public assembly within the airport runway protection zone.
- Article 3, Section 24 requires that driveways longer than 500 feet be widened at 300-foot maximum intervals to allow for the passing of vehicles.
- Article 10, Section 10 requires age-restricted housing developments to be served by public water and sewer, that all electrical, cable, telephone, and other service utilities be placed underground, and that fire hydrants be provided as directed by the Commission. In addition, such developments must reserve 30% of the total area of the site as open space.
- Article 12 presents Oxford's soil erosion and sediment control regulations.
- Article 13 presents Oxford's regulations regarding trailers and mobile homes.
- Article 14 presents Oxford's regulations regarding earth regarding and excavation.
- Article 15 presents the regulations for the Flood Plain District. The Flood Plain District consists of all areas of special flood hazard within the Town of Oxford identified by FEMA dated December 17, 2010. The regulations further reference the "Flood Plain Management Ordinance" passed by Town Meeting on November 8, 1979. Oxford utilizes the Flood

Insurance Rate Map (FIRM) established by FEMA to identify the local Special Flood Hazard Area (SFHA). Plot plans are required to show the locations of wetlands and floodplain lines where appropriate. Applications for development in floodprone areas require a concurrent application for a Flood Hazard Areas Permit from the Commission.

Flood Plain Management Ordinance

Chapter 151 of the Oxford Town Ordinances presents Oxford's "Floods and Floodplain Regulations", while Chapter 152 presents "Flood Damage Prevention". These ordinances comprise the town's Flood Plain Management Ordinance. Chapter 151 indicates the following:

- Section 02 vests the Planning and Zoning Commission with the authority to delineate or assist with the delineation of the limits of special flood (and/or mudslide hazards) in the community, provide information to the program Administrator concerning present usage of the floodplain area, to cooperate with other agencies to map such areas in order to prevent aggravation of existing hazards, and to maintain a record of elevations of the lowest floor and next lowest floor (if needed) of all new or substantially improved structures located in special flood hazard areas.
- Section 15 requires that all new construction or substantial improvement be designed and anchored to prevent floatation, collapse, or lateral movement of the structure, and use construction materials and utilities through construction methods and practices that will minimize flood damage.
- Section 16 requires the Commission to review all subdivision proposals and other new developments to ensure that they are consistent with the need to minimize flood damage; that all public utilities and facilities are located, elevated, and constructed to minimize or eliminate flood damage; and that adequate drainage is provided to reduce exposure to flood hazards.
- Section 17 authorizes the local Sanitarian to require that new or replacement water supply systems and/or sanitary sewage systems be designed to minimize or eliminate infiltration of floodwaters into the systems, discharge from the systems into floodwaters, and require on-site wastewater disposal systems to be located so as to avoid impairment of them or contamination from them during a flood.

Chapter 152 states that the flood hazard areas of Oxford are subject to periodic inundation which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base. All these adversely affect the public health, safety, and general welfare. Such flood losses are caused by the cumulative effect of obstructions in floodplains causing increases in flood heights and velocities, and by the occupancy in flood hazard areas by uses vulnerable to floods or inadequately elevated, floodproofed or otherwise unprotected from flood damages. The goal of Chapter 152 is to protect human life and health, to minimize expenditure of public money for costly flood control projects, to minimize the need for rescue and relief efforts associated with flooding, to minimize business interruptions, and to minimize damage to public facilities and infrastructure.

- Section 15 identifies the base flood (the area subject to 1% or greater chance of flooding in any given year) as the area of Special Flood Hazard.

- Section 31 defines the base flood as being shown on maps prepared by FEMA dated December 17, 2010 unless amended by a map amendment or map revision obtained from FEMA.
- Section 36 states that the degree of flood protection required by Chapter 152 is considered reasonable for regulatory purposes.
- Section 50 identifies the Planning and Zoning Commission as being appointed to administer and implement the provisions of this chapter.
- Section 51 requires a registered professional engineer or architect is required to certify that the design and methods of construction are in accordance with the accepted standards of practice for meeting the floodplain provisions.
- Section 53 requires that elevation, floodproofing, and access information be submitted with a Flood Plain Permit.
- Section 70 presents the general standards (generally the same as in Chapter 151).
- Section 71 presents requirements for manufactured homes and recreational vehicles.
- Section 72 presents regulations for above-ground storage tanks.
- Section 76 authorizes the Commission to obtain, review, and reasonably utilize any base flood elevation and floodway data as criteria for activities in Zone A. No activities shall be permitted which will increase base flood elevations more than one foot at any point along the watercourse when all anticipated development is considered cumulatively with the proposed development.
- Section 77 states that proof of dry access to the structure during the 1% annual chance flood is required.
- Section 79 requires new construction or substantial improvement to have the lowest floor, including basement, elevated at least one foot above the base flood elevation. Non-residential structures may be floodproofed to a similar elevation in lieu of being elevated. A professional engineer or architect must certify the floodproofing.
- Section 81 states that no activities are allowed in the floodway that will result in any (0.00 feet) increase in flood levels during occurrence of the base flood discharge.
- Section 82 requires compensatory storage for floodplain activities that reduce floodplain storage.
- Section 83 requires equal conveyance in the floodplain, i.e. activities may not increase flood levels or flood velocity.
- Section 111 allows variances for historic buildings, pre-existing small lots, and functional-dependent uses provided no increase in flood levels in the floodway would result.

Overall, the Planning and Zoning Regulations and the Flood Plain Development Ordinance are considered effective at preventing unwanted side effects of development. These regulations are updated by the Planning and Zoning Commission as needed. While it is recognized that there are areas where improvement could be made (as discussed throughout this HMP), the current political environment is relatively slow to accept significant regulatory changes.

Subdivision Regulations

Several of the stated purposes of the Oxford *Subdivision Regulations* (as revised through August 19, 2004) include securing safety from fire, flood, and other dangers; to provide proper provision for surface drainage; to insure proper protective and flood control measures for areas near brooks, rivers, and other bodies of water and to prevent damage from flooding and storm water runoff; to encourage wise use and management of natural resources; and to provide for open spaces and environmental protection through the most efficient design and layout of the land.

- Article 3, Section 5 requires concurrent submittal of any application to the Oxford Inland Wetlands Agency if the application includes a regulated activity as defined by the Inland Wetlands regulations.
- Article 5 requires grades over 20% to be specially shaded on site plans, delineation of special flood hazard areas, and submittal of a soil erosion and sedimentation control plan.
- Article 6 presents a variety of requirements for subdivisions. This article restricts permanent dead-end or cul-de-sacs to being less than 1,500 feet in length and discourages their use. Utilities are required to be located underground in subdivisions. Fire hydrants are required at a maximum of 600 feet apart. Where public water is not available, an alternative and adequate supply of water for fire control may be required by the Commission. Land with slopes greater than 35% shall not be distributed from its natural state.
- Article 6, Section 12-A provides the drainage requirements for Oxford. Drainage improvements shall be designed to achieve no net increase in stormwater runoff from the predevelopment condition. The use of retention basins or any structures that are designed to hold standing water for an extended period of time shall be avoided. The subdivision plan is required to indicate that the Town is not responsible for the maintenance of retention basins, detention basins, swales, and other surface water features and shall designate the party or parties responsible for such maintenance.
- Article 8 requires up to 20% of the gross area of the subdivision to be designated as open space. A maximum of 50% of this space so designated may be wetlands or watercourses. Open space areas are required to perform one or more of the following functions: conservation of soils or wetlands, preservation of natural streams or water bodies, provision and preservation of wildlife corridors, provision of land suitable for active recreation facilities, and enhance the overall design of the subdivision by providing breaks in the urban development. Open space must be physically accessible to the public, have frontage on a public road, or be accessible through existing open space.
- Article 12 requires that any subdivisions designed with the Special Flood Hazard Area be designed and constructed with the need to minimize flood damage, that utilities must be located and constructed to minimize flood damage, that adequate drainage shall be provided to reduce exposure to flood hazards, and that base flood elevation data shall be indicated on the record subdivision plan.

Overall, the subdivision regulations are considered to be effective at preventing unwanted side effects of intensive development. These regulations are updated by the Planning and Zoning Commission as needed.

<u>Inland Wetland and Watercourses Regulations</u>

The Inland Wetlands and Watercourses Regulations in Oxford were last amended in May 2007. The regulations require a permit for certain regulated activities which take place within 100 feet of a wetland or watercourse or that may impact a wetland or watercourse. These regulations build on the preventative flood mitigation provided by the Flood Plain Management Ordinance by preventing fill and sedimentation that could lead to increased flood stages. The wetland regulations are considered to be an effective additional level of flood mitigation for Oxford.

2.11 Critical Facilities and Existing Emergency Response Capabilities

Oxford has identified many critical facilities. Most critical facilities, such as police, fire, and governmental buildings as well as utilities are required to ensure that day-to-day management of the town continues. The local airport is a critical facility as it is an important regional supply distribution point. Other facilities such as schools, the local housing authority, and a significant age-restricted development (Oxford Greens) are also considered critical facilities since these contain populations that are more susceptible in an emergency. Not all municipal buildings are critical facilities.

Table 2-2 presents a list of critical facilities in Oxford, and Figure 2-7 presents the location of each facility. Critical facilities that are vulnerable to one or more natural hazards will be discussed as appropriate in this document.

Oxford High School is the primary shelter. The facility has a generator and can shelter approximately 200 people. Backup shelters include Quaker Farms School, Great Oak Middle School, Center Fire Department, and at Senior Housing. These facilities all have generators. The Town Hall also has areas that could be used for sheltering, but the facility does not have a generator. The shelters had not been utilized since the mid-1980's prior to Tropical Storm Irene in 2011. While the primarily shelter was not available during that event, the backup shelters provided ample space and also supported pet sheltering. In case of a sustained power outage, it is anticipated that 10 to 20% of the population (1,200 to 2,500 people) would relocate, although not all of those relocating would necessarily utilize the shelter facilities.
Emergency response capabilities are overseen by the Emergency Management Director. Evacuations are managed on a case-by-case basis. As noted in Table 1-11, Oxford's emergency communications were recently updated.

The public works garage houses the community's Emergency Operations Center (EOC). The Center Fire Department is the backup EOC. An improved EOC is important from a local and regional perspective since Oxford Airport is a regional supply distribution point. The current EOC is a 10-foot by 10-foot room that is inadequately-sized for emergency response activities and is not suited for long-term emergency management activities such as during the extended power outages associated with Tropical Storm Irene and Winter Storm Alfred. Furthermore, Oxford needs a climate-controlled facility to store emergency food supplies and equipment. The current storage space is too small and not climate-controlled, limiting the shelf life of food supplies. **Oxford should identify and outfit a new EOC facility with an adjacent storage center.**

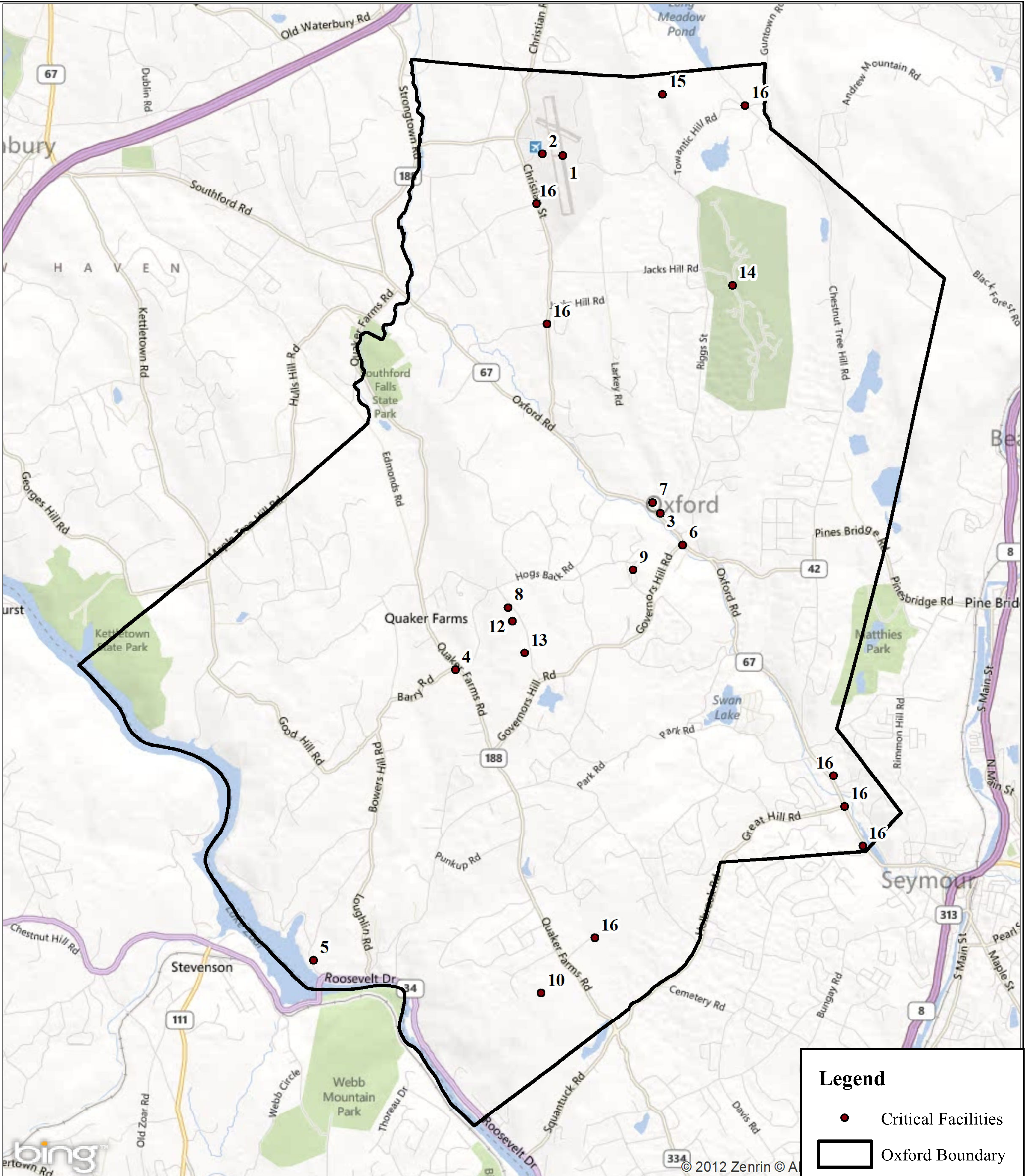
Oxford is fortunate to have public water supply in certain areas, but often requires the installation of fire suppression tanks in new developments. The Fire Department has portable generators that they can set up for people who have special needs such that they do not need to go to an established shelter.

Oxford utilizes the "CodeRED" Emergency Notification System to send geographically-specific telephone warnings into areas at risk for natural hazard damage. This is extremely useful for natural hazard mitigation, as 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 system is particularly useful for warning residents of flooding and controlled releases along the Housatonic River.

Table 2-2
Critical Facilities

ID	Facility	Address or Location	Comment	Emergency Power?	Shelter?	In 1% Annual Chance Floodplain?
1	Airport Runway Lighting	Woodruff Hill Road	Regional Airport			
2	FAA Facility	Airport Road	Regional Airport			
3	Oxford Center Fire House	484 Oxford Road	Emergency Response			*
4	Quaker Farms Fire House	403 Quaker Farms Road	Emergency Response			
5	Riverside Fire House	151 Coppermine Road	Emergency Response			
6	Police Department	429 Oxford Road	Emergency Response			✓
7	Oxford Town Hall	486 Oxford Road	Critical Records			
8	Public Works Building*	21 Great Oak Road	Emergency Operations Center	✓		
9	Housing Authority	100 Stakum Circle	Susceptible Population			
10	Oxford High School	61 Quaker Farms Road	Primary Shelter	✓	✓	
11	Oxford Center School	462 Oxford Road	Elementary School	✓	✓	
12	Quaker Farms School	30 Great Oak Road	Elementary School	✓	✓	
13	Great Oak School	50 Great Oak Road	Elementary School	✓	✓	
14	Oxford Greens	Putting Green Lane	Elderly Population			
15	Gas Pumping Station (Spectra Energy)	40 Woodruff Hill Road	Natural Gas			
16	Waste Water Pump Stations	Towner Lane Christian Street 100 Oxford Road Perkins Road Long Meadow Road 3 Oxford Road 58 Oxford Road	Waste Water System			? ? ✓ ? ?

*In 0.2% Annual Chance Floodplain



SOURCE(S):	Figure 2-7: Critical Facilities	LOCATION: Oxford, CT
"Town Boundary" CT DEEP "Microsoft Virtual Earth Roads" Bing		

Oxford Natural Hazard Mitigation Plan

MXD: Y:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_2-7.mxd

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Oxford distributes public information regarding natural hazards and preparedness to residents with FEMA flyers being available in the municipal buildings. Evaluation of emergency services, shelters, equipment, critical facilities, and supplies is performed at least annually (concurrent with the EOP review) or more often if necessary. Similarly, emergency training is conducted as appropriate and Oxford purchases new equipment when funding is available.

In addition, the town roadway system is reviewed each year to identify critical risks and evaluate alternative access, and new applications are reviewed for safety concerns. This information is provided to the Planning and Zoning Commission as requested to facilitate improvements through associated developments. For example, private communities often have one-way roads but are typically required to have two modes of egress and emergency access points. In addition, there are many cul-de-sacs located throughout Oxford. A proposed subdivision on Moose Hill will only have one mode of egress because there is not a viable alternative.

Oxford is has evaluated emergency backup power needs at critical facilities and at other locations throughout the town along with potential methods to provide emergency power to these areas. They are currently pursuing grants that will allow for the installation of generators. Additional areas will be evaluated as necessary as part of the annual review process.

3.0 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 minor streams.

In general, the potential for flooding in Oxford is high particularly along the Housatonic River, the Little River, and Riggs Street Brook. Most major flooding events occur along established SFHAs. 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 also a common problem. This type of flooding occurs particularly along roadways as a result of inadequate drainage and other factors. The frequency of flooding in Oxford is considered likely for any given year, with flood damage potentially having significant effects during extreme events (refer to Table 1-3).

3.2 Hazard Assessment

Flooding is 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 ice jams or dam failure (Section 8.0), and may also cause landslides and slumps in affected areas. According to FEMA, there are several different types of inland flooding:

- **Riverine Flooding**: Also known as overbank flooding, it occurs when channels receive more rain or snowmelt from their watershed than normal, or the channel becomes blocked by an ice jam or debris. Excess water spills out of the channel and into the channel's floodplain area.

- **Flash Flooding:** A rapid rise of water along a water channel or low-lying urban area, usually a result of an unusually large amount of rain and/or high velocity of water flow (particularly in hilly areas) within a very short period of time. Flash floods can occur with limited warning.

- **Shallow Flooding:** Occurs in flat areas where a lack of a water channel results in water being unable to drain away easily. The three types of shallow flooding include:
  - **Sheet Flow:** Water spreads over a large area at uniform depth;
  - **Ponding:** Runoff collects in depressions with no drainage ability; and

- **Urban Flooding:** Occurs when man-made drainage systems are overloaded by a larger amount of water than the system was designed to accommodate.

Flooding presents several safety hazards to people and property and can cause extensive damage and potential injury or loss of life. 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, deteriorating municipal drainage systems, and diverting municipal staff and resources.

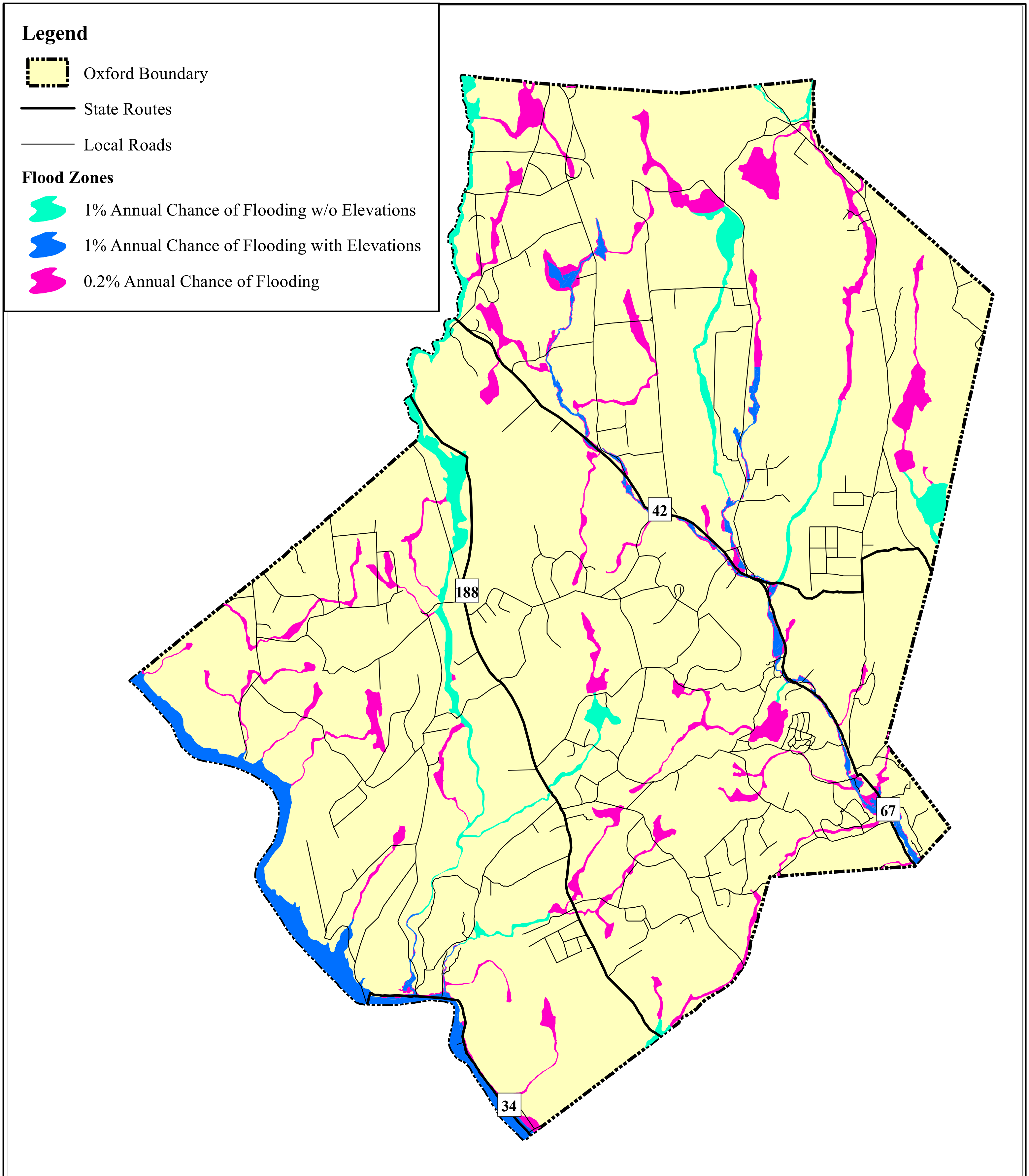
Furthermore, damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Snakes and rodents are forced out of their natural habitat and into closer contact with people, and ponded water following a flood presents a breeding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

> ***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 1% annual chance floodplain that are outside the floodway and are subject to inundation but do not convey the floodwaters at a high velocity.***

In order to provide a national standard without regional discrimination, the 1% annual chance flood (previously known as the "100-year" flood) has been adopted by FEMA as the base flood for purposes of floodplain management and to determine the need for insurance. 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 the 1% annual chance floodplain has a 26% change of suffering flood damage during the term of a 30-year mortgage. The 0.2% annual chance floodplain (previously known as the "500-year" floodplain) indicates areas of moderate flood hazard.

Oxford has consistently participated in the NFIP since December 4, 1979. SFHAs in Oxford are delineated on a Flood Insurance Rate Map (FIRM) and supported by a Flood Insurance Study (FIS). The FIRM delineates areas within Oxford that are vulnerable to flooding and was most recently published on July 8, 2013. The current New Haven County FIS which includes Oxford was published on July 8, 2013. The original FIS and FIRMs for flooding sources in Oxford are based on work completed in the late 1970's and in March 1988.

The majority of the watercourses and water bodies in Oxford are mapped as Zone A or as areas of moderate flood hazard, while the Housatonic River, the Little River, and parts of Eightmile Brook, Fivemile Brook, and Riggs Street Brook are mapped as Zone AE. Refer to Figure 3-1 for the areas of Oxford susceptible to flooding based on FEMA flood zones. Table 3-1 describes the various zones depicted on the FIRM panel for Oxford.



SOURCE(S):
"Town Boundary", "State Routes", "Streets" CT DEEP, FEMA Flood Zones DFRIM 2010

Figure 3-1: FEMA Flood Zones in Oxford

LOCATION:
Oxford, CT

N

Oxford Natural Hazard Mitigation Plan

MXD: P:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_3_1.mxd

Map By: JDW
MMI#: 1452-11
Original: 07/23/2013
Revision: 7/24/2013
Scale: 1 inch = 1 mile

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Table 3-1
FIRM Zone Descriptions

Zone	Description
A	An area inundated by 1% annual chance flooding, for which no base flood elevations (BFEs) have been determined.
AE	An area inundated by 1% annual chance flooding, for which flood elevations have been determined. This area may include a mapped floodway.
X	An area that is determined to be outside the 1% and 0.2% annual chance floodplains.
0.2%	An area inundated by 0.2% annual chance flooding (moderate flood hazard), for which no base flood elevations have been determined.

Flooding can occur in some areas with a higher frequency than those mapped by FEMA. This nuisance flooding occurs during heavy rains with a much higher frequency than those used to calculate the 1% annual chance 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 Section 3.6).

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 1% annual chance flood event on a tributary may only contribute to a 2% annual chance flood event downstream. This is due to the distribution of rainfall throughout large watersheds during storms 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 by providing storage.

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 0.4% annual chance event while flood frequencies were only slightly greater than a 10% annual chance 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 historic record.

3.3 Typical 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*.

3.3.1 Prevention

> ***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.***

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, floodplain, and wetland ordinances. It also occurs when land is prevented from being developed through the use of conservation easements or conversion of land into open space.

Drainage System Maintenance: An effective drainage system must be continually maintained to ensure efficiency and functionality. The use of Geographic Information System (GIS) technology can greatly aid the identification and location of problem areas.

Planning and Zoning: Zoning and Subdivision ordinances 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. Site plan and new subdivision regulations typically 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 drainage-ways; and
- A requirement that developers dedicate open space and flood flow, drainage, and maintenance easements.
- Policies requiring the design and location of utilities to areas outside of flood hazard areas when applicable and the placement of utilities underground when possible.
- A variety of structural-related mitigation strategies, including the use of freeboard, can be applied to new development and substantial redevelopment although these are beyond the minimum requirements of the NFIP.
- Adherence to the State Building Code requires 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.

> ***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. The FEMA Region I office has more information on this topic. Contact information can be found in Section 11.***

FEMA encourages local communities to use more accurate topographic maps to expand upon the FIRMs published by FEMA. This is because many FIRMs were originally created using quadrangle maps prepared by the United States Geological Survey 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. An alternate approach is to record high water marks and establish those areas inundated by a recent severe flood to be the new regulatory floodplain. While these maps cannot replace the FIRM for insurance purposes, they may be used to regulate development provided that the mapped area is the same size or larger than that mapped on the FIRM.

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, many Letters of Map Amendment (LOMA) have been submitted under the LOMC program for Oxford, which is expected given the relatively developed nature of the local floodplains.

Stormwater Management Policies: Development and redevelopment policies to address the prevention of flood damage must include effective stormwater management policies. Developers are typically required to build detention and retention facilities where appropriate. Additional techniques include enhancing infiltration to reduce runoff volume through the use of swales, infiltration trenches, vegetative filter strips, and permeable paving blocks. The goal is that post-development stormwater does not leave a site at a rate higher than under predevelopment conditions.

Due to its topography, various parts of Oxford lie situated in the upper, middle, *and* lower portions of several watersheds. 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 to the peak discharge during any given storm event.

3.3.2 Property Protection

A variety of steps can be taken to protect existing public and private properties from flood damage. Performing such measures for repetitive loss properties would provide the greatest benefit to residents and the NFIP. Potential measures for property protection include:

- ***Relocation of structures at risk for flooding to a higher location on the same lot or to a different lot outside of the floodplain***. Moving an at-risk structure to a higher elevation can reduce or eliminate flooding damages to that property. If the structure is relocated to a new lot, the former lot can be converted to open space in a manner similar to that described above.

- ***Elevation of the structure***. Building 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. The area below the first floor may only be used for building access and parking.

- ***Construction of localized property improvements such as barriers, floodwalls, and earthen berms***. Such structural projects can be used to prevent shallow flooding and are described in Section 3.3.6.

- ***Performing structural improvements to mitigate flooding damage***. Such improvements can include:

  - ***Dry floodproofing of the structure to keep floodwaters from entering***. Walls may be coated with compound or plastic sheathing. Openings such as windows and vents would be either permanently closed or covered with removable shields. Flood protection should extend only two to three feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water.

    <u>Dry floodproofing</u> refers to the act of making areas below the flood level watertight.

    <u>Wet floodproofing</u> refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures.

  - ***Wet floodproofing of the structure to allow floodwaters to pass through the lower area of the structure unimpeded***. Wet floodproofing should only be used as a last resort above the first floor level. If considered, furniture and electrical appliances should be elevated above the 1% annual chance flood elevation.

  - ***Performing other potential home improvements to mitigate damage from flooding***. FEMA suggests several measures to protect home utilities and belongings, including:

    - Relocating valuable belongings above the 1% annual chance flood elevation to reduce the amount of damage caused during a flood event;
    - Relocate or elevate water heaters, heating systems, washers, and dryers to a higher floor or to at least 12 inches above the high water mark (if the ceiling permits). A wooden platform of pressure-treated wood can serve as the base.
    - Anchor the fuel tank to the wall or floor with non-corrosive metal strapping and lag bolts.
    - Install a septic backflow valve to prevent sewer backup into the home.
    - Install a floating floor drain plug at the lowest point of the lowest finished floor.
    - Elevate the electrical box or relocate it to a higher floor, and elevate electric outlets to at least 12 inches above the high water mark.

- ***Encouraging property owners to purchase flood insurance under the NFIP and to make claims when damage occurs***. While having flood insurance will not prevent flood damage, it will help a family or business put things back in order following a flood event. Property owners should be encouraged to submit claims under the NFIP whenever flooding damage occurs in order to increase the eligibility of the property for projects under the various mitigation grant programs.

3.3.3 Emergency Services

A natural hazard mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for 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 EOP outlining procedures for the mobilization and position of staff, equipment, and resources to facilitate evacuations and emergency floodwater control; and
- 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.

3.3.4 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.

The promotion of awareness of natural hazards among citizens, property owners, developers, and local officials is necessary for proper preparedness. 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.

3.3.5 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.

Projects that improve the natural condition of areas or restore diminished or destroyed resources can reestablish an environment in which the functions and values of these resources are again optimized. Acquisitions of floodprone property with conversion to open space are the most common of these types of projects. Acquisition of heavily damaged structures (particularly repetitive loss properties) after a flood may be an economical and practical means to accomplish this. In some cases, it may be possible to purchase floodprone properties adjacent to existing recreation areas which will allow for the expansion of such recreational use or the creation of floodplain storage areas. 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.

> ***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***

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

- Expand open space in floodplains by acquiring and demolishing repetitive loss properties and other floodprone structures and converting the parcels to open space. This type of project eliminates future flooding damage potential to the structure, and such a project could be designed to increase floodplain storage which would reduce future flooding potential to remaining properties;
- Pursue the acquisition of additional municipal open space properties as discussed in the *Plan of Conservation and Development*, particularly near existing open space;
- Selectively pursue conservation objectives listed in the Plan of Conservation and Development and/or more recent planning studies and documents; and
- Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.

Municipalities should work with local land trusts to identify undeveloped properties (or portions thereof) worth acquiring that are within or adjacent to floodplains.

3.3.6 Structural Projects

Structural projects include the construction or modification of structures to lessen the impact of a flood event. Examples of structural projects include:

- Stormwater controls such as drainage systems, detention dams and reservoirs, and culvert resizing can be employed to modify flood flow rates.
- 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 modify flood flows.
- Individuals can protect private property by raising structures and constructing walls and levees around structures.

Care should be taken when using these techniques to ensure that problems are not exacerbated in other areas of the impacted watersheds.

Given the many culverts and bridges in a typical community and the increasing rainfall rates in Connecticut described in Section 2.4, reevaluation of the drainage computations on culverts and bridges is recommended.

3.4 Historic Record

Oxford 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 1980 FEMA FIS, the notable historical floods in the early 20th century occurred in November 1927, March 1936, September 1938, December 1948, and August and October 1955. The August 1955 flood had a recurrence interval of about 110 years on the Housatonic River, while the October 1955 flood was the most severe and had a recurrence interval of 120 years on the Housatonic River.

According to FEMA, flooding has been known to occur on the Housatonic River near the corporate limits with the Town of Seymour and further upstream at its confluence with Eightmile Brook and Fivemile Brook. In particular, the vicinity of “Under the Rocks Park” along Route 34 is prone to flooding. Flooding has also been prevalent on portions of the Little River at Hogs Back Road and at the confluence of Towantic Brook near Route 67. Riggs Street Brook also causes flooding at Route 67 near its confluence with the Little River, and upstream of the school access road.

In general, minor flooding problems are widespread throughout Oxford. Extreme events along defined floodplains often result in damage to insured structures. The most common damage is to infrastructure and occurs due to flash flooding. The most extreme damage occurs to homes and businesses along the Housatonic River corridor resulting from extreme rainfall events.

According to the NCDC Storm Events Database, since 1996 there have been 18 flooding and 41 flash flooding events in New Haven County. The following are descriptions of more recent examples of floods in Oxford as described in the NCDC Storm Events Database, and based on correspondence with municipal officials. Note that flooding was not necessarily limited to the described areas. Information on disaster declarations was taken from articles within FEMA's Connecticut Disaster History database.

- October 19, 1996: Heavy rains produced 7.10 inches of rain in Oxford resulting in flash flooding.

- September 16-17, 1999: The remnants of Hurricane Floyd brought tropical storm winds and exceptionally heavy rainfall to western Connecticut that produced widespread flooding. The combination of heavy winds and saturated ground produced widespread downing of trees across New Haven County. A major disaster declaration was declared (DR-1302).

- March 28, 2005: Heavy rain produced widespread urban flooding across the region. A total of 1.45 inches of rain was measured in Oxford.

- October 11-14, 2005: Periods of heavy rain caused widespread flooding and dam failures throughout Connecticut. Rainfall amounts totaled 8.1 inches in Meriden and 14.0 inches in Milford. A major disaster declaration was declared (DR-1619).

- April 15, 2007: A nor'easter produced heavy rain and high winds that caused widespread and significant river, stream, and urban flooding. The Housatonic River overflowed its banks the following day. A total of 3.32 inches of rain was measured in Oxford. A major disaster declaration was declared (DR-1700).

- March 2010-May 2010: A series of nor'easters and severe storms produced multiple flooding events throughout Connecticut. A major disaster declaration was declared (DR-1904).

- March 7, 2011: An unnamed winter storm producing heavy rain and snow caused the Housatonic River to swell more than two feet over its flood mark. Several empty cars, two pickup trucks, and around 20 homes in New Haven County were swept into the rain-swollen Housatonic River. The flooding caused the evacuation of dozens of people. Three vehicles and two structures were seen floating down the Housatonic River in Oxford.

- August 29, 2011: Tropical Storm Irene tracked across New Haven County producing heavy rainfall between five and 10 inches within a 12-hour period. The rainfall resulted in widespread moderate to major flooding across the county. Numerous road closures, downed trees and power lines, and evacuations were reported. A major disaster declaration was declared (DR-4023).

3.5 Existing Programs, Policies, and Mitigation Measures

Oxford has in place a number of measures to prevent flood damage. These include measures typical to those in the categories presented in Section 3.3.

Prevention

The Department of Public Works (DPW) is in charge of the maintenance of local drainage systems and performs clearing of bridges and culverts and other maintenance as needed. Oxford currently has an "as-needed" schedule of drainage system maintenance, with regular inspections of drainage systems supplemented by problem areas reported to the Director of Public Works. Maintenance includes programs to clean out blockages caused by overgrowth and debris. The current frequency of these inspection and maintenance programs is considered sufficient to meet the needs of the Town of Oxford. Increasing the budget for these preventative activities would slightly improve the effectiveness of local drainage systems but not to a sufficient degree to be considered cost-effective.

The Connecticut Department of Transportation (DOT) is responsible for maintenance along the state roadways. Two state-owned bridges have been identified as being "scour-critical" along the Little River (at Route 42 and Route 67) and are inspected during storms.

Oxford has a variety of regulations to help prevent increasing the vulnerability of residents and businesses to flood hazards. Regulations pertaining to flood damage prevention were detailed in Section 2.10. 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 Oxford 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 Oxford for participation in the National Flood Insurance Program

The Zoning Enforcement Officer in the Planning and Zoning Department is currently the NFIP administrator for Oxford and oversees the enforcement of NFIP regulations. The degree of flood protection established by the variety of regulations in Oxford meets the minimum reasonable for regulatory purposes under the NFIP. Oxford plans to remain compliant with the NFIP and will continue to participate in the NFIP. The Town Engineer (a private consulting firm) reviews all proposals to ensure compliance with Oxford's floodplain regulations. Oxford is considering enrollment in the Community Rating System program to lower the cost of flood insurance for their residents.

The Planning and Zoning Commission uses the 1% annual chance flood areas 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. Although placing utilities underground is a requirement for subdivisions and age-restricted developments, it is not a requirement for all development cases. Oxford strongly encourages the placement of utilities underground whenever possible as part of the review process, although this is not always possible due to the prevalence of shallow ledge throughout much of the community.

While strengthening the Flood Plain Management Ordinance, Planning and Zoning Regulations, and Subdivision Regulations above the minimum standards of the NFIP would provide a higher level of flood protection for new development and substantial improvements, there is little political will at this point to perform detailed revisions to the regulations. The current regulations are believed to be generally effective at preventing flood damage to new development and substantial improvements, and the majority of flooding issues within the Town of Oxford are related to infrastructure or existing properties (Section 3.6). Instead, minor revisions to the regulations have been suggested in this plan.

Property Protection

All of the property protection mitigation measures listed in Section 3.3.2 may be useful to prevent damage to individual properties from inland and nuisance flooding. Local officials are prepared to provide outreach and education in these areas where appropriate. For example, Oxford routinely encourages residents to purchase flood insurance although homes without mortgages are not required to do so. These intermittent outreach efforts are considered to be generally effective, although additional staff and funding would be necessary to make them a regular occurrence. Such additional funding is not currently available.

Many property protection improvements are costly and may require acquisition of grant funding to successfully complete. Oxford has experience in preparing grant applications such that this effort can be performed when applicable. The Town has an in-house Grant Writer who has recently prepared five grant applications that have been submitted to FEMA, three of which are to perform home elevations along the Housatonic River. Details are as follows:

- Drainage remediation at Oxford Center Fire House: $402,200
- Drainage remediation at home on Brooklawn Terrace: $10,676
- Home elevation (~11 feet) along Roosevelt Drive: $255,100
- Home elevation (~11 feet) along Roosevelt Drive: $229,000
- Home elevation (~11 feet) along Roosevelt Drive: $149,000

In addition, beaver activity is also an issue in certain areas. The Public Works Department is constantly addressing beaver dam activity to ensure passable conditions along roadways. The response is generally effective at mitigating the flood potential of the beaver dams, although many times the beavers are active on private property out of view from public streets. As such, the Town must rely on citizen reporting to identify problem areas.

<u>Emergency Services</u>

Oxford already implements the emergency services mitigation measures outlined in Section 3.3.3. Oxford utilizes the "CodeRED" emergency notification system to target emergency calls into specific areas of the community.

Oxford receives regular weather updates through DEMHS Region 5 email alerts as well as watches and warnings through the National Weather Service. 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 Emergency Management Director and the Fire Department monitor local flood warnings. The National Weather Service website http://www.weather.gov/ can be accessed to obtain the latest flood watches and warnings before and during precipitation events.

The Oxford Fire Department also has a supply of portable pumps that they utilize to perform basement pumpouts. They also have a fire boat to perform water rescues. The existing equipment and capabilities are considered to be effective for responding to flood damage (except as specified in Section 3.6) and are evaluated at least annually.

<u>Public Education and Awareness</u>

Oxford makes a variety of information available for the public at its municipal buildings regarding mitigation flood hazards, including FEMA pamphlets on preparedness. The Director of Emergency Management, Zoning Enforcement Officer, and Building Official are local resources for preparedness and mitigation activities. The availability of these materials and resources is considered sufficient for the amount of flooding present in the community.

The Oxford Fire Department is responsible for warning residents along the Housatonic River when there will be controlled releases from Stevenson Dam. The residents of Under the Rock Park operate their own electrical power service shut-off for periods of controlled flooding.

Natural Resource Protection

Open space preservation is part of all subdivision projects as well as other development projects, with areas within wetlands and floodplains being prioritized for preservation by the Planning and Zoning Commission. Maintaining stream buffers is a priority for Oxford planners that has the secondary benefit of mitigating flood damage. Maintenance of such buffers is accomplished through the Inland Wetlands review. These activities have been effective at maintaining stream buffers in the community.

Oxford is interested in acquiring floodprone properties near the Housatonic River and converting the properties to open space although they have not received any commitments from property owners at this time. The community also maintains a wish list of open space that is desired that is annually reviewed. However, the ability to obtain such properties is subject to property availability and available funding.

Structural Projects

There are no existing flood control structures in Oxford. Structural projects have generally included evaluating local bridges and culverts and repairing or replacing these structures as needed. The regular evaluations have allowed Oxford staff to compile a list of undersized culverts, floodprone areas, and drainage problems as discussed in Section 3.6.

In summary, many of Oxford's capabilities to mitigate for flood damage have improved since the initial hazard mitigation plan was adopted, particularly with regard to knowledge of hazard areas. The increased knowledge of vulnerable areas, combined with other local planning efforts, have assisted community officials and commissions to provide a variety of flood mitigation recommendations for new development.

3.6 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to flooding within Oxford. As shown in the historic record, flooding can impact a variety of river corridors and cause severe damages. Flooding due to poor drainage and other factors is also a persistent hazard and can cause minor infrastructure damage, expedite maintenance, and create nuisance flooding of yards and basements.

3.6.1 Vulnerability Analysis of Private Property

Many structures in Oxford are located within the floodplains delineated by FEMA. Oxford does not currently have a list identifying the location and number of structures that are susceptible to flooding. **Oxford should utilize current aerial photography and parcel mapping to determine the number of houses within the 1% annual chance floodplain.** Table 3-2 presents a list of roadways with structures known to be located in floodprone areas.

Table 3-2
Areas with Structures in the 1% Annual Chance Floodplain

Street	Flooding Source
O'Neil Road	Eightmile Brook
Pope Road	
Route 188 (Quaker Farms Road)	
Route 188 (Strongtown Road)	
Punkup Road	Housatonic River
Route 34 (Roosevelt Drive)	
Fiddlehead Road	Lake Zoar
Freeman Road	
Maple Tree Hill Road	
Bice Drive	Little River
Brooklawn Terrace	
Governors Hill Road	
Hogs Back Road	
Old State Road 3	
Old State Road No. 67	
Route 67 (Oxford Road)	
Seth Den Road	
Woodside Avenue	
Wyant Road	
Trefoil Drive	Nichols Pond
Academy Road	Riggs Street Brook
Riggs Street	
Still Road	Sixmile Brook
Route 42 (Chestnut Hill Road)	Towantic Brook

According to the 2013 FEMA FIRM, a total of 920 acres of land in Oxford are mapped within the 1% annual chance floodplain, and a total of 1,027 additional acres of land are mapped within the 0.2% annual chance floodplain. Based on correspondence with the State of Connecticut NFIP Coordinator at the Connecticut DEEP, a total of 16 repetitive loss properties (RLPs) are located in Oxford. Three of these properties are considered to be Severe Repetitive Loss Properties. Each of the properties are residential and each is located along Route 34 (Roosevelt Drive) within the floodway of the Housatonic River downstream of Stevenson Dam. One of the 16 properties is listed as having been mitigated. Based on the RLP list, properties along the Housatonic River appear to be at the greatest risk of receiving flood damage. **Oxford should continue to pursue home elevations in this area.** If property owners are amenable, **Oxford should also pursue acquisition of floodprone property in this area with conversion of the property to open space.** Finally, **Oxford should pursue acquisition of undeveloped land within the Special Flood Hazard Area defined by FEMA in order permanently protect such land from development.**

One of the best methods of property protection is for the homeowner to purchase flood insurance through the NFIP. While insurance does not prevent flooding, insurance payouts assist homeowners in restoring their properties more quickly than could be performed with savings alone. **Local officials should encourage residents within the 1% annual chance floodplain to**

purchase flood insurance through the NFIP and complete elevation certificates for their structures. Elevation certificates help to identify the magnitude of a flood event that can impact a structure and provide information that is often necessary for federal grant applications. The 2012 Biggert-Waters Reform Act has restructured the NFIP such that insurance rates for pre-FIRM homes will no longer be subsidized in the near future. As such, elevation certificates are critical to ensure that a property receives a proper insurance rating. The above activities will assist Oxford in **joining the Community Rating System to reduce the cost of flood insurance for its residents.** The Town has expressed an interest in joining this FEMA program.

Chapter 152 of Oxford's Flood Plain Management Ordinance requires one foot of freeboard for new development or substantial improvement in floodplains. Given recent changes to rainfall and runoff patterns discussed in Section 2.4, **Oxford should consider requiring additional freeboard beyond one foot.** Additionally, the Flood Plain Management Ordinance already requires submission of and retention of elevations for such activities; the use of a standardized form would streamline the data collection and retention process. **Oxford should formally require the use of the FEMA Elevation Certificate to record all elevation submissions for new developments and substantial improvements requiring a Flood Hazards Area Permit.**

Emergency responders and code enforcement officials continue to be frustrated by unpermitted additions and renovations to residential structures within floodplains. This trend, particularly along the Housatonic River, has had the effect of transforming what was predominantly a seasonal population to year-round status. This has created a situation where residents and emergency responders are exposed to risk more often than in the past. One potential mitigation measure suggested by Town officials is to **install signage showing flood elevations along the Housatonic River** as a deterrent to development**.**

The use of an emergency notification system can help communities avoid casualties due to flash flooding. **Oxford should utilize the list of structures within the 1% annual chance floodplain to collect phone numbers of residents and businesses at risk in order to target flood warnings through the CodeRED system.** In addition, the Fire Department has found that it needs more equipment to properly respond to widespread flooding. **Oxford should pursue acquiring more portable pumps and an additional rescue boat.**

3.6.2 Vulnerability Analysis of Critical Facilities

The list of critical facilities provided by Oxford (Section 2.9) was used with Oxford's online parcel data and 2012 aerial photography to accurately locate each critical facility. The Oxford Police Department building appears to be located partially in the 1% annual chance floodplain, while the Oxford Center Fire House building appears to be mapped within the 0.2% annual chance floodplain.

The Oxford Police Department Building is located at the corner of Governor's Hill Road and Route 67. The southwest corner of the building appears to be located within the 1% annual chance floodplain of the Little River along with most of the rear parking area. The remainder of the building is located within the 0.2% annual chance floodplain. **Oxford may wish to consider installation of a low flood wall to protect this structure.** An elevation survey may also be needed to determine if the building is truly subject to the 1% annual chance flood.

The Center Fire House has drainage and flooding issues related to Kirk's Pond. Funding was being applied for at the time of the previous plan, but improvements were not performed. **Oxford should consider floodproofing measures for the northern side of the fire house.**

As noted at the public information meeting, many sewer pumping stations are located in low areas adjacent to watercourses as these areas are where pumping is needed. It is not currently known which sewer pumping stations may be at risk of flooding, although some are definitely in or near floodplains as described in Table 2-2. **Oxford should perform a survey of each sewer pumping station to determine if they are vulnerable to flooding.**

As noted in the historic record, Oxford's transportation network is at risk of flooding either from poor drainage or overbank conditions. This is particularly a concern given fact that flooding can make it difficult for ambulances to access hospital facilities in Derby and Waterbury if a variety of detours are enacted on State Roads due to road closures.

3.6.3 Vulnerability Analysis of Areas along Watercourses

In addition to the recurrent flooding conditions along the Housatonic River discussed above, the Little River and Riggs Street Brook are also reported as being recurring problem areas for flooding. The Little River has experienced flooding problems at Hogs Back Road and at its confluence with Towantic Brook in the south portion of Oxford near the Route 67 crossing, with the flooding extending to Park Road. Additional flooding has occurred at the Riggs Street Brook crossing of Route 67 near its confluence with the Little River. Flooding has also occurred on Riggs Street Brook upstream of the school access road. **Oxford should pursue funding to complete flood mitigation projects along the Little River.**

Many structures along the route of Riggs Street Brook and the Little River are threatened by even relatively routine floodwaters. Emergency evacuations have been completed during flood periods at a shopping plaza in the southeastern part of Oxford where the Little River crosses Route 67. Eightmile Brook also has areas with recurring flooding issues; most of the problems are to conveyance structures and roadways and not to individual structures. Residents also indicated that flooding along Towantic Brook was an issue.

There are many old and deteriorating bridges in the community that are often overtopped and/or undermined during even routine storm events due to aging components and inadequate sizing. A list of these bridges is presented in Table 3-3. A detailed evaluation of the flooding impact on the local transportation system is a town goal. Such an evaluation would include an engineering study to prioritize culvert and small bridge replacement projects. For example, the Park Road bridge over the Little River is one lane and floodprone, but has been difficult to mitigate because it is a historic structure. The Dutton Road bridge over the Little River is also floodprone. **Oxford should evaluate culverts and bridges and prioritize potential flood mitigation projects.**

Table 3-3
Floodprone Bridges in Oxford

Bridge	Flooding Source
Barry Road	Eight Mile Brook
Edmonds Road	Eight Mile Brook
Loughlin Road	Eight Mile Brook
O'Neil Road	Eight Mile Brook
East Hill Road at Punkup Road	Fivemile Brook
Moose Hill Road at Holbrook Road	Fourmile Brook
Brooklawn Terrace at Route 67	Little River
Dutton Road	Little River
Governor's Hill Road	Little River
Hogs Back Road	Little River
Old State Road No. 3	Little River
Park Road	Little River
Seth Den Road at Old State Road No. 67	Little River
Academy Road	Riggs Street Brook
Autumn Ridge Road	Riggs Street Brook
Fairfield Road at Great Hill Road	Unnamed Tributary to Little River

Given that rainfall intensity and magnitude has been increasing over the past few decades since the time that many local bridges and culverts were designed, the conveyance of each structure should be checked utilizing more recent rainfall data, and the structure redesigned if necessary. This could be done on a case-by-case basis, or as part of a larger watershed effort. The construction of a hydrologic and hydraulic model of the Little River watershed could be utilized to re-size bridges and check culvert sizes against the recently updated NRCC rainfall return periods and various flood events. Such a model could further enable Oxford to present comprehensive flooding data from various storm sizes and flood magnitudes in a straightforward manner for use by planners, emergency responders, and design professionals. While a model of this scope will be costly to develop, Oxford should consider creating such a model for future use following the proposed evaluation of culverts discussed above.

Residents indicated that Oxford needs to do a better job of controlling runoff into ponds and streams. Oxford's control over runoff typically occurs prior to development through the Planning and Zoning process, and when applicants come forward for improvement permits. As the town does not have jurisdiction on private property, it is instead focusing its efforts towards studying its existing drainage system such that upgrades and mitigation actions may be prioritized.

Residents also indicated that Oxford should coordinate water releases from dams before storms. This potential mitigation measure should be considered within a watershed framework for prioritizing mitigation projects. It is possible that lowering the water level behind particular dams could help mitigate downstream flooding during large storms. The creation of a watershed model would help make this determination on a case-by-case basis.

3.6.4 Vulnerability of Other Areas

Oxford has a variety of areas that are subject to flooding away from defined watercourses. Many of these areas flood due to clogged or undersized drainage systems, or the complete lack of a drainage system. Such minor flood events can damage roads and cause ponding of nearby yards, basement flooding, and other damages. These events can usually be repaired by the Department of Public Works through cleaning, curb repair, and asphalt patching. More extreme events can require complete infrastructure replacement. As noted in Section 2.4, these damage events are expected to become more frequent in the future as the intensity and magnitude of rainfall events continues to increase.

Many new flooding problems are related to drainage from recent developments. Ridge Street, Wyatt Road, Academy Road, O'Neil Road, Dutton Road, Park Road, East Hill Road, Edmonds Road, and Route 188 all have areas with new drainage issues that initially occurred following the construction of upgradient developments. Great Hill Road and Echo Valley Road near Haynes Materials have also seem to have become more floodprone. Higher intensity rainfall and the use of outdated drainage computations may also be playing a role in the new drainage issues. Additional areas identified by the Department of Public Works as having drainage problems include:

- Riggs Street
- Hurley Road
- Pope Road
- Ploch Road
- Old Farm Road at Old Country Road
- Dorman Road
- Seth Den Road
- Moose Hill Road
- Kirk's Pond at Center Fire House (Route 67)

Similar to the other flooding areas, it is likely that these areas will experience more frequent and intensive flooding events in the future. **Oxford should continue evaluating drainage systems to reduce the impacts and frequency of nuisance flooding.**

3.6.5 HAZUS-MH Vulnerability Analysis

HAZUS-MH is FEMA's loss estimation methodology software for flood, wind, and earthquake hazards. The current version of the software utilizes year 2000 U.S. Census data and a variety of engineering information to calculate potential damages (valued in year 2006 dollars) to a user-defined region. The software was utilized to perform a basic analysis to generate potential damages to major streams in Oxford from a 1% annual chance riverine flood event. Hydrology and hydraulics for the streams and rivers were generated utilizing digital elevation models available from the DEEP that were prepared using the 2000 LiDAR study and digital FIRM mapping available from FEMA. HAZUS-MH output is included in Appendix D. The following paragraphs discuss the results of the HAZUS-MH analysis.

Major streams in Oxford that were analyzed include the following.

- Eight Mile Brook;

- Fivemile Brook;
- Housatonic River;
- Little River; and
- Riggs Street Brook

A summary of the default building counts and values is shown in Table 3-4. Approximately two billion dollars of building value were estimated to exist within Oxford.

Table 3-4
HAZUS-MH Flood Scenario – Basic Information

Occupancy	Dollar Exposure
Residential	$678,534,000
Commercial	$164,676,000
Other	$77,733,000
Total	**$920,943,000**

The HAZUS-MH simulation estimates that during a 1% annual chance flood event, 23 buildings will be at least moderately damaged in the community from flooding. A total of 20 of these buildings will be substantially damaged and uninhabitable. Table 3-5 presents the expected damages based on building type.

Table 3-5
HAZUS-MH Flood Scenario – Building Stock Damages

Stream	1-10% Damaged	11-20% Damaged	21-30% Damaged	31-40% Damaged	41-50% Damaged	Substantially Damaged
Eight Mile Brook	0	0	0	0	0	0
Fivemile Brook	0	0	0	0	0	0
Housatonic River	0	0	0	0	3	20
Little River	0	0	0	0	0	0
Riggs Street Brook	0	0	0	0	0	0

HAZUS-MH utilizes a subset of critical facilities known as "essential facilities" that are important following natural hazard events. These include fire stations, hospitals, police stations, and schools. The software simulated that under the 1% annual chance flood event, none of the essential facilities will incur moderate or greater damage.

The HAZUS-MH simulation estimated the following tons of debris would be generated by flood damage for the 1% annual chance flood scenario along each stream. The simulation also estimates the number of truckloads (at approximately 25 tons per truck) that will be required to remove the debris. The breakdown of debris generation is as follows:

Table 3-6
HAZUS-MH Flood Scenario – Debris Generation (Tons)

Stream	Finishes	Structural	Foundations	Total	Truckloads
Eight Mile Brook	3	2	2	7	<1
Fivemile Brook	2	1	<1	2	<1
Housatonic River	340	679	525	1,544	62
Little River	75	20	16	111	4
Riggs Street Brook	4	0	0	4	<1

HAZUS-MH calculated the potential sheltering requirement for the 1% annual chance flood event along each stream. Displacement includes households evacuated from within or very near to the inundated areas. Of these households, some people will seek temporary shelter in public shelters, while others are predicted to stay with friends, family, or in hotels or motels. The predicted sheltering requirements for flood damage are relatively minor such that the existing sheltering space is likely sufficient for the community's needs.

Table 3-7
HAZUS-MH Flood Scenario – Sheltering Requirements

Stream	Displaced Households	Population Using Public Shelters
Eight Mile Brook	1	0
Fivemile Brook	0	0
Housatonic River	31	41
Little River	28	6
Riggs Street Brook	5	1

HAZUS-MH also calculated the predicted economic losses due to the 1% annual chance flood event along each stream. Economic losses are categorized between building-related losses and business interruption losses. Building-related losses (damages to building, content, and inventory) are the estimated costs to repair or replace the damage caused to the building and its contents. This information is presented in Table 3-8. Business interruption losses are those associated with the inability to operate a business because of the damage sustained during the flood, and include lost income, relocation expenses, lost rental income, lost wages, and temporary living expenses for displaced people. This information is presented in Table 3-9.

Table 3-8
HAZUS-MH Flood Scenario – Building Loss Estimates

Stream	Residential	Commercial	Industrial	Others	Total
Eight Mile Brook	$70,000	$20,000	$0	$0	$90,000
Fivemile Brook	$10,000	$0	$0	$0	$10,000
Housatonic River	$7,930,000	$450,000	$180,000	$10,000	$8,560,000
Little River	$870,000	$3,000,000	$340,000	$620,000	$4,830,000
Riggs Street Brook	$80,000	$0	$0	$0	$80,000

Table 3-9
HAZUS-MH Flood Scenario – Business Interruption Estimates

Stream	Residential	Commercial	Industrial	Others	Total
Eight Mile Brook	$0	$0	$0	$0	$0
Fivemile Brook	$0	$0	$0	$0	$0
Housatonic River	$0	$0	$0	$0	$0
Little River	$0	$20,000	$0	$30,000	$40,000
Riggs Street Brook	$0	$0	$0	$0	$0

The HAZUS-MH results are consistent with observed conditions in Oxford. The most damaging floods occur along the Housatonic River and the Little River, while flooding in other areas primarily causes minor damage to structures. Structures are not generally not impacted by flooding except along the Housatonic River.

4.0 HURRICANES

4.1 Setting

Several types of hazards may be associated with tropical storms and hurricanes including heavy or tornado winds, heavy rains, and flooding. While only some of the areas of Oxford 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 Oxford. A hurricane striking Oxford is considered a possible event each year and could cause critical damage to the town and its infrastructure (refer to Table 1-3 and Table 1-4).

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 Typical Mitigation Measures, Strategies, and Alternatives

Many typical mitigation measures for hurricanes include those appropriate for inland flooding. These were presented in Section 3.3. 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. Note that natural resource protection projects are not typically available for wind damage.

4.3.1 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:

- Instituting tree limb inspection and maintenance programs to ensure that the potential for downed power lines is diminished.
- Locating utilities underground in new developments or during redevelopment whenever possible.
- Have current Emergency Operations Plans, evacuation plans, supply distribution plans, and other emergency planning documents for the community as appropriate.
- Utilize evacuation procedures whenever the mobile home parks or campgrounds are threatened by hurricane wind damage.

4.3.2 Property Protection

Most people perform basic property protection measures in advance of hurricanes, including cutting dangerous tree limbs, boarding windows, and moving small items inside that could be carried away by heavy winds. Property protection measures for hurricanes also include those described for flooding in Section 3.3.2 due to the potential for heavy rainfall to accompany the storm. In terms of new construction and retrofits, various structural projects for wind damage mitigation on buildings are described in Section 4.3.5, including the use of shutters and wind-resistant windows.

Local tree wardens should conduct 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.

4.3.3 Emergency Services

Emergency Operation Plans typically include 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 community website, (2) by creating informational displays in local municipal buildings and high traffic businesses such as supermarkets, and (3) through press releases to local radio and television stations and local newspapers. In addition, communities should identify and prepare additional backup facilities for evacuation and sheltering needs. Communities should also continue to review their mutual aid agreements and update as necessary to ensure help is available as needed, and ensure that the community is not hindered responding to its own emergencies as it assists with regional emergencies.

The Connecticut Public Utility Regulatory Authority is currently piloting a “micro-grid” program designed to provide backup power supplies to small areas critical to public supply distribution.

These infrastructure improvements will allow for small areas of the power grid to be isolated and powered by emergency generators, such as those where supermarkets and gas stations are located.

4.3.4 Public Education and Awareness

Tracking of hurricanes has advanced to the point where areas often have one week of warning time or more prior to a hurricane strike. The public should be made aware of available shelters prior to a hurricane event, as well as potential measures to mitigate personal property damage. This was discussed in Sections 4.3.2 and 4.3.3 above.

4.3.5 Structural Projects

While structural projects to completely eliminate wind damage are not possible, potential structural mitigation measures for buildings include designs for hazard-resistant construction and retrofitting techniques. These generally 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. The four categories of structural projects for wind damage mitigation in private homes and critical facilities include the installation of shutters, load path projects, roof projects, and code plus projects and are defined below.

- 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 infrequency of hurricane wind damage in Connecticut, it is unlikely that any structural project for mitigating wind damage would be cost effective (and therefore eligible for grant funding) unless it was for a critical facility. Communities should encourage the above measures in new construction, and require it for new critical facilities. Continued 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.

4.4 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 (1851-2012), 2 Category Three Hurricanes, 8 Category Two Hurricanes, 11 Category One Hurricanes, 54 tropical storms, and 8 tropical depressions have tracked within a 150 nautical mile radius of Waterbury, Connecticut. This location was chosen for its prominence in the COGCNV region. The representative storm strengths were measured as the peak intensities for each individual storm passing within the 150-mile radius. The 21 hurricanes noted above occurred in August and September as noted in Table 4-1.

Table 4-1
Tropical Cyclones by Month within 150 Nautical Miles of Waterbury Since 1851

Category	May	June	July	Aug.	Sept.	Oct.	Nov.
Tropical Depression	None	1	1	3	1	1	None
Tropical Storm	2	7	4	11	16	11	2
One	None	None	1	2	7	2	None
Two	None	None	None	3	6	None	None
Three	None	None	None	None	2	None	None
Total	**2**	**8**	**6**	**19**	**32**	**14**	**2**

A description of the more recent tropical cyclones near Oxford follows:

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 USD).

As explained in Section 3.3, the year 1955 was a devastating year for flooding in Connecticut. Connie was a declining tropical storm over the Midwest when its effects hit Connecticut in August of 1955, producing heavy rainfall of four to six inches across the state. The saturated soil conditions exacerbated the flooding caused by Tropical Storm Diane five days later, the wettest tropical cyclone on record for the northeast. The storm produced 14 inches of rain in a 30-hour period, causing destructive flooding conditions along nearly every major river system in the state.

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.

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.

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.

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).

Tropical Storm Floyd in September 1999 produced widespread flooding and high winds (sustained at 50 knots) that caused power outages throughout New England and at least one death in Connecticut.

Tropical Storm Irene in August 2011 produced five to 10 inches of rainfall across western Connecticut resulting in widespread flash flooding and river flooding. Local wind gusts exceeded 60 miles per hour. The combination of strong winds and saturated soil led to numerous downed trees and power outages throughout the region. The wind damage caused power outages lasting eight days throughout most of Oxford, although in some instances individual properties were out even longer.

Hurricane Sandy struck the Connecticut shoreline as a Category 1 Hurricane in late October 2012, causing power outages for 600,000 customers and at least $360 million in damages in Connecticut. Significant tree damage and damage to power lines occurred in Oxford.

4.5 Existing Programs, Policies, and Mitigation Measures

Existing mitigation measures appropriate for flooding have been discussed in Section 3.0. 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, local flood protection projects, and riprap.

Wind loading requirements are addressed through the state building code. The 2005 Connecticut State Building Code was amended in 2011 and adopted with an effective date of October 6, 2011. 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 Oxford is 90 miles per hour. Oxford has adopted the Connecticut Building Code as its building code, and literature is available regarding design standards in the Building Department office.

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. For example, the power company performed significant trimming in the Park Road area following the recent severe storms.

The electric utility has assigned a liaison to the community through whom the Public Works Department may present concerns and request assistance. Communication and response can be limited such that the best results for Oxford were when the power company simply assigned a crew to operate under the town's direction. As a result of the extended power outages, many residents in Oxford have installed generators since the 2011 storms.

The local tree warden and encourages residents to cut trees that can be dangerous to power lines. The Department of Public Works has a budget for tree trimming but a larger budget would be preferred since a large percentage goes to outside contractors for elevated tree work. Oxford has several crews and sufficient equipment to perform ground-level tree maintenance and cleanup. In addition, all utilities must be located underground in certain developments and are encouraged to be placed underground wherever possible in order to mitigate storm-related damages. These regulations have been effective at reducing vulnerability for new developments. While moving all utilities underground would prevent wind damage to this infrastructure, this activity is too cost-prohibitive for the community.

During emergencies, Oxford currently has a designated emergency shelter as discussed in Section 2.9. 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. None of these shelters are known to be specifically designed to resist the effects of wind.

Oxford 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. Prior to severe storm events, Oxford ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas. These protocols are considered effective preparation for storm events.

In summary, many of Oxford's capabilities to mitigate for wind damage and prevent loss of life and property have improved slightly since the initial hazard mitigation plan was adopted. Furthermore, Connecticut Light & Power has increased its capabilities and response relative to tree and tree limb maintenance near utility lines.

4.6 Vulnerabilities and Risk Assessment

NOAA issues an annual hurricane outlook to provide a general guide to each upcoming hurricane season based on various climatic factors. However, 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 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 previous 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 data 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 New Haven County to be 39 years and 68 years, respectively.

The 2010 *Connecticut Natural Hazard Mitigation Plan Update* also notes that some researchers have suggested that the intensity of tropical cyclones has increased over the last 35 years, with some believing that there is a connection between this increase in intensity 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 intensity 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. One particular area of vulnerability for recurring tree damage is located on Pines Bridge Road. Large pine trees snap and fall during high wind events and damage overhead utilities in the area.

Due to the relatively limited communication coming from Connecticut Light & Power, Oxford typically does not know what resources are available during and immediately following a severe storm event. Therefore, Oxford performs much of its own trimming and cleanup during emergencies, which can be problematic if lines are not de-energized. In addition, while the electric utility trimmed in some areas, they did not trim in many areas that were planned.

Residents have indicated concerns relative to the need for increased trimming near power lines along town rights-of-way. In particular, Chestnut Tree Hill Road was mentioned by residents as a problem area for downed trees and power lines. Several suggested actions related to storm cleanup and trimming are available. **Oxford should review the existing tree maintenance budget and make improvements if necessary. Additionally, the acquisition of a boom truck would allow for town personnel to perform elevated tree work, saving the expense of contracting such work out. Finally, Oxford should work with other communities in the State to improve communications with Connecticut Light & Power during emergency situations.**

Oxford is vulnerable to hurricane damage from wind and flooding and from any tornadoes accompanying the storm. In fact, most of the damage to Oxford from historical tropical cyclones has been due to the effects of flooding. Fortunately, Oxford 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 community 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, Oxford is expected to experience substantial population growth of nine percent per five-year period through 2030. All areas of growth and development increase the community's vulnerability to natural hazards such as hurricanes, although new development is expected to mitigate potential damage by meeting the standards of the most recent building codes. As noted in Section 4.1, wind damage from hurricanes and tropical storms has the ability to affect all areas of Oxford, while areas susceptible to flooding are even more vulnerable. Areas of known and potential flooding problems are discussed in Section 3.0, and tornadoes (which sometimes develop during tropical cyclones) will be discussed in Section 5.0.

Some critical facilities are more susceptible than others to flooding damage associated with hurricane rainfall. Such facilities susceptible to flooding were discussed in Section 3.5.

The Emergency Management Director is unsure if any Town-owned critical facilities have wind-mitigation measures installed to specifically reduce the effects of wind. Thus, it is believed that nearly all of the critical facilities in the community are as likely to be damaged by hurricane-force winds as any other. Newer critical facilities are more likely to meet current building code requirements and are therefore considered to be the most resistant to wind damage even if they are not specifically wind-resistant. Older facilities, such as schools, are considered to be more susceptible to wind damage as they have older roofs.

Oxford'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 community predates the recent code changes, many structures are highly susceptible to roof and window damage from high winds.

Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. There are currently no mobile home parks in Oxford.

As Oxford is not affected by storm surge, hurricane sheltering needs have not been calculated by the U.S. Army Corps of Engineers for the community. Oxford determines sheltering need based upon areas damaged or needing to be evacuated within the community. Under limited emergency conditions, a high percentage of evacuees will seek shelter with friends or relatives rather than go to established shelters. In the case of a major (Category Three or above) hurricane, it is likely that Oxford will depend on state and federal aid to assist sheltering displaced populations until normalcy is restored.

HAZUS-MH Simulation

In order to quantify potential hurricane damage, HAZUS-MH simulations were run for historical and probabilistic storms that could theoretically affect Oxford. For the historical simulations, the results estimate the potential maximum damage that would occur in the present day (based on year 2006 dollar values using year 2000 census 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 calculate damage for wind effects alone and not damages due to flooding or other non-wind effects. Thus, the damage and displacement estimates presented below are likely lower than would occur during a hurricane associated with severe rainfall. Results are presented in Appendix D and summarized below.

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

The FEMA default values were used for each census tract in the HAZUS simulations. A summary of the default building counts and values was shown in Table 3-3.

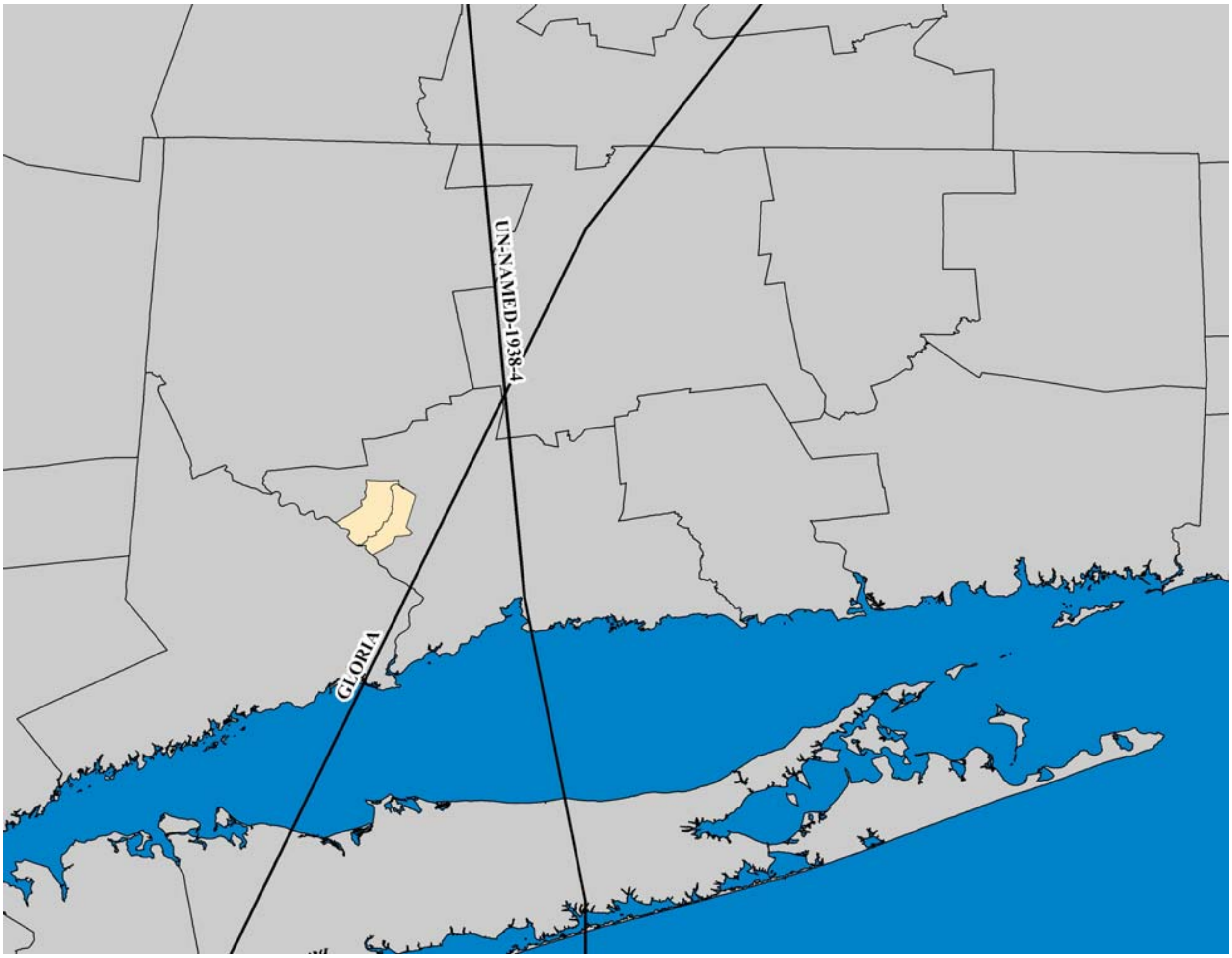


Figure 4-1: Historical Hurricane Storm Tracks

The FEMA *Hurricane Model HAZUS-MH 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 4-3 presents the peak wind speeds during each wind event simulated by HAZUS for Oxford. The number of expected residential buildings to experience various classifications of damage is presented in Table 4-3, and the total number of buildings expected to experience various classifications of damage is presented in Table 4-4. Minimal damage is expected to buildings for wind speeds less than 75 mph, with overall damages increasing with increasing wind speed.

Table 4-3
HAZUS 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	42	0	0	0	0	0
20-Years	57-58	0	0	0	0	0
Gloria (1985)	75	9	0	0	0	9
50-Years	75-76	14	0	0	0	14
100-Years	88-89	127	6	0	0	133
200-Years	99-100	401	36	1	0	438
Unnamed (1938)	105	590	72	3	2	667
500-Years	112	942	183	16	10	1,151
1000-Years	120	1,281	377	63	39	1,760

Table 4-4
HAZUS 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	1	0	0	0	1
Gloria (1985)	11	0	0	0	11
50-Years	17	0	0	0	17
100-Years	137	7	0	0	144
200-Years	431	40	1	1	473
Unnamed (1938)	636	82	5	2	715
500-Years	1,021	210	22	10	1,263
1000-Years	1,392	441	78	40	1,951

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. Note that the essential facilities in HAZUS-MH may not necessarily be the same today as they were in 2000. Nevertheless, the information is useful from a planning standpoint. As shown in Table 4-5, minimal damage to essential facilities is expected for wind speeds less than 89 mph. Minor damage to schools occurs for all greater wind events with a corresponding loss of service.

Table 4-5
HAZUS-MH Hurricane Scenarios – Essential Facility Damage

Return Period or Storm	Fire Stations (3)	Police Stations (1)	Schools (3)
10-Years	None or Minor	None or Minor	None or Minor
20-Years	None or Minor	None or Minor	None or Minor
Gloria (1985)	None or Minor	None or Minor	None or Minor
50-Years	None or Minor	None or Minor	None or Minor
100-Years	None or Minor	None or Minor	None or Minor
200-Years	None or Minor	None or Minor	None or Minor
Unnamed (1938)	None or Minor	None or Minor	All schools have minor damage, loss of use > 1day
500-Years	None or Minor	None or Minor	All schools have minor damage, loss of use > 1day
1000-Years	None or Minor	None or Minor	All schools have minor damage, loss of use > 1day

Table 4-6 presents the estimated tonnage of debris that would be generated by wind damage during each HAZUS storm scenario. The model breaks the debris into four general categories based on the different types of material handling equipment necessary for cleanup. As shown in Table 4-6, minimal debris are expected for storms less than the 20-year event, and reinforced concrete and steel buildings are not expected to generate debris except for the highest wind events simulated. Much of the debris that is generated is tree-related.

Table 4-6
HAZUS-MH Hurricane Scenarios – Debris Generation (Tons)

Return Period or Storm	Brick / Wood	Reinforced Concrete / Steel	Eligible Tree Debris	Other Tree Debris	Total
10-Years	None	None	None	None	None
20-Years	None	None	11	70	81
Gloria (1985)	40	None	73	458	571
50-Years	54	None	90	571	715
100-Years	301	None	1,986	10,770	13,057
200-Years	858	None	2,551	13,946	17,355
Unnamed (1938)	1,336	None	3,455	18,602	23,392
500-Years	2,685	1	7,261	38,843	48,790
1000-Years	5,422	35	13,457	72,283	91,197

Table 4-7 presents the potential sheltering requirements based on the various wind events simulated by HAZUS. The predicted sheltering requirements for wind damage are minimal and can be met through the use of existing shelters. However, it is likely that hurricanes will also produce heavy rain and flooding that will increase the overall sheltering need in Oxford.

Table 4-7
HAZUS Hurricane Scenarios – Shelter Requirements

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

Table 4-8 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 4-8
HAZUS Hurricane Scenarios – Economic Losses

Return Period or Storm	Residential Property Damage Losses	Total Property Damage Losses	Business Interruption (Income) Losses	Total Losses
10-Years	None	None	None	None
20-Years	$37,000	$37,000	$30	$37,030
Gloria (1985)	$778,790	$814,320	$1,560	$815,870
50-Years	$987,060	$1,031,500	$2,330	$1,033,820
100-Years	$3,400,650	$3,639,140	$200,710	$3,839,860
200-Years	$7,726,320	$8,565,730	$652,270	$9,218,000
Unnamed (1938)	$11,657,090	$13,167,440	$1,137,740	$14,305,180
500-Years	$24,546,350	$28,399,340	$2,984,420	$31,383,760
1000-Years	$53,353,940	$62,788,090	$7,016,550	$69,804,640

Losses are minimal for storms with return periods of less than 20-years (58 mph) but increase rapidly as larger storms are considered. For example, a reenactment of the 1938 hurricane would cause approximately $14.3 million in wind damages to Oxford. As these damage values are based on 2006 dollars, it is likely that these estimated damages will be higher today due to inflation.

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

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 Oxford. 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 community without harming another. The entire town 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 Oxford each year, although lightning strikes typically 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 New Haven County each year that could cause significant damage to a small area (refer to Table 1-3 and Table 1-4).

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. Flooding caused by heavy rainfall was covered in Section 3.0 of this plan and will not be discussed in detail herein.

Tornadoes

NOAA defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." The two types of tornadoes include those that develop from supercell thunderstorms and those that do not. While the physics of tornado development are fairly well understood, there are many unknowns still being studied regarding the exact conditions in a storm event required to trigger a tornado, the factors affecting the dissipation of a tornado, and the effect of cloud seeding on tornado development.

Supercell thunderstorms are long-lived (greater than one hour) and highly organized storms feeding off an updraft that is tilted and rotating. This rotation is referred to as a "mesocyclone" when detected by Doppler radar. The figure below is a diagram of the anatomy of a supercell that has spawned a supercell tornado. Tornadoes that form from a supercell thunderstorm are a very small extension of the larger rotation; they are the most common and the most dangerous type of tornado, as most large and violent tornadoes are spawned from supercells.

Non-supercell tornadoes are defined by NOAA as circulations that form without a rotating updraft. Damage from these types of tornadoes tends to be F2 or less (see Fujita Scale, below). The two types of non-supercell tornadoes are gustnadoes and landspouts:

- ❑ A gustnado is a whirl of dust or debris at or near the ground with no condensation tunnel that forms along the gust front of a storm.

- ❑ A landspout is a narrow, rope-like condensation funnel that forms when the thunderstorm cloud is still growing and there is no rotating updraft. Thus, the spinning motion originates near the ground. Waterspouts are similar to landspouts but occur over water.

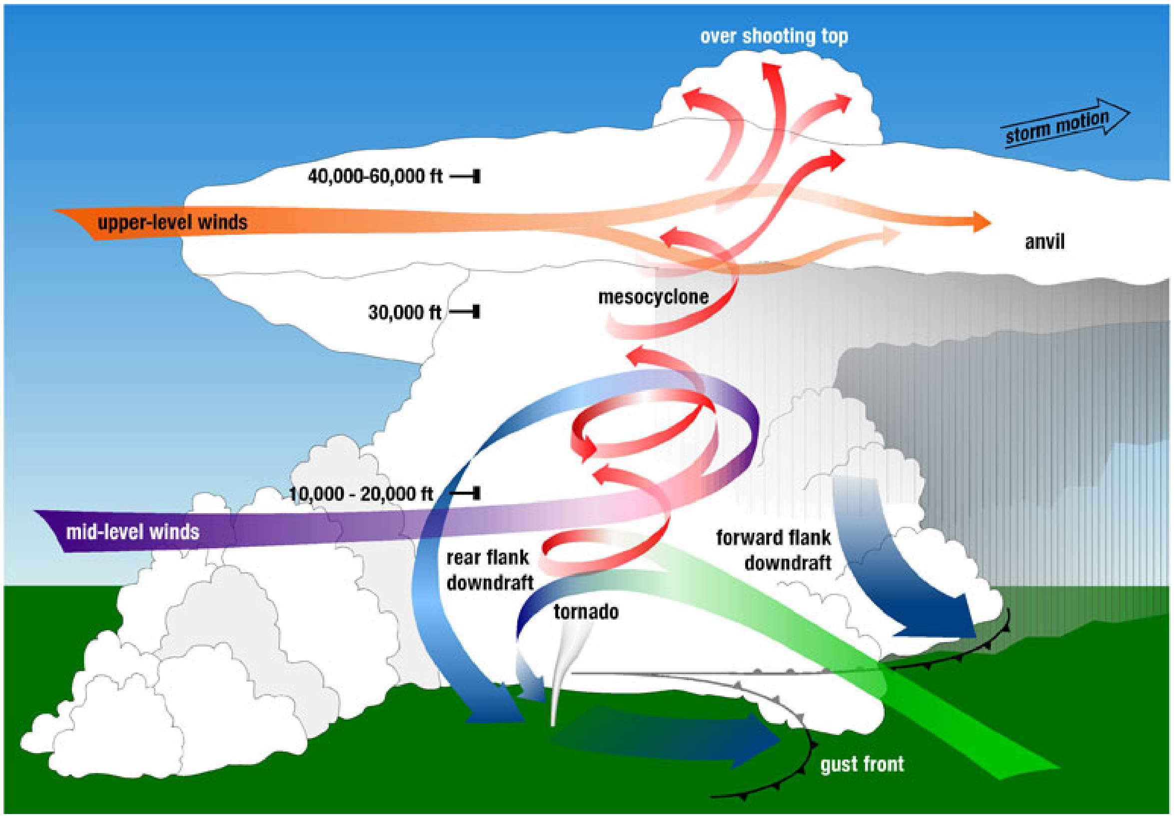
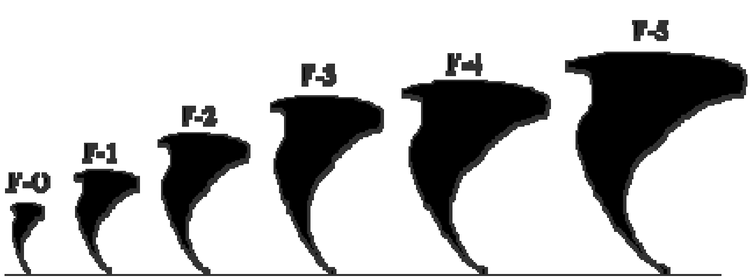


Figure 5-1: Anatomy of a Tornado. Image from NOAA National Severe Storms Laboratory.

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. A description of the scale follows in Table 5-1.



Fujita Tornado Scale. Image courtesy of FEMA.

Table 5-1
Fujita Scale

F-Scale Number	Intensity	Wind Speed	Type of Damage Done
F0	Gale tornado	40-72 mph	Some damage to chimneys; branches broken off trees; shallow-rooted trees knocked over; damage to sign boards.
F1	Moderate tornado	73-112 mph	Peels surface off of 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.
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 for 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 de-barked; steel reinforced concrete structures badly damaged.

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 supercell tornadoes (F4 and above) are extremely destructive but rare 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

Fujita Scale			**Derived EF Scale**		**Operational EF Scale**	
F Number	*Fastest 1/4-mile (mph)*	*3 Second Gust (mph)*	*EF Number*	*3 Second Gust (mph)*	*EF Number*	*3 Second Gust (mph)*
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 1,000 tornadoes is reported each year in the United States. The historic record of tornadoes near Oxford is discussed in Section 5.4. Tornadoes are most likely to occur in Connecticut in June, July, and August of each year

Lightning


Image courtesy of NOAA.

Lightning is a discharge of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. According to NOAA, the creation of lightning during a storm is a complicated process that is not fully understood. 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.

The historic record of lightning strikes both in Connecticut and near Oxford is presented in Section 5.4.

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).*

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. This implies that there are approximately 10,000 downbursts reported in the United States each year, and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This value suggests that downbursts are a relatively uncommon yet persistent hazard. A few downbursts have occurred in Oxford as reported in the historic record in Section 5.4.

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. NOAA has estimates of the velocity of falling hail ranging from nine meters per second (m/s) (20 mph) for a one centimeter (cm) diameter hailstone, to 48 m/s (107 mph) for an eight cm, 0.7 kilogram stone. While crops are the major victims of hail, larger hail is also a hazard to people, 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.

5.3 Typical Mitigation Measures, Strategies, and Alternatives

Most of the mitigation activities for summer storm and tornado wind damage are similar to those discussed in Section 4.3 and are not reprinted here.

5.3.1 Prevention

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. 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. Residents should be encouraged to purchase a NOAA weather radio containing an alarm feature.

More information is available at:

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

5.3.2 Property Protection

In addition to other educational documents, the Building Official should make literature available regarding appropriate design standards for grounding of structures.

5.3.3 Emergency Services

Warnings are critical to mitigating damage from hail, lightning, and tornadoes. These hazards can appear with minimal warning such that the ability to quickly notify a large area is critical. The community alert system should be utilized to inform the public when severe weather events may occur.

5.3.4 Public Education and Awareness

Public education is one of the best ways to mitigate damage from hail, lightning, and tornadoes. Annual pamphlets or information posted to the community website can help to remind residents of potential dangers.

5.3.5 Structural Projects

Although tornadoes pose a legitimate threat to public safety, as stated in Section 5.2 their occurrence is considered too infrequent in Connecticut to justify the construction of tornado shelters.

5.4 Historic Record

According to NOAA, the highest number of occurrences of tornadoes in Connecticut is Litchfield (22 events between 1950 and 2009) and Hartford counties, followed by New Haven and Fairfield counties, and then Tolland, Middlesex, Windham, and finally New London County. Three tornadoes have occurred in New Haven County between January 1996 and April 2013.

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. Table 5-3 summarizes the tornado events near Oxford through July 2013 based on the Wikipedia list.

Table 5-3
Tornado Events near Oxford From 1648 to July 2013

Date	Location	Fujita Tornado Scale	Property Damage	Injuries / Deaths
August 17, 1784	Roxbury to South Britain	-	Ten houses, five barns, and three mills badly damaged or destroyed	5 injured
July 22, 1817	Woodbury to Watertown	-	Tree damage	NR
September 15, 1901	Shelton to Monroe	-	Hundreds of trees and several barns destroyed	1 death
October 24, 1955	Near Waterbury	F2	NR	NR
May 24, 1962	Northern New Haven and Southern Hartford Counties (11 miles)	F3	200 buildings destroyed, 600 damaged, $4,000,000 in damages	1 death, 50 injured
July 29, 1972	Downtown Waterbury	F3 / F2	Factory unroofed, houses damaged	2 injured
July 12, 1973	Southeastern Litchfield County	F2	NR	NR
July 10, 1989	Watertown to northern Waterbury	F2	50 homes unroofed or severely damaged	70 injured
May 29, 1995	South Britain to Southbury (2 miles)	F1	Tree damage, minor damage to homes	NR
July 23, 1995	Prospect	F0	Tractor trailer thrown 200 yards	NR
July 3, 1996	Downtown Waterbury	F1	Damage to high school	NR
May 31, 2002	Southbury	F0	Tree damage	NR
May 16, 2007	Bethel to Newtown	EF1	NR	NR

NR = Not Reported

Damaging winds are considered to be the most frequent natural hazard occurring in Oxford. The severe storm of July 10, 1989 is one of the best remembered wind occurrences in Connecticut. This storm produced an F2 tornado that tracked from Watertown into Waterbury, injuring 70 people and damaging 50 homes. The storms produced damaging straight-line winds that resulted in one death when a girl was killed when a tree fell onto her tent. Some meteorologists have suggested that the 1989 tornado was actually a series of microbursts.

Thunderstorms occur on 18 to 35 days each year in Connecticut. Only 17 lightning-related fatalities occurred in Connecticut between 1959 and 2009. Most recently, on June 8, 2008, lightning struck a pavilion at Hamonassett Beach in Madison, Connecticut, injuring five and killing one. Hail is often a part of such thunderstorms as seen in the historic record for Oxford (below). A limited selection of summer storm damage in and around Oxford taken from the NCDC Storm Events database, is listed below:

- ❑ May 31, 1998 – Severe thunderstorms produced 0.88-inch hail in Derby.

- September 16, 1999 – In addition to the flooding damages described in Section 3.4, the remnants of Tropical Storm Floyd also produced wind gusts up to 60 miles per hour causing widespread downing of trees and power lines.

- June 16, 2002 – Thunderstorms tracking across the State produced an F0 tornado in Lanesville and 0.75-inch hail in Waterbury. High winds downed trees in Naugatuck.

- May 28, 2003 – A line of severe thunderstorms produced 0.75-inch hail in Waterbury.

- August 20, 2004 – An intense severe thunderstorm produced 1.75-inch hail in Waterbury and very strong wind gusts that downed several trees that damaged cars and blocked roads.

- June 1, 2007 – Severe thunderstorms produced 1.00-inch hail in Waterbury and some wind damage.

- June 5, 2007 – Severe thunderstorms produced 1.75-inch hail in Southbury that damaged car windshields and accumulated to one inch deep that required plowing by Connecticut DOT. Isolated flash flooding also occurred.

- June 26, 2009 – Severe thunderstorms produced 1.00-inch hail in Watertown and 0.75-inch hail in Waterbury.

- July 7, 2009 – Severe thunderstorms produced 0.88-inch hail in Waterbury.

- November 20, 2009 – A thunderstorm caused a lightning bolt that damaged a house and caused a thundercrack that damaged the hearing of the resident in Waterbury.

- August 1, 2011 – Severe thunderstorms produced 1.00-inch hail in Waterbury and Naugatuck, and 61 knot gusts across the area. At least two homes in Waterbury were struck by lightning.

- July 1, 2012 – Severe thunderstorms tracked across the region, producing 0.75-inch hail in Waterbury and 2.00-inch hail in Cheshire. Wind speeds were sustained at 61 knots.

5.5 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.

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.

Table 5-5
NOAA Weather Warnings

Weather Condition	Meaning	Actions
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.

Aside from warnings, several other methods of mitigation for wind damage are employed in Oxford as explained in Section 4.0. In addition, the Connecticut State Building Code includes guidelines for the proper grounding of buildings and electrical boxes.

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.

Municipal responsibilities relative to summer storm and tornado mitigation and preparedness include:

- Developing and disseminating emergency public information and instructions concerning tornado, thunderstorm wind, lightning, and hail safety, especially guidance regarding in-home protection and evacuation procedures and locations of public shelters.

- Designating appropriate shelter space in the community that could potentially withstand lightning and tornado impact.

- Periodically test and exercise tornado response plans.

- Putting emergency personnel on standby at tornado "watch" stage.

- Utilizing the "CodeRED" Emergency Notification System to send warnings into potentially affected areas.

These protocols are considered effective for mitigating wind and summer storm-related damage in the Town of Oxford. While additional funding could be utilized to strengthen the current level of mitigation, such funding is not currently considered cost-effective for the current level of vulnerability.

5.6 Vulnerabilities and Risk Assessment

According to the 2010 *Natural Hazard Mitigation Plan Update,* Litchfield County is the most susceptible county in Connecticut to tornado activity. By virtue of its location in New Haven County, Oxford has a more moderate potential to experience tornado damage. However, NOAA states that climate change has the potential to increase the frequency and intensity of tornadoes, so it is possible that the pattern of occurrence in Connecticut could change in the future.

Although tornadoes pose a threat to all areas of the state, their occurrence is not considered frequent enough to justify the construction of tornado shelters. Instead, the State has provided NOAA weather radios to all public schools as well as many local governments for use in public buildings. The general public continues to rely on mass media for knowledge of weather warnings. Warning time for tornadoes is very short due to the nature of these types of events, so pre-disaster response time can be limited. However, the NOAA weather radios provide immediate notification of all types of weather warnings in addition to tornadoes, making them very popular with communities.

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.

In general, thunderstorms and hailstorms in Connecticut are more frequent in the western and northern parts of the state, and less frequent in the southern and eastern parts. Thunderstorms are expected to impact Oxford at least 20 days each year. The majority of these events do not cause any measurable damage. Although lightning is usually associated with thunderstorms, it can occur on almost any day. The likelihood of lightning strikes in the Oxford area is very high during any given thunderstorm although no one area of the community is at higher risk of lightning strikes. The risk of at least one hailstorm occurring in Oxford is considered moderate in any given year.

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 a downburst from a thunderstorm and have no associated rotation. The risk of downbursts occurring during such storms and damaging Oxford is believed to be low for any given year. All areas of the community particularly susceptible to damage from high winds, although more building damage is expected in the more densely populated areas, while more tree damage is expected in the less densely populated areas in the northern part and eastern part of the community.

Secondary damage from falling branches and trees is more common than direct wind damage to structures. Heavy winds can take down trees near power lines, leading to the start and spread of fires. Most downed power lines in Oxford are detected quickly and any associated fires are quickly extinguished. Such fires can be extremely dangerous during the summer months during dry and drought conditions. The need for adequate water supply for fire protection to ensure this level of safety is maintained is discussed in Section 9.

Similar to the discussion for hurricanes in Section 4.6, there are no critical facilities believed to be more susceptible to summer storm damage than any other. While the Public Works Garage is reportedly located within a "wind corridor" that can experience higher than normal winds, damage to this facility has not been recorded. Some critical facilities are more susceptible than others to flooding damage due to summer storms. Such facilities susceptible to flooding damage were discussed in Section 3.6.

In summary, the entire community is at relatively equal risk for experiencing damage from summer storms and tornadoes. Based on the historic record, only a few summer storms and no tornadoes have resulted in costly damages to Oxford. Most damages are relatively site-specific and occur to private property (and therefore are paid for by private insurance). For municipal property, the budget for tree removal and minor repairs may need to be increased. **Oxford should review the existing tree maintenance budget and make improvements if necessary.** Given the limited historic record for damaging tornado events, an estimate of several million dollars in damage may be reasonable for an EF2 tornado directly striking the downtown area, with less damage for a tornado striking the outskirts of the community, and with a greater damage amount to be expected should an EF3 or stronger tornado strike.

6.0 WINTER STORMS

6.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any area of the Oxford. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. The entire community is susceptible to winter storms and, due to its variable elevation, can have higher amounts of snow in the upper reaches of the community than in the valleys. In general, winter storms are considered highly likely to occur each year (although 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 community (refer to Tables 1-3 and 1-4).

6.2 Hazard Assessment

This section focuses on those effects commonly associated with winter weather, including blizzards, freezing rain, ice storms, nor'easters, sleet, snow, and winter storms; and to a secondary extent, extreme cold.

- **Blizzards** include winter storm conditions of sustained winds or frequent gusts of 35 mph or greater that cause major blowing and drifting of snow, reducing visibility to less than one-quarter mile for three or more hours. Extremely cold temperatures and/or wind chills are often associated with dangerous blizzard conditions.

- **Freezing Rain** consists of rain that freezes on objects, such as trees, cars, or roads and forms a coating or glaze of ice. Temperatures in the mid- to upper atmosphere are warm enough for rain to form, but surface temperatures are below the freezing point, causing the rain to freeze on impact.

- **Ice Storms** are forecasted when freezing rain is expected to create ice build-ups of one-quarter inch or more that can cause severe damage.

- **Nor'easters** are the classic winter storm in New England, 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 rain or snow. They usually occur between November 1st and April 1st of any given year, with such storms occurring outside of this period typically bringing rain instead of snow.

- **Sleet** occurs when rain drops freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. It can accumulate like snow and cause a hazard to motorists.

- **Snow** is frozen precipitation composed of ice particles that forms in cold clouds by the direct transfer of water vapor to ice.

- **Winter Storms** are defined as heavy snow events which have a snow accumulation of more than six inches in 12 hours, or more than 12 inches in a 24-hour period.

> ***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.***

Impacts from severe winter weather can become dangerous and a threat to people and property. Most winter weather events occur between December and March. Winter weather may include snow, sleet, freezing rain, and cold temperatures. According to NOAA, winter storms were responsible for the death of 33 people per year from 2000 to 2009. 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, and flooding as a result of snowmelt.

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. 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

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. A total of 49 of the most notable historic winter storms to impact the Northeast have been analyzed and categorized by NESIS through February 2013. NOAA has also created Regional Snowfall Indices for other regions of the country that experience severe winter storms differently than the Northeast.

6.3 Typical Mitigation Measures, Strategies, and Alternatives

Potential mitigation measures for flooding caused by winter storms include those appropriate for flooding and wind damage. These were presented in Section 3.3, Section 4.3, and Section 5.3. Winter storm mitigation measures must also address blizzard, snow, and ice hazards. These are emphasized below. Note that natural resource protection measures are not typically available for winter storm damage.

6.3.1 Prevention

Cold air, wind, snow, and ice cannot be prevented from impacting any particular region. Thus, mitigation is typically focused on property protection and emergency services (discussed below) and prevention of damage related to wind and flooding hazards.

Previous suggested actions for tree limb inspections and maintenance are thus applicable to winter storm hazards as well. Utilities should be placed underground wherever 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.

6.3.2 Property Protection

Property can be protected during winter storms through the use of structural measures such as shutters, storm doors, and storm windows. Pipes should be adequately insulated to protect against freezing and bursting. Compliance with the amended Connecticut Building Code for wind speeds is necessary. Finally, as recommended in previous sections, dead or dangerous tree limbs overhanging homes should be trimmed. All of these suggested actions should apply to new construction although they may also be applied to existing buildings during renovations.

> ***FEMA has produced a Snow Load Safety Guidance Document available at http://www.fema.gov/media-library/assets/documents/29670?id=6652***

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. This can occur in both older buildings as well as newer buildings constructed in compliance with the most recent building codes. Communities should develop plans to prioritize the removal of snow from critical facilities and other municipal buildings and have funding available for this purpose. Heating coils may also be used to melt or evaporate snow from publicly and privately-owned flat roofs.

6.3.3 Emergency Services

Emergency services personnel should continue to identify areas that may be difficult to access during winter storm events and devise contingency plans to continue servicing those areas when regular access is not feasible. The creation of through streets with new developments increases the amount of egress for residents and emergency personnel into neighborhoods and should be promoted when possible.

Standardized plowing routes that prioritize access to and from critical facilities should be utilized as these facilities are primarily located along state and primary local roads. 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 community website. Such routes may 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. In addition, existing mutual aid agreements with surrounding municipalities should be reviewed and updated as necessary to ensure help will be available when needed.

6.3.4 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 themselves and their homes for cold and icy weather, including stocking homes, preparing vehicles, and taking care of themselves during winter storms.

Traffic congestion and safe travel of people to and from work can be mitigated by the use of staggered timed releases from work, pre-storm closing of schools, and later start times for companies. Many employers and school districts employ such practices. Communities should consider the use of such staggered openings and closings to mitigate congestion during and after severe weather events if traffic conditions warrant.

6.3.5 Structural Projects

While structural projects to completely eliminate winter storm damage are not possible, structural projects related to the mitigation of wind (Section 4.3) or flooding damage (Section 3.3) to structures can be effective in the mitigation of winter storm damage. Additional types of structural 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.

6.4 Historic Record

The NCDC receives data from the Wigwam Reservoir in Watertown regarding snowfall. Median annual snowfall 39.8 inches per year, with a maximum monthly snowfall of 39.1 inches as recorded in March 1956.

The most significant blizzard to impact Connecticut occurred from March 11 through March 14 1888. Nicknamed the "Great White Hurricane," the storm dropped 45 to more than 50 inches of snow in Connecticut with up to reportedly 80 mph wind gusts creating snow drifts 30-40 feet in height. The New York – New Haven railroad in Westport, CT was closed for eight days while snow drifts were removed. The storm literally shut down major cities throughout the Northeast. Over 400 people on the east coast died as a result of the blizzard, and fire stations were completely immobilized: Total damages from fire alone were estimated at over $25 million (1888 USD), and total damages in Connecticut were estimated at $20 million (1888 USD).

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. The Blizzard of February 1978 brought record snowfall amounts to several areas of Connecticut as heavy snow continued unabated for an unprecedented 33 straight hours. The State of Connecticut was essentially shut down for three days when all roads were ordered closed except for emergency travel. The storm was responsible for over 100 deaths, 4,500 injuries, and $520 million in damages (1978 USD). This storm is rated 13th overall by NESIS as a "Category 3 – Major" storm.

Most recently, two severe winter storms have struck Connecticut. Winter Storm Alfred occurred just prior to Halloween in 2011, producing high winds and 12 to 18 inches of heavy wet snow across Connecticut that caused widespread snapping of trees and tree limbs. Over 830,000 customers were without power, with some outages lasting for more than a week, and the storm resulted in ten deaths and more than $3 billion in damages to Connecticut. Homes in Oxford were without power for seven to eight days, and all shelters were opened. Tree damage and damage to power lines caused the biggest impact during this storm. A major disaster declaration was declared for the State (DR-4046).

A fierce nor'easter (dubbed "Nemo" by the Weather Channel) in February 2013 brought blizzard conditions to most of the Northeast, producing snowfall rates of five to six inches per hour in parts of Connecticut. Many areas of Connecticut experienced more than 40 inches of snowfall, and the storm caused more than 700,000 power outages. Spotters at Oxford Airport reported at least three consecutive hours of blizzard conditions, and wind gusts as high as 48 mph were reported in Waterbury. All roads in Connecticut were closed for two days. A major disaster declaration was declared for Connecticut (DR-4106). This storm was ranked as a "Major" storm by NESIS.

Ten major winter nor'easters have occurred in Connecticut during the past 30 years (in 1983, 1988, 1992, 1996, 2003, 2006, 2009, 2010, two in 2011, and 2013). The December 1992 nor'easter, in particular, caused the third-highest tides ever recorded in Long Island Sound and damaged 6,000 coastal homes. A federal disaster declaration was made for Fairfield, New Haven, and Middlesex Counties. The majority of northeastern Connecticut received up to four feet of snow that left 50,000 homes without power.

However, 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. Additional examples of recent winter weather events to affect the Oxford area, taken from the NCDC database, include:

- March 13-14, 1993 – A massive, powerful storm dubbed the "Storm of the Century" caused "whiteout" blizzard conditions stretching from Jacksonville, FL into eastern Canada and affected 26 states, producing 24 inches of snow in Hartford, CT and up to 21 inches of snow in Litchfield County. A total of 40,000 power outages and $550,000 in property damage was reported throughout Connecticut, and the state received a federal emergency declaration. The storm had a NESIS rating of "Category 5 –Extreme" and is the highest ranking storm recorded by NESIS.

- January 15-16, 1994 – A Siberian air mass 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.

- 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.

- January 7-8, 1996 – Winter Storm Ginger caused heavy snow throughout the State, causing many power outages, several roofs to collapse, and approximately $80,000 in damages. Reported snowfall totals included 24 inches in New Hartford, 22 inches in Harwinton, and up to 27 inches of snow in other parts of Connecticut. The storm was classified as a blizzard in Fairfield County. The storm shut down the State of Connecticut for an entire day and the state received a federal major disaster declaration (DR-1092). The storm had a NESIS rating of "Category 5 – Extreme" and is the second-highest ranked storm by NESIS.

- 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.

- February 17, 2003 – A heavy snow storm caused near blizzard conditions and produced 24 inches of snow as recorded in New Fairfield. The storm had a NESIS rating of "Category 4 – Crippling" and is the fourth-highest ranked winter storm by NESIS. The State of Connecticut received a federal emergency declaration.

- February 12-13, 2006 – This nor'easter is ranked 25th overall and as a "Category 3 – Major" storm on the NESIS scale. The storm produced 18 to 24 inches of snow across Connecticut. Five Connecticut counties, including Fairfield County, received a federal emergency declaration.

- March 16, 2007 – A winter storm beginning during the Friday afternoon rush hour produced six to 12 inches of snow and sleet across New Haven County. The storm caused treacherous travel conditions that resulted in many accidents. This storm regarded by NESIS as a "Category 2 – Significant" storm.

- The winter storms of December 24-28, 2010 and January 9-13, 2011 were rated as "Category 3 – Major" storms on NESIS. The successive winter storms in late January to early February 2011 reportedly caused 70 inches of snowfall and collapsed nearly 80 roofs throughout the state, Critical facilities experiencing roof collapses in Connecticut included the Barkhamsted Highway Department Salt Shed, Fire Engine Station 4 in Meriden, and the Public Works Garage in the Terryville section of Plymouth. The Nye Street Fire Station in Vernon was also closed due to concerns related to the possible collapse of the roof due to heavy snow. The January storm resulted in Presidential Snowfall Disaster Declaration (DR-1958) being declared for the State.

6.5 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. Other programs are aimed at warning residents about potential winter hazards, such making educational pamphlets available at municipal buildings.

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important for Oxford to budget fiscal resources toward snow management. In extreme years, such as the winter of 2010-2011, this budget can be quickly eclipsed and must be supplemented from other budget sources. The Public Works Department is prepared to assist the Board of Education with snow removal and assessments of schools, as occurred after the heavy snowfalls in January 2011.

Oxford primarily uses Town staff for plowing operations and has adequate capacity to deal with snow and ice. Oxford has defined plow routes with priority given to accessing critical facilities and primary roads, and an established snow removal plan. This plan is reviewed annually. As Oxford is very hilly, most areas receive treatment in the winter to prevent icing. The Connecticut Department of Transportation plows all state roads. Homeowners, private associations, and businesses are responsible for plowing their own driveways and roads, as well as clearing sidewalks and fire hydrants fronting their properties.

Prior to a winter weather event, Oxford ensures that all warning/notification and communications systems are ready, and ensures that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order. Oxford 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). During emergencies, plow vehicles are temporarily rerouted to clear the route ahead of an emergency vehicle.

Overall, these programs are considered effective at mitigating the effects of winter storms. While additional budget could supplement these programs, the amount of experience that local personnel have in managing winter storm events makes it unlikely that a significant additional benefit could be achieved with additional funding.

6.6 Vulnerabilities and Risk Assessment

Based on the historic record in Section 6.3, Connecticut experiences at least one major nor'easter approximately every four years, although a variety of minor and moderate snow and ice storms occur nearly every winter. According to the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, Connecticut residents can expect at least two or more severe winter weather events per season, including heavy snow storms, potential blizzards, nor'easters, and potential ice storms. Fortunately, catastrophic ice storms are relatively 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.

According to the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, recent climate change studies predict a shorter winter season for Connecticut (as much as two weeks) and less snow-covered days with a decreased overall snowpack. These models also predict that fewer, more intense precipitation events will occur with more precipitation falling as rain rather than snow. This trend suggests that future snowfalls will consist of heavier (denser) snow and the potential for ice storms will increase. Such changes will have a large impact on how the State and its communities manage future winter storms, and the impact such storms have on the residents, roads, and utilities in the State.

The amount of snowfall and freezing precipitation in Oxford is elevation-dependent during storms. As the population of Oxford increases and more areas (particularly in the higher elevations are developed, the vulnerability of Oxford residents to the effects of winter storms will increase. 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.

After a storm, snow piled on the sides of roadways can inhibit sight lines and reflect a blinding amount of sunlight. When coupled with slippery road conditions, poor sightlines and heavy glare create dangerous driving conditions. Stranded motorists, especially senior and/or handicapped citizens, are at particularly high risk of injury or death from exposure during a blizzard. The elderly population in Oxford, in particular, is susceptible to the impacts created by winter storms due to resource needs (heat, electricity loss, safe access to food, etc.).

The structures and utilities in Oxford are vulnerable to a variety of winter storm 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. Drifting snow can occur after large storms, but the effects are generally mitigated through municipal plowing efforts and have not been an issue in recent years. In particular, drifting snow used to be an issue along Jacks Hill Road were 12- to 13-foot drifts would form. Such drifts have not occurred recently.

Residents have expressed concern regarding existing snow removal processes. While Oxford performs plowing on local roads to the extent reasonable and practical for a given storm event and local financial capabilities, it is recognized that most residents want their own roads cleared as fast as possible. This is in conflict with the town’s established plowing plan which prioritizes access to main roads and critical facilities. In addition, local officials have little direct control over the timing of plowing along State roads.

Icing causes difficult driving conditions throughout the hillier sections of the community, but local personnel note that there are few unusual areas or particular "trouble spots" for icing. Most areas prone to icing are associated with areas of poor drainage discussed in Section 3.6. Ice jams are not typically a problem along the rivers and streams in Oxford.

Similar to the discussion for hurricanes and summer storms in the previous two sections, no critical facilities are believed to be more susceptible to winter storm damage than any other. Some critical facilities are more susceptible than others to flooding damage due to winter storms. Such facilities susceptible to flooding damage were discussed in Section 3.5. **Critical facilities and schools should be evaluated for the design snow load of each structure and a response plan developed to clear excessive snow from each facility.**

In summary, the entire community is at relatively equal risk for experiencing damage from winter storms, although some areas may be more susceptible. Based on the historic record, it is difficult to determine if any winter storms have resulted in costly damages to the community, as damage estimates for severe storms are generally spread over an entire county. Many damages are relatively site-specific and occur to private property (and therefore are paid for by private insurance), while repairs for power outages are often widespread and difficult to quantify to any one municipality. For municipal property, the budget for plowing and minor repairs is generally adequate to handle winter storm damage, although the plowing budget is often depleted in severe winters. In particular, the heavy snowfalls associated with the winter of 2010-2011 drained the local plowing budget and raised a high level of awareness of the danger that heavy snow poses to roofs.

7.0 EARTHQUAKES

7.1 Setting

All of Oxford is susceptible to earthquake damage. However, even though earthquake damage has the potential to occur anywhere both in the community 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 community (Table 1-3 and Table 1-4).

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. A comparison of Richter magnitude to typical Modified Mercalli intensity is presented in Table 7-1.

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.

Table 7-1
Comparison of Earthquake Magnitude and Intensity

Richter Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 3.0	I
3.0 to 3.9	II - III
4.0 to 4.9	IV - V
5.0 to 5.9	VI - VII
6.0 to 6.9	VII - IX
7.0 and above	VIII - XII

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.

The built environment in Connecticut includes old non-reinforced masonry that is not seismically designed. Those who live or work in non-reinforced 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 Typical Mitigation Measures, Strategies, and Alternatives

As earthquakes are relatively infrequent, difficult to predict, and can affect the entire community, potential mitigation should include adherence to building codes, education of residents, and adequate planning. Note that natural resource protection measures to prevent earthquake damage are not possible. The following potential mitigation measures have been identified:

7.3.1 Prevention

***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.*

Communities should consider preventing new residential development in areas most prone to collapse or liquefaction. Many Connecticut communities already have regulations restricting development on steep slopes. Additional regulations could be enacted to buffer development a certain distance from the bottom of steep slopes, or to prohibit development on fill materials and areas of fine sand and clay (glacial lake bottom deposits). The State Geologist indicates that such deposits have the highest risk for seismic wave amplification. Other regulations could specify a minimum level of compaction for filled areas before it is approvable for development.

7.3.2 Property Protection

Requiring adherence to current State building codes for new development and redevelopment is necessary to minimize the potential risk of earthquake damage.

7.3.3 Emergency Services

Departments providing emergency services should have backup plans and adequate backup facilities such as portable generators in place in case earthquake damage occurs to critical facilities. The Public Works Department should also have adequate backup plans and facilities to ensure that roads can be opened as soon as possible after a major earthquake.

7.3.4 Public Education and Awareness

The fact that damaging earthquakes are rare occurrences in Connecticut heightens the need to educate the public about this potential hazard. An annual pamphlet outlining steps each family can take to be prepared for disaster is recommended. Also, because earthquakes generally provide little or no warning time, municipal personal and students should be instructed on what to do during an earthquake in a manner similar to fire drills.

7.3.5 Structural Projects

Critical facilities should be retrofitted to reduce potential damage from seismic events. Potential mitigation activities may include bracing of critical equipment such as generators, identifying and hardening critical lifeline systems (such as water and sewer lines), utilizing flexible piping where possible, and installing shutoff valves and emergency connector hoses where water mains cross fault lines. Potential seismic mitigation measures for all buildings include strengthening and retrofitting non-reinforced masonry buildings and non-ductile concrete facilities that are particularly vulnerable to ground shaking, retrofitting building veneers to prevent failure, installing window films to prevent injuries from shattered glass, anchoring rooftop-mounted equipment, and reinforcing masonry chimneys with steel bracing.

Municipal departments should have backup plans and adequate backup facilities such as portable generators in place in case earthquake damage occurs to critical facilities, particularly public water and the waste water treatment facilities.

7.4 Historic Record

According to the Northeast States Emergency Consortium and the Weston Observatory at Boston College, there were 139 recorded earthquakes in Connecticut between 1668 and 2011. The vast majority of these earthquakes had a magnitude of less than 3.0. 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 Weston Observatory, the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, 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 Hebron on November 14, 1925. No significant damage was reported.
- The Timiskarning, 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 noticeable 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.

- 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.
- A magnitude 3.9 earthquake occurred 117 miles southeast of Bridgeport, Connecticut on the morning of November 30, 2010. The quake did not cause damage in Connecticut but was felt by residents along Long Island Sound.
- A magnitude 5.8 earthquake occurred 38 miles from Richmond, Virginia on August 23, 2011. The quake was felt from Georgia to Maine and reportedly as far west as Chicago. Many residents of Connecticut experienced the swaying and shaking of buildings and furniture during the earthquake although widespread damage was constrained to an area from central Virginia to southern Maryland. According to Cornell University, the August 23 quake was the largest event to occur in the east central United States since instrumental recordings have been available to seismologists.
- A magnitude 2.1 quake occurred near Stamford on September 8, 2012. Dozens of residents reported feeling the ground move, but no injuries were reported.

7.5 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 Oxford. Oxford has adopted these codes for new construction, and they are enforced by the Building Official. Due to the infrequent nature of damaging earthquakes, land use policies in Oxford do not directly address earthquake hazards. However, the various regulations do attempt to prevent development on steep slopes or ridgelines.

The Town of Oxford's capabilities to mitigate for earthquake damage and prevent loss of life and property have not necessarily changed since the initial hazard mitigation plan was adopted, although the State's building code has been updated and Oxford has incorporated those changes. If the event that a damaging earthquake occurs, Oxford will activate its Emergency Operations Plan and initiate emergency response procedures as necessary.

7.6 Vulnerabilities and Risk Assessment

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can 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 Oxford are underlain by sand and gravel, particularly within the valleys associated with major streams and rivers. Figure 2-5 depicts surficial materials in the community. 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 Oxford 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 2-5 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.

> ***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.***

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 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 30th 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 43rd 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 occurring within 50 kilometers of Oxford. Results are presented in Table 7-2 below.

Table 7-2
Probability of a Damaging Earthquake in the Vicinity of Oxford

Timeframe (Years)	Probability of the Occurrence of an Earthquake Event > Magnitude 5.0	Probability of the Occurrence of an Earthquake Event > Magnitude 6.0
50	1% to 2%	< 1%
100	3% to 4%	<1%
250	8% to 10%	2% to 3%
350	12% to 15%	2% to 3%

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 Oxford 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 Oxford.

As a damaging earthquake would likely affect a large area beyond Oxford, it is likely that the community may not be able to receive regional aid for a few days. **It is important for municipal facilities and departments to have adequate backup plans and backup supplies to ensure that restoration activities may begin and continue until outside assistance can be provided.**

HAZUS-MH Simulations

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 Oxford 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 and presented below. These results are believed conservative and considered appropriate for planning purposes in Oxford. Note that potentially greater impacts could also occur.

Table 7-3 presents the number of residential buildings (homes) damaged by the various earthquake scenarios, while Table 7-4 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*, available on the FEMA website, for the definitions of each building damage state based on building construction.

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

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	248	50	5	1	304
Portland – 5.7	254	53	5	1	313
Stamford – 5.7	232	46	4	0	282
East Haddam – 6.4	448	115	12	1	576

Table 7-4
HAZUS-MH Earthquake Scenarios – Total Number of Buildings Damaged

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	281	65	7	1	354
Portland – 5.7	288	67	7	1	363
Stamford – 5.7	264	60	6	0	330
East Haddam – 6.4	511	152	19	2	684

The HAZUS simulations consider a subset of critical facilities termed "essential facilities" which are important during emergency situations. As shown in Table 7-5, minor damage to essential facilities is expected for each earthquake scenario.

Table 7-5
HAZUS-MH Earthquake Scenarios – Essential Facility Damage

Epicenter Location and Magnitude	Fire Stations (3)	Police Stations (1)	Schools (3)
Haddam – 5.7	Minor damage (76% functionality)	Minor damage (74% functionality)	Minor damage (75% functionality)
Portland – 5.7	Minor damage (76% functionality)	Minor damage (73% functionality)	Minor damage (75% functionality)
Stamford – 5.7	Minor damage (74% functionality)	Minor damage (77% functionality)	Minor damage (76% functionality)
East Haddam – 6.4	Minor damage (65% functionality)	Minor damage (63% functionality)	Minor damage (64% functionality)

Table 7-6 presents potential damage to utilities and infrastructure based on the various earthquake scenarios. The HAZUS-MH software assumes that the Oxford transportation network and utility network includes the following:

- Highway: 23 major roadway bridges and seven important highway segments totaling 28 kilometers;
- Airport: One airport facility and one runway;
- A potable water system consisting of 201 kilometers of distribution lines;
- A waste water system consisting of 121 kilometers of mains; and
- A natural gas system consisting of 80 kilometers of distribution lines.

As shown in Table 7-6, highway bridges are predicted to experience minor damage but remain open under each earthquake scenario. Damage is also expected to airport facilities although the runways will remain operational. In terms of utilities, leaks and breaks are expected in the potable water, waste water, and natural gas distribution systems for each scenario, but no loss of potable water or electrical service is expected. The software did not simulate any ignitions following the earthquake.

Table 7-6
HAZUS-MH Earthquake Scenarios – Utility, Infrastructure, and Fire Damage

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Haddam – 5.7	Minor damage to highway bridges ($40,000), minor damage to airport facility ($530,000), no loss of use	3 leaks and 1 major break in potable water system ($10,000), 2 leaks in waste water system ($10,000), 1 leak in natural gas system (<$10,000). No loss of service expected.	No ignitions were simulated.
Portland – 5.7	Minor damage to highway bridges ($50,000), minor damage to airport facility ($590,000), no loss of use	3 leaks and 1 major break in potable water system ($20,000), 2 leaks in waste water system ($10,000), 1 leak in natural gas system (<$10,000). No loss of service expected.	No ignitions were simulated.
Stamford – 5.7	Minor damage to highway bridges ($50,000), minor damage to airport facility ($430,000), no loss of use	3 leaks and 1 major break in potable water system ($10,000), 2 leaks in waste water system ($10,000), 1 leak in natural gas system (<$10,000). No loss of service expected.	No ignitions were simulated.
East Haddam – 6.4	Minor damage to highway bridges ($360,000), minor damage to airport facility ($800,000), no loss of use	12 leaks and 3 major breaks in potable water system ($50,000), 6 leaks and 1 major break in waste water system ($30,000), 2 leaks in natural gas system ($10,000). No loss of service expected.	No ignitions were simulated.

Table 7-7 presents the estimated tonnage of debris that would be generated by earthquake damage during each HAZUS-MH scenario. As shown in Table 7-7, significant debris is expected for each of the four earthquake scenarios, with the East Haddam earthquake scenario generating the most debris in the community.

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

Epicenter Location and Magnitude	Brick / Wood	Reinforced Concrete / Steel	Total	Estimated Cleanup Truckloads (25 Tons / Truck)
Haddam – 5.7	670	330	1,000	40
Portland – 5.7	670	330	1,000	40
Stamford – 5.7	670	330	1,000	40
East Haddam – 6.4	2,688	2,112	4,800	120

Table 7-8 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 East Haddam scenario. However, it is possible that an earthquake could also produce a dam failure (flooding) or be a contingent factor in another hazard event that could increase the overall sheltering need in the community. Thus, the existing shelters may be insufficient during an event such as the East Haddam or Stamford scenario when one considers damage from the earthquake, fires, and potential dam failures.

Table 7-8
HAZUS-MH Earthquake Scenarios – Shelter Requirements

Epicenter Location and Magnitude	Number of Displaced Households	Short Term Sheltering Need (Number of People)
Haddam – 5.7	1	0
Portland – 5.7	1	0
Stamford – 5.7	0	0
East Haddam – 6.4	2	1

Table 7-9 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; and
- Severity Level 4: Victims are killed by the earthquake.

Table 7-9
HAZUS-MH Earthquake Scenarios – Casualty Estimates

Epicenter Location - Magnitude	2 AM Earthquake	2 PM Earthquake	5 PM Earthquake
Haddam – 5.7	1 (Level 1)	1 (Level 1)	1 (Level 1)
Portland – 5.7	1 (Level 1)	1 (Level 1)	1 (Level 1)
Stamford – 5.7	1 (Level 1)	1 (Level 1)	1 (Level 1)
East Haddam – 6.4	2 (Level 1)	2 (Level 1)	2 (Level 1)

Minimal casualties are expected due to earthquake damage in Oxford for the four earthquake scenarios, with the East Haddam scenario producing the highest level of casualties including deaths. 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 7-10 presents the total estimated losses and direct economic impact that may result from the four earthquake scenarios created for Oxford 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. Note that these damages do not include transportation, utility, or fire damage in Table 7-6.

Table 7-10
HAZUS-MH Estimated Direct Losses from Earthquake Scenarios

Epicenter Location and Magnitude	Estimated Total Capital Losses	Estimated Total Income Losses	Estimated Total Losses
Haddam – 5.7	$5,410,000	$1,250,000	$6,670,000
Portland – 5.7	$5,620,000	$1,310,000	$6,920,000
Stamford – 5.7	$5,040,000	$1,200,000	$6,250,000
East Haddam – 6.4	$12,630,000	$3,470,000	$16,100,000

The maximum simulated damage considering direct losses and infrastructure losses is approximately $17.4 million for the East Haddam scenario. 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 within HAZUS-MH, providing a more recent dataset for analysis.

Despite the low probability of occurrence, earthquake damage presents a potentially significant hazard to Oxford. Additional infrastructure not modeled by HAZUS-MH, such as sewer pumping stations and water storage tanks could be affected by an earthquake, so the results of this analysis may be conservatively low. However, it is very unlikely that the community would be at the epicenter of such a damaging earthquake. Should a damaging earthquake occur in Connecticut, it is possible that some Oxford emergency personnel will be needed in other parts of the state that are harder hit by the earthquake.

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 17 inventoried dams, many upstream dams, and potentially several other minor dams in the community, dam failure can occur almost anywhere in Oxford. While flooding from a dam failure generally has a moderate geographic extent, the effects are potentially catastrophic. Fortunately, a major dam failure is considered only a possible natural hazard event in any given year (Table 1-3 and Table 1-4).

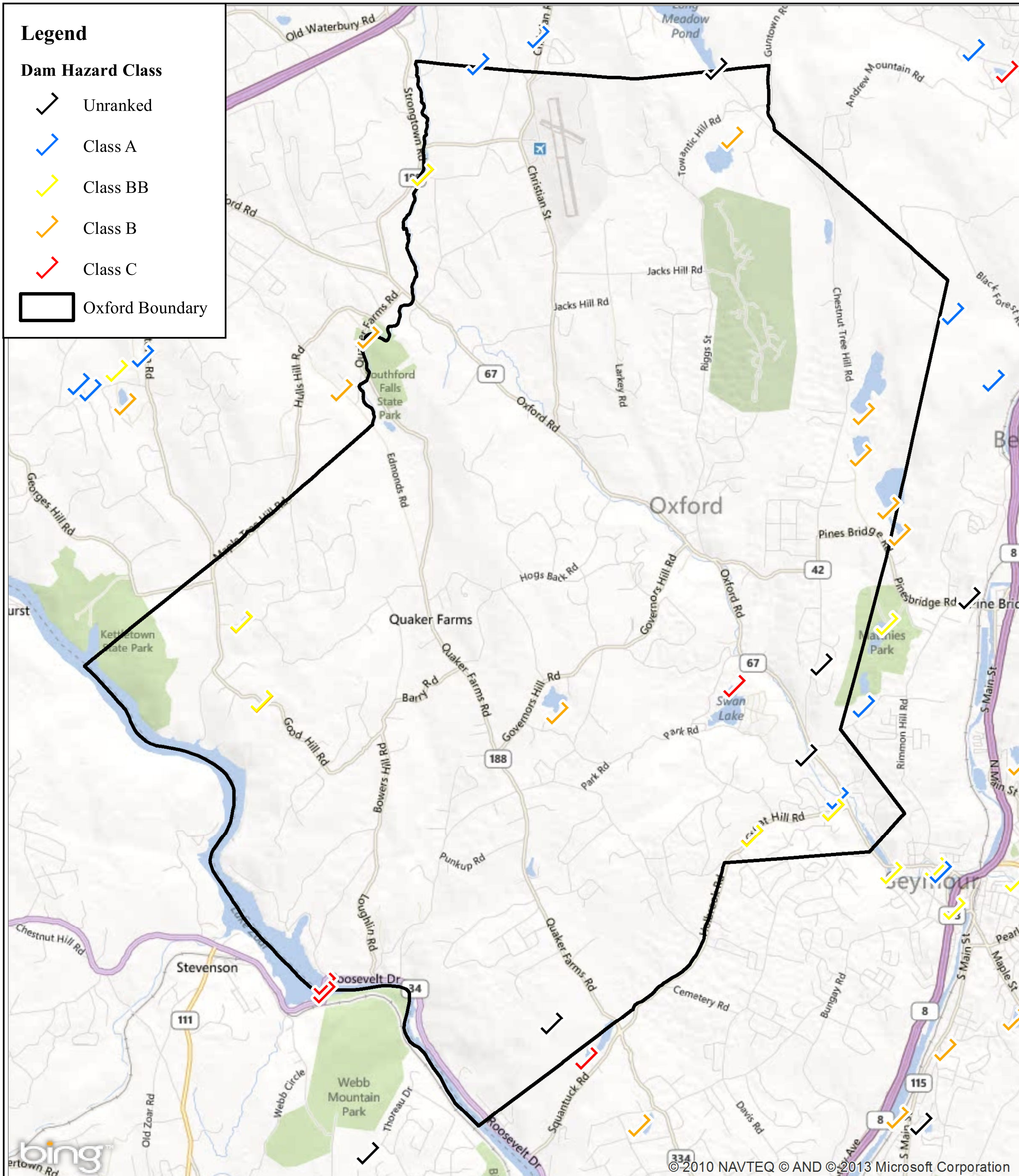
8.2 Hazard Assessment

The Connecticut DEEP administers the statewide Dam Safety Program and designates a classification to each state-inventoried 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 16 DEEP-inventoried dams within Oxford. The list of Class B and C dams was updated by the DEEP in 2007. Dam classifications include zero Class AA, one Class A, five Class BB, six Class B, two Class C, and three that are undefined. DEEP-inventoried dams in Oxford are listed in Table 8-1. There are also Class C dams upstream of Oxford along the Housatonic River that are used for electrical generation purposes such as the Shepaug Dam in Southbury.

This section primarily discusses the possible effects of failure of high hazard (Class C) dams. Failure of a Class C dam has a high potential for loss of life and extensive property and infrastructure damage. Dams pertinent to Oxford are presented in Figure 8-1.



SOURCE(S):
"Town Boundary" CT DEEP
"Dam Classification" CT DEEP
"Microsoft Virtual Earth Roads" Bing

Figure 8-1: Dam Hazard Classifications

LOCATION: **Oxford, CT**

Oxford Natural Hazard Mitigation Plan

MXD: Y:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_8-1.mxd

Map By: scottb
MMI#: 1452-11
Original: 07/26/2013
Revision: 9/19/2013
Scale: 1 inch = 5,280 feet

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Table 8-1
Dams Inventoried by the DEEP in Oxford

Number	Name	Location	Class	Owner
10801	Stevenson Dam	Lake Zoar / Housatonic River	C	First Light
10802	Seymour Reservoir Dam #3	Seymour Reservoir #3	B	Connecticut DEEP
10803	Seymour Reservoir Dam #2	Seymour Reservoir #2	B	Connecticut DEEP
10805	Towantic Pond Dam	Towantic Pond	B	Private
10806	Great Hill Road Pond Dam	North of Great Hill Road	BB[1]	Private
10807	Emerson Dam	Little River above Park Road	-	Private
10808	Swan Lake Dam	Swan Lake	C	Swan Lake Estates
10809	Seymour Reservoir Dam #4	Seymour Reservoir #4	B	Connecticut DEEP
10810	Long Meadow Pond Dam	Long Meadow Pond	B	Chemtura Corp.
10811	Stoddard Dam	North of Great Hill Road	BB[1]	Private
10812	Hurley Road Pond Dam	Eight Mile Brook at Hurley Road	BB[1]	Private
10813	Keiser Dam	North of Labordie Road	BB[1]	Private
10814	Good Hill Road Pond Dam	North of Good Hill Road	BB[1]	Private
10815	Nichols Pond Dam	Nichols Pond	B	Nichols Pond Estates
10817	Byles Dam	Little River at Oxford Road	A	Private
10820	Misty Pond Dam	East of Chestnut Tree Hill Road	-	Private
10822	Vonwettenberg Pond dam	South of Oxford High School	-	Private

[1]Listed as a Class B dam in 1996, but not listed on the 2007 DEEP list of Class B and Class C dams.

8.3 Typical Mitigation Measures, Strategies, and Alternatives

Typical mitigation measures for preventing dam failure include many of those for preventing flooding in addition to the ones presented below:

8.3.1 Prevention

Preventative measures for preventing dam failure include semi-annual or annual inspections of each dam. Dam inspections in the State of Connecticut are required to be conducted by a registered professional engineer. In addition, local communities should maintain a dialogue with Connecticut DEEP regarding the development of Emergency Operations Plans and Dam Failure Analysis for dams not owned by the municipality, and encourage Connecticut DEEP to approach dam owners of Class B and Class C dams to develop or update such plans as needed.

8.3.2 Property Protection

Property protection measures for preventing flooding from dam failure are similar to those presented for reducing flooding damage as presented in Section 3.

8.3.3 Emergency Services

Communities containing or located downstream from high and significant hazard dams should maximize their emergency preparedness for a potential dam failure. This can be done by having copies of the Emergency Operations Plan for each dam on file with the local emergency manager and the local engineering department as well as by including potential inundation areas in an emergency notification database. It is important to maintain up to date dam failure inundation mapping in order to properly direct notifications into potentially affected areas. Dam failure inundation areas should be mapped for all community-owned significant and high hazard dams. For dams without a mapped failure inundation area, the 100-year and 500-year floodplains described in Section 3 could be utilized to provide approximate failure inundation areas for the notification database.

8.3.4 Public Education and Awareness

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 at http://www.damsafety.org/resources/downloads/

Public education and awareness should be directed at dam owners in the community in order to keep them up to date on maintenance resources, repair resources, funding sources, and regulatory changes. Public education for residents will be similar to those for flooding, but should also be directed to residents in potential inundation areas. Such residents should be given information regarding preparing evacuation kits and potential evacuation procedures.

8.3.5 Natural Resource Protection

Natural resource protection measures related to preventing dam failure are similar to those for flooding.

8.3.6 Structural Projects

Structural projects for preventing dam failure are typically focused on maintaining and repairing subject dams to be in good condition, resizing spillways to pass a larger flood event without causing damage, and maintaining upstream dams such that sequential failures do not occur.

8.4 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 DEEP believes that more dams were damaged in these events than in the 1982 event listed below or the 2005 dam failure events listed on the next page.
- 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.

More recently, the NCDC reports that flash flooding on April 16, 1996 caused three small dams in Middletown and one in Wallingford to breach. The Connecticut DEEP 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	DEEP
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	DEEP
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	DEEP

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.

Town personnel could not recall any significant dam failures occurring within Oxford. However, one member of the Riverside Fire Department in Oxford indicated that the Stevenson Dam came very close to overtopping during the 1955 floods. The potentially catastrophic consequences of a failure of this dam are discussed in Section 8.6.

8.5 Existing Programs, Policies, and Mitigation Measures

The Dam Safety Section of the DEEP 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 inventoried 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 inventoried 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 DEEP currently performs inspections of those dams which pose the greatest potential threat to downstream persons and properties, and also performs inspections as complaints are registered.

Legislation will be effective October 1, 2013 that will shift the burden of annual inspection responsibility to the dam owner such that DEEP staff will be free to concentrate on permit review and complaint investigation activities. Oxford currently inspects each of its dams semi-annually.

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 DEEP may issue an administrative order requiring the owner to restore the structure to a safe condition and may refer noncompliance with such an order to the Attorney General's office for enforcement. As a means of last resort, the DEEP 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.

In addition, owners of Class C dams are required to maintain Emergency Operation Plans (EOPs). The Class C dams owned by First Light Power Resources (Stevenson Dam) and by Swan Lake Estates (Swan Lake Dam) are believed to have current EOPs.

Dams permitted by the DEEP must be designed to pass the 1% annual chance 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 1% annual chance rainfall event, such as the probable maximum flood.

Guidelines for dam EOPs were published by DEEP in 2012, creating a uniform approach for development of EOPs. As dam owners develop EOPs using the new guidance, DEEP anticipates that the quality of EOPs will improve, which will ultimately help reduce vulnerabilities to dam failures.

Important dam safety program changes are underway in Connecticut. House Bill 6441 passed in June 2013 and describes new requirements for dams related to registration, maintenance, and EOPs, which will be called emergency action plans (EAPs) moving forward. This bill requires owners of certain unregistered dams or similar structures to register them by October 1, 2015. It generally shifts regularly scheduled inspection and reporting requirements from the DEEP to the owners of dams. The bill also makes owners generally responsible for supervising and inspecting construction work and establishes new reporting requirements for owners when the work is completed.

Effective October 1, 2013, the owner of any high or significant hazard dam must develop and implement an EAP after the Commissioner of DEEP adopts regulations. The EAP shall be updated every two years, and copies shall be filed with DEEP and the chief executive officer of any municipality that would potentially be affected in the event of an emergency. New regulations shall establish the requirements for such EAPs, including but not limited to (1) criteria and standards for inundation studies and inundation zone mapping; (2) procedures for monitoring the dam or structure during periods of heavy rainfall and runoff, including personnel assignments and features of the dam to be inspected at given intervals during such periods; and (3) a formal notification system to alert appropriate local officials who are responsible for the warning and evacuation of residents in the inundation zone in the event of an emergency.

The Connecticut DEEP 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. Oxford has not formally established a Flood and Erosion Control Board by ordinance, but the Planning and Zoning Commission performs similar actions and reviews that are enforced by the Zoning Enforcement Officer.

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.

Oxford uses "CodeRED" for emergency notification. The dam failure inundation mapping discussed in the next section can be used to help streamline the geographic contact areas if the failure of a major dam is imminent.

Overall, the Town of Oxford's capability to mitigate for dam failure and prevent loss of life and property have increased since the initial hazard mitigation plan was adopted, mainly as a result of recent statewide legislative actions described above. This is because the Town of Oxford does not have any direct control over the high and significant hazard dams within or upstream of the community. Over the next few years, it is expected that dam safety programs will continue to strengthen in Connecticut.

8.6 Vulnerabilities and Risk Assessment

The Town of Oxford considers itself highly vulnerable to dam failure with the potential for a catastrophic amount of damage. The largest concern is associated with a failure of the Stevenson Dam and the potential to cause catastrophic damage to homes along the Housatonic River, while the second greatest concern is associated with the failure of the Swan Lake Dam and its possible significant impacts downstream along the Little River. **Oxford should utilize the dam failure inundation mapping associated with the EOPs/EAPs for these dams to identify properties that could be affected such that telephone calls can be directed to failure areas.**

As noted in Section 1.5, the Stevenson Dam is also of concern for the Town of Newtown. **Oxford should pursue improved communications with the Town of Newtown and First Light regarding emergency response along Lake Zoar.**

Residents indicated that they considered the Towantic Pond dam, a privately owned Class B dam, to be vulnerable to dam failure. Residents should contact Connecticut DEEP directly with any concerns at (860) 424-3706. **Oxford should work with the Connecticut DEEP to ensure that it has copies of the most current Emergency Action Plans on file.** In addition, residents indicated that coordination of water releases at dams prior to storms could help to mitigate downstream flooding. **Oxford should work with dam owners in an attempt to coordinate such releases.**

A significant dam failure event would likely occur as part of a large flood event. This belief has fostered a climate of responsibility to ensure that dam failure is adequately prevented and prepared for through proper planning and maintenance of the structures. While the higher hazard dams are generally believed to be in good conditions, the condition of the many lower hazard, privately-owned dams throughout the community is not known. It is assumed that they are in generally adequate to good condition.

9.0 WILDFIRES

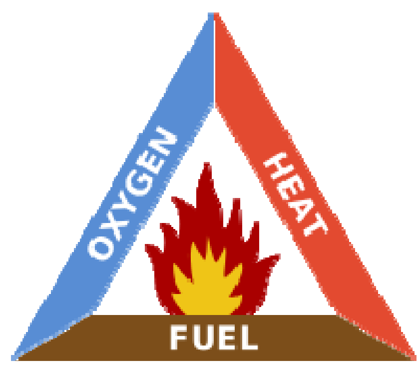
9.1 Setting

The ensuing discussion about wildfires is focused on the undeveloped wooded and shrubby areas of Oxford, 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 community are not considered.

Oxford is generally considered a low-risk area for wildfires. Wildfires are of particular concern in outlying areas without public water service and other areas with poor access for fire-fighting equipment. Figure 9-1 presents the wildfire risk areas for Oxford. 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

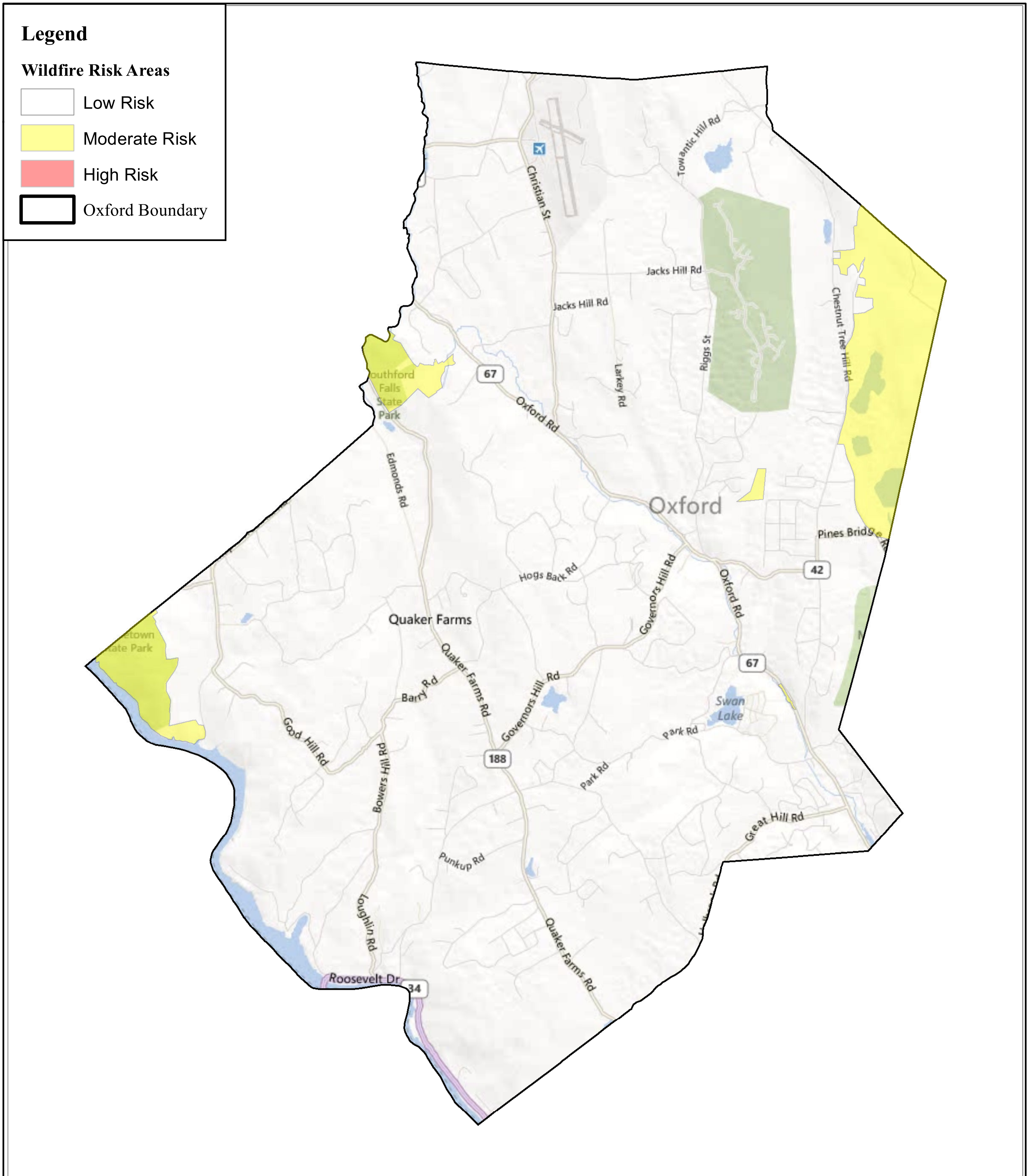
Wildfires are any non-structure fire, other than a prescribed burn, that occurs in undeveloped areas. They are considered to be highly destructive, uncontrollable fires. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially under dry conditions. Wildfires are also known as "wildland fires." According to the U.S. Bureau of Land Management, each of three elements (known as the fire triangle) must be present in order to have any type of fire:



The Fire Triangle. Public Domain Image Hosted by Wikimedia Commons.

- ❑ Fuel – Without fuel, a fire will stop. Fuel can be removed naturally (when the fire has consumed all burnable fuel), or manually by mechanically or chemically removing fuel from the fire. Fuel separation is important in wildfire suppression and is the basis for controlling prescribed burns and suppressing other wildfires. The type of fuel present in an area can help determine overall susceptibility to wildfires. According to the Forest Encyclopedia Network, four types of fuel are present in wildfires:
  - o Ground Fuels, consisting of organic soils, forest floor duff, stumps, dead roots, and buried fuels;
  - o Surface Fuels, consisting of the litter layer, downed woody materials, and dead and live plants to two meters in height;
  - o Ladder Fuels, consisting of vine and draped foliage fuels; and
  - o Canopy Fuels, consisting of tree crowns

- ❑ Heat – Without sufficient heat, a fire cannot begin or continue. Heat can be removed through the application of a substance, such as water, powder, or certain gases, that reduces the amount of heat available to the fire. Scraping embers from a burning structure also removes the heat source.



SOURCE(S):
"Town Boundary" CT DEEP
"Microsoft Virtual Earth Roads" Bing

Figure 9-1: Wildfire Risk Areas

LOCATION:

Oxford, CT

N

Oxford Natural Hazard Mitigation Plan

MXD: Y:\1452-11\Design\GIS\Maps\Oxford\OxfordFig_9-1.mxd

Map By: scottb
MMI#: 1452-11
Original: 07/26/2013
Revision: 9/19/2013
Scale: 1 inch = 5,280 feet

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- ❑ Oxygen – Without oxygen, a fire cannot begin or continue. In most wildland fires, this is commonly the most abundant element of the fire triangle and is therefore not a major factor in suppressing wildfires.

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. According to the USGS, wildfires can increase the potential for flooding, debris flows, or landslides; increase pollutants in the air; temporarily destroy timber, foliage, habitats, scenic vistas, and watershed areas; and have long term impacts such as reduced access to recreational areas, destruction of community infrastructure, and reduction of cultural and economic resources.

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 Typical Mitigation Measures, Strategies, and Alternatives

Typical mitigation measures for preventing wildfires include the following measures presented below:

9.3.1 Prevention

Preventative measures for wildfire damage includes placing utilities underground in new developments and instituting regulations that encourage fire breaks, emergency access, and the availability of fire protection water. Utilities that are located underground cannot be harmed by wildfires. The Fire Department or the Fire Marshall typically reviews zoning and subdivision applications for emergency access and fire protection requirements. The inclusion of open area buffer requirements around new construction can eliminate fuel that would otherwise allow wildfires to spread near buildings. In addition, the installation of sprinkler systems can help to abate the effects of wildfires on nearby structures.

9.3.2 Property Protection

Residents along the woodland-urban interface should be encouraged to remove deadfall in wooded areas of their property. In addition, homeowners should be encouraged to trim back overgrowth that is encroaching on the structure that could encourage a structure fire spreading from a wildfire. Property owners should also be encouraged to widen access roads into private property such that fire trucks and other emergency vehicles can access remote locations.

9.3.3 Emergency Services

Most wildfire prevention and response activities in a community are performed by the various emergency services departments. Communities should continue to promote inter-municipal cooperation in firefighting efforts, enforce regulations and permits for open burning, and patrol community-owned open space and parks to prevent unauthorized campfires. Maintaining proper equipment and training in wildfire response is also important.

9.3.4 Public Education and Awareness

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. Educational materials and programs are typically available through local Fire Departments, such has fire extinguisher use and how to properly manage burning and campfires on private property. Educational materials are often available at other municipal offices as well. Booklets such as *Is Your Home Protected from Wildfire Disaster? – A Homeowner's Guide to Wildfire Retrofit* can be made available in permit offices when developers and homeowners pick up or drop off applications;

9.3.5 Natural Resource Protection

Communities that control large areas of forests and brush land should consider conducting controlled burns to minimize the amount of low-lying combustible materials that could lead to dangerous wildfires during dry conditions. Such burns could be performed with the assistance of the State and regional departments as they can be excellent training exercises for area fire fighters. Clearing and maintaining fire access roads into isolated areas is also important.

9.3.6 Structural Projects

Water system improvements are an important class of potential mitigation for wildfires. Communities are encouraged to add additional supplies of firefighting water where adequate water supplies do not currently exist. Such measures can include extension of public water supply, the use of dry hydrants, or the use of storage tanks.

9.4 Historic Record

According to the Connecticut DEEP Forestry Division, much of Connecticut was deforested by settlers and turned into farmland during the colonial period. A variety of factors in the 19th century caused the decline of farming in the State, and forests reclaimed abandoned farm fields. In the early 20th century, deforestation again occurred in Connecticut, this time for raw materials needed to ship goods throughout the world. Following this deforestation, shipping industries in Connecticut began to look to other states for raw materials, and the deciduous forests of today began to grow in the State.

During the early 20th century, wildfires regularly burned throughout Connecticut. Many of these fires began accidentally by sparks from railroads and industry, while others were deliberately set to clear underbrush in the forest and provide pasture for livestock. A total of 15,000 to 100,000 acres of land was burned annually during this period. This destruction of resources led to the creation of the position of the State Forest Fire Warden and led to a variety of improved coordination measures described in Section 9.5.

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 (NIFC) reports that a total of 3,448 acres of land burned in Connecticut from 2002 through 2012 due to 2,334 non-prescribed wildfires, an average of 1.5 acres per fire and 313 acres per year (Table 9-1). The Connecticut DEEP Forestry Division estimates the average acreage burned per year to be much higher (1,000 acres per year) in the 2010 *Connecticut Natural Hazard Mitigation Plan Update*. 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

Year	Number of Wildland Fires	Acres Burned	Number of Prescribed Burns	Acres Burned	Total Acres Burned
2012	180	417	4	42	459
2011	196	244	7	42	286
2010	93	262	6	52	314
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
Total	**2,334**	**3,448**	**85**	**913**	**4,361**

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 recent past 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 Watertown burned 300 acres. No major wildfires have occurred in Oxford.

9.5 Existing Programs, Policies, and Mitigation Measures

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.

The technology used to combat wildfires has significantly improved since the early 20th 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. Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. Firefighters are typically focused on training for either structural fires or wildland fires, and maintain a secondary focus on the opposite category.

The Connecticut DEEP Division of Forestry monitors the weather each day during non-winter months as it relates to fire danger. The Division utilizes precipitation and soil moisture data to compile and broadcast daily forest fire probability forecasts. Forest fire danger levels are classified as low, moderate, high, very high, or extreme. In addition, the NWS issues a Red Flag warning when winds will be sustained or there will be frequent gusts above a certain threshold (usually 25 mph), the relative humidity is below 30%, and precipitation for the previous five days has been less than one-quarter inch. Such conditions can cause wildfires to quickly spread from their source area.

Regulations regarding fire protection are outlined in the *Zoning Regulations* and the *Subdivision Regulation*s. The Fire Marshall reviews new developments for fire protection requirements and provides recommendations to the Planning and Zoning Commission. The Fire Marshal encourages new developments to connect to public water supply whenever possible. New developments in outlying areas are either fitted with dry hydrants or are required to install underground storage tanks to store firefighting water. The level of fire protection is considered adequate throughout the community.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the Oxford 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 and storage tanks, but primarily relies on the use of the municipal water system to fight fires throughout the community whenever possible.

Oxford has all-terrain vehicles and other equipment for fighting fires in remote areas. The community also has mutual aid agreements with all of its neighbors, and works with Connecticut DEEP regarding fire protection of State-owned lands. Oxford is generally the first responder to fires occurring within State Forests in Oxford, with the State firefighters assuming command when they arrive on scene. Fire protection needs and potential problem areas are reviewed at least annually. Finally, the DEEP Forestry Division uses rainfall data from a variety of sources to compile forest fire probability forecasts. This allows the DEEP and Oxford to monitor the drier areas of the state to be prepared for forest fire conditions.

Aside from moderate changes in State policy and improvements to the public water systems in Oxford, local capability to mitigate for wildfires and prevent loss of life and property have not changed significantly since the initial hazard mitigation plan was adopted. The Town of Oxford will continue to evaluate whether capabilities need to be strengthened in the future.

9.6 Vulnerabilities and Risk Assessment

Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEEP, 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. It is at this interface that the most damage to buildings and infrastructure occurs.

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 DEEP, the actual forest fire risk in Connecticut is low due to several factors. First, the overall incidence of forest fires is very low (an average of 212 fires per year occurred in Connecticut from 2002 to 2010, 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 such as driveways too narrow to permit emergency vehicles are site specific. Finally, trained firefighters at the local and state level are readily available to fight fires in the state, and inter-municipal cooperation on such instances is common.

As suggested by the historic record presented in Section 9.4, 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 community, including the use of nearby water bodies, and longstanding mutual aid assurances the Oxford 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 community as well.

Oxford understands that there are weaknesses in its firefighting capability, particularly in outlying areas away from the public water systems. There are areas of the community where access roads into residential properties are long and narrow. This hinders emergency access to fight fires. 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.**

There are limited public camping areas in the community, so there are few fires caused by out of control campfires. The State Forest lands in Oxford are considered to be the areas of greatest vulnerability for wildfire because there are so few roads allowing access. Oxford personnel work with the DEEP to address the forests.

In summary, Oxford is a generally low-risk area for wildfires. The area at highest risk for wildfire are the State Forest lands throughout the community. These areas are considered to be at moderate risk for wildfires as shown on Figure 9-1.

10.0 SUGGESTED ACTIONS

10.1 Summary of Suggested Actions

Suggested mitigation actions from the previous HMP were presented in Table 1-11 along with the status of those recommendations. Those mitigation actions have been presented throughout this document in individual sections as related to each natural hazard or as general strategies. Additional suggested actions have also been proposed throughout the document. These actions will build upon the existing capabilities of the community.

This section summarizes specific suggested actions without any priority ranking. Suggested actions that span multiple hazards are only reprinted once in this section under "Multiple Hazards".

Multiple Hazards

- The Local Coordinator will be responsible for ensuring that the suggested actions identified herein are incorporated into local planning activities and for determining the extent of the revisions to other community documents.
- Identify and outfit a new EOC facility and adjacent storage center.

Flooding

- Utilize current aerial photography and parcel mapping to determine the addresses of houses within the 1% annual chance floodplain.
- Continue to pursue home elevations along the Housatonic River.
- Pursue acquisition of homes in the floodplain of the Housatonic River (particularly RLPs) for demolition and conversion to permanent open space.
- Pursue acquisition of undeveloped land in floodplains to permanently protect such land from development.
- Encourage residents within the 1% annual chance floodplain to purchase flood insurance under the NFIP and to complete elevation certificates.
- Join FEMA's Community Rating System to reduce the cost of flood insurance for residents.
- Consider requiring additional freeboard beyond one foot for new development or substantial improvement within the 1% annual chance floodplain.
- Formally require the use of the FEMA Elevation Certificate to record all elevation submissions for new developments and substantial improvements requiring a Flood Hazards Area Permit.
- Install signage depicting flood elevations along the Housatonic River as a deterrent to development.
- Utilize the list of structures within the 1% annual chance floodplain to collect phone numbers of residents and businesses at risk in order to target flood warnings through the CodeRED system.
- Pursue the acquisition of additional portable pumps and an additional rescue boat.
- Consider installation of a low flood wall to protect the Police Department from flooding.
- Consider floodproofing measures for the north side of the Oxford Center Fire House.
- Perform a survey of each sewer pumping station to determine if they are vulnerable to flooding.
- Pursue funding to complete flood mitigation projects along the Little River.

- Evaluate culverts and bridges utilizing current rainfall statistics to prioritize potential flood mitigation projects.
- Evaluate existing drainage systems utilizing current rainfall statistics and the need for additional drainage systems in order to reduce the impacts and frequency of nuisance flooding.

Wind

- Review the existing tree maintenance budget and make improvements if necessary.
- Pursue the acquisition of a boom truck and appropriate employee training such that Oxford personnel may perform elevated tree work.
- Work with other communities to improve communications with Connecticut Light & Power during and following emergency situations.

Winter Storms

- Develop response plans to remove excessive snow from critical facilities and schools.

Earthquakes

- Ensure that adequate backup plans and backup supplies are in place such that restoration activities may begin and continue until outside assistance can be provided following a major earthquake.

Dam Failure

- Utilize dam failure inundation mapping to identify vulnerable properties such that contact information may be included in the emergency notification system database.
- Pursue improved communications with the Town of Newtown and First Light Power Resources regarding emergency response along Lake Zoar.
- Oxford should work with the Connecticut DEEP to ensure that it has copies of the most current Emergency Action Plans on file.
- Work with private dam owners to coordinate pre-storm releases from dams in order to mitigate peak flooding downstream.

Wildfires

- Encourage homeowners and private communities to widen access for emergency vehicles where applicable.

10.2 Prioritization of Recommendations

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. The STAPLEE method was not used in the previous HMP but was selected as a tool to include as part of the update process. The STAPLEE was prepared in coordination with the Town of Oxford.

Overview of the STAPLEE Prioritization Process

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 the jurisdiction?
  - Costs: Are there any equity issues involved that would mean that one segment of the region 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 each community to administer future mitigation or emergency response actions?
  - Costs: Does each community have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the community 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 the community 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? Should the considered action be tabled 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; a score of “0.5” was assigned if there would be a slightly beneficial effect; 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; a score of “-0.5” was assigned if there would be a slightly unfavorable impact; 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 were summed to determine each strategy's final STAPLEE score. The highest possible score is 9.0, while the lowest possible score is -9.0. An evaluation matrix with the total scores from each suggested action is presented as Table 10-1.

TABLE 10-1: TOWN OF OXFORD STAPLEE MATRIX FOR PRIORITIZING SUGGESTED ACTIONS

SUGGESTED ACTIONS	Recommendation Status	Responsible Department[1]	Schedule	Cost[2]	Potential Funding Source[3]	Weighted STAPLEE Criteria[4] – *Benefits*								*Costs*								Total STAPLEE Score
						Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
MULTIPLE HAZARDS																						
Incorporate suggested actions into other local planning activities	New	EMD, BoS	By 2018	Minimal	OB	1	0	1	0.5	1	0	0	**3.5**	0	0	0	0	0	0	0	**0.0**	***3.5***
Identify and outfit a new EOC facility with adjacent storage center	New	EMD	By 2018	High	CI*	1	1	1	1	1	1	1	**9.0**	0	0	-0.5	0	0	-1	0	**-2.5**	***6.5***
FLOODING																						
Utilize aerial photography and parcel mapping to identify addresses within the 1% annual chance floodplain	New	ZEO	By 2015	Low	OB	1	0.5	1	1	1	1	0	**7.0**	0	0	-0.5	0	0	0	0	**-0.5**	***6.5***
Continue to pursue home elevations along the Housatonic River	Deferred	ZEO, GW	By 2018	High	OB*	1	1	1	1	1	0.5	0	**7.0**	-0.5	0	-0.5	0	0	-0.5	0	**-2.0**	***5.0***
Pursue acquisition of homes in the floodplain of the Housatonic River for demolition and conversion to permanent open space	Deferred	ZEO, GW	By 2018	High	CI*	1	1	1	1	1	0.5	1	**8.0**	-1	0	-0.5	0	0	0	0	**-1.5**	***6.5***
Pursue acquisition of undeveloped land in floodplains to permanently protect such land from development	Deferred	BoS, ZEO	By 2018	High	OB*	1	1	1	1	1	0.5	1	**8.0**	-0.5	0	0	0	0	-0.5	0	**-1.5**	***6.5***
Encourage residents within the 1% annual chance floodplain to purchase flood insurance under the NFIP and complete elevation certificates	New	ZEO	By 2015	Minimal	OB	1	1	1	0.5	1	1	0	**7.5**	0	0	0	0	0	0	0	**0.0**	***7.5***
Join FEMA's Community Rating System to reduce the cost of flood insurance for residents	New	BoS, ZEO	By 2016	Moderate	OB	0.5	0.5	1	1	1	1	0	**6.5**	-1	0	-1	-0.5	0	-0.5	0	**-3.5**	***3.0***
Consider requiring additional freeboard beyond one foot for new development or substantial improvement	New	PZ	By 2015	Minimal	OB	1	1	1	0.5	1	1	0	**7.5**	-0.5	0	0	-0.5	-0.5	0	0	**-1.5**	***6.0***
Formally require the use of the FEMA elevation certificate to record all elevation submissions	New	PZ	By 2015	Minimal	OB	1	0.5	1	1	1	1	0	**7.0**	-0.5	0	0	-0.5	0	0	0	**-1.0**	***6.0***
Install signage depicting flood elevations along the Housatonic River as a deterrent to development	New	DPW	By 2016	Moderate	OB	1	0.5	1	1	1	0.5	0	**6.0**	-0.5	-0.5	0	-0.5	0	-1	0	**-4.0**	***2.0***
Utilize the list of structures within the 1% annual chance floodplain to target warnings through the CodeRED system	New	EMD	By 2016	Minimal	OB	1	1	1	1	1	1	0	**8.0**	0	0	-0.5	0	0	0	0	**-0.5**	***7.5***
Pursue the acquisition of additional portable pumps and an additional rescue boat	New	EMD, GW	By 2015	Moderate	CI*	1	1	1	1	1	0.5	0	**7.0**	0	0	0	0	0	0	0	**0.0**	***7.0***
Consider installation of a low flood wall to protect the Police Department	New	EMD, DPW	By 2017	Moderate	CI*	1	0.5	1	1	1	1	0.5	**7.5**	0	-0.5	-0.5	0	-0.5	-0.5	0	**-3.0**	***4.5***
Consider floodproofing measures for the north side of the Oxford Center Fire House	New	EMD, DPW	By 2017	Moderate	CI*	1	1	1	1	1	1	0	**8.0**	0	-0.5	-0.5	0	0	-0.5	0	**-2.5**	***5.5***
Pursue funding to complete flood mitigation projects along the Little River	New	DPW, GW	By 2018	High	CI*	1	1	1	1	1	0.5	0.5	**7.5**	0	0	0	-0.5	0	-0.5	0	**-1.5**	***6.0***
Evaluate culverts and bridges utilizing current rainfall statistics to prioritize potential flood mitigation projects	Deferred	DPW	By 2018	Low	OB	1	1	1	1	1	1	0	**8.0**	0	0	-0.5	-0.5	0	-0.5	0	**-2.0**	***6.0***
Evaluate existing drainage systems utilizing current rainfall statistics and the need for additional drainage systems	New	DPW	By 2018	Low	OB	1	1	1	1	1	0.5	0	**7.0**	0	0	-0.5	-0.5	0	-0.5	0	**-2.0**	***5.0***
WIND																						
Review the existing tree maintenance budget and make improvements if necessary	New	DPW, BoS	By 2015	Minimal	OB	1	1	1	0.5	1	0.5	0	**6.5**	0	0	0	-0.5	0	0	0	**-0.5**	***6.0***
Pursue acquisition of a boom truck and appropriate employee training so the town may perform elevated tree work	New	DPW, GW	By 2016	High	CI*	1	1	1	1	1	1	0	**8.0**	0	0	0	0	0	0	0	**0.0**	***8.0***
Work with other communities to improve communications with Connecticut Light & Power	Deferred	BoS, EMD	By 2018	Minimal	OB	1	1	1	1	1	0.5	0	**7.0**	0	0	0	0	0	0	0	**0.0**	***7.0***
WINTER STORMS																						
Develop response plans to remove excessive snow from critical facilities and schools	New	EMD	By 2015	Low	OB	1	1	1	0.5	1	1	0	**7.5**	0	0	0	0	0	0	0	**0.0**	***7.5***
EARTHQUAKES																						
Ensure that adequate backup plans and supplies are available for continued functionality following an earthquake	New	EMD	By 2018	Moderate	OB, CI	0.5	0.5	1	0	0.5	0.5	0	**4.0**	0	-0.5	0	-1	0	-0.5	0	**-3.0**	***1.0***

TABLE 10-1: TOWN OF OXFORD STAPLEE MATRIX FOR PRIORITIZING SUGGESTED ACTIONS

SUGGESTED ACTIONS	Recommendation Status	Responsible Department [1]	Schedule	Cost [2]	Potential Funding Source [3]	Weighted STAPLEE Criteria [4] – *Benefits*: Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	*Costs*: Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Total STAPLEE Score
DAM FAILURE																						
Utilize dam failure innundation mapping to identify properties for inclusion in the emergency notification system	New	EMD	By 2016	Low	OB	1	1	1	0.5	1	1	0	**7.5**	0	0	-0.5	0	0	0	0	**-0.5**	***7.0***
Pursue improved communications with the Town of Newtown and First Light regarding emergency response along Lake Zoar	New	BoS, EMD	By 2018	Minimal	OB	1	1	1	0.5	1	0.5	0	**6.5**	0	0	0	0	0	0	0	**0.0**	***6.5***
Encourage owners of Class C and Class B dams to have current EAPs on file at Connecticut DEEP and with the town	New	EMD	By 2015	Minimal	OB	1	1	1	1	1	0.5	0	**7.0**	-0.5	0	0	0	0	0	0	**-0.5**	***6.5***
Work with private dam owners to coordinate pre-storm releases from dams in order to mitigate peak flooding downstream	New	EMD	By 2016	Low	OB	1	0.5	1	0.5	1	0.5	0	**5.5**	-0.5	-0.5	-1	-0.5	-0.5	-0.5	0	**-4.5**	***1.0***
WILDFIRES																						
Encourage homeowners and private communities to widen access for emergency vehicles where applicable	New	EMD, ZEO	By 2018	Minimal	OB	1	0.5	1	0.5	1	0	0	**4.5**	0	-0.5	0	0	0	0	0	**-1.0**	***3.5***

NOTES

1. Departments:
   BoS = Board of Selectmen
   DPW = Department of Public Works
   EMD = Emergency Management Director (Local Coordinator)
   GW = Grant Writer
   PZ = Planning and Zoning Commission
   ZEO = Zoning Enforcement Officer
2. Minimal = To be completed by staff or volunteers where costs are primarily printing, copying, or meetings; Low = Costs are less than $10,000; Moderate = Costs are less than $100,000; High = Costs are > than $100,000.
3. OB = Operating Budget; CI = Capital Improvement budget; a * indicates that grant funding will be pursued
4. A beneficial or favorable rating = 1; an unfavorable rating = -1. Technical and Financial benefits and costs are double-weighted (i.e. their values are counted twice in each subtotal)

The highest scoring is determined to be of more importance economically, socially, environmentally, and politically and, hence, prioritized over those with lower scoring. Note that the scoring system inherently favors recommendations that have minimal incremental costs, such as modifying regulations (which is accomplished by existing municipal personnel and commissions).

10.3 Benefit-Cost Ratio and Estimated Project Costs

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 majority of mitigation actions require the calculation of a benefit-cost ratio (BCR) that exceeds one; namely, that the benefits of the project outweigh its costs. Calculation of the BCR is typically conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation may be complex, vary with the mitigation action of interest, and is dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

Calculation of cost estimates for recommendations is not appropriate for a HMP, as this information can be misleading or inaccurate in several years and lead to problems when municipal personnel receive cost estimates from contractors. Potential costs of each recommendation is therefore listed as “minimal”, “low”, “intermediate”, or “high” on the STAPLEE matrix. These identifiers are defined as follows:

- “Minimal” costs only include printing, copying, or meetings of personnel. Direct expenditures are expected to be less than $1,000 (staff time is not included).

- “Low” costs can typically be handled by existing personnel with few outside expenses. These projects typically cost less than $10,000.

- “Intermediate” costs would require less than $100,000 to implement and may include studies, investigations, or small improvement projects. Such projects often require the use of outside consultants.

- “High” costs would require greater expenditures and may require grant funding to successfully complete the project. Such projects typically include capital expenditures for construction or infrastructure along with associated permitting and engineering costs.

10.4 Priority Recommendations

The STAPLEE scores were used to prioritize the 24 suggested mitigation actions. The top 13 highest ranking projects (STAPLEE scores of 6.5 and above) are summarized below.

1. Pursue the acquisition of a boom truck and appropriate employee training such that Oxford personnel may perform elevated tree work (8.0).
2. Encourage residents within the 1% annual chance floodplain to purchase flood insurance under the NFIP and to complete elevation certificates (7.5).

3. Utilize the list of structures within the 1% annual chance floodplain to collect phone numbers of residents and businesses at risk in order to target flood warnings through the CodeRED system (7.5).
4. Develop response plans to remove excessive snow from critical facilities and schools (7.5).
5. Pursue the acquisition of additional portable pumps and an additional rescue boat (7.0).
6. Work with other communities to improve communications with Connecticut Light & Power during and following emergency situations (7.0).
7. Utilize dam failure inundation mapping to identify vulnerable properties such that contact information may be included in the emergency notification system database (7.0).
8. Identify and outfit a new EOC facility with adjacent storage center (6.5).
9. Utilize current aerial photography and parcel mapping to determine the addresses of houses within the 1% annual chance floodplain (6.5).
10. Pursue acquisition of homes in the floodplain of the Housatonic River (particularly RLPs) for demolition and conversion to permanent open space (6.5).
11. Pursue acquisition of undeveloped land in floodplains to permanently protect such land from development (6.5).
12. Pursue improved communications with the Town of Newtown and First Light Power Resources regarding emergency response along Lake Zoar (6.5).
13. Oxford should work with the Connecticut DEEP to ensure that it has copies of the most current Emergency Action Plans on file (6.5).

11.0 RESOURCES AND REFERENCES

11.1 Potential Sources of Funding

The following sources of funding and technical assistance may be available for the priority projects listed above. This information comes from a variety of government websites including the FEMA website (http://www.fema.gov/government/grant/index.shtm). Funding requirements and contact information is given in Section 11.2.

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 grand 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

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 if 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 DEMHS.

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.

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.*

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.*

11.2 Technical 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, 6th 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
- *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.

<u>Environmental Protection Agency</u>
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>U.S. Department of Housing and Urban Development</u>
20 Church Street, 19th 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>U.S. Army Corps of Engineers</u>
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 several flood control acts and the Floodplain Management Services Program (FPMS). Specific programs used by the Corps for mitigation are listed below.

- *Section 205 – Small Flood Damage Reduction Projects*: This section of the 1948 Flood Control Act authorizes the Corps to study, design, and construct small flood control projects in partnership with non-federal government agencies. Feasibility studies are 100% federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65% with a 35% non-federal match. In certain cases, the non-federal share for construction could be as high as 50%. The maximum federal expenditure for any project is $7 million.

- *Section 14 – Emergency Streambank and Shoreline Protection:* This section of the 1946 Flood Control Act authorizes the Corps to construct emergency shoreline and streambank protection works to protect public facilities such as bridges, roads, public buildings, sewage treatment plants, water wells, and nonprofit public facilities such as churches, hospitals, and schools. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $1.5 million.

- *Section 103 – Hurricane and Storm Damage Reduction Projects:* This section of the 1962 River and Harbor Act authorizes the Corps to study, design, and construct small coastal storm damage reduction projects in partnership with non-federal government agencies. Beach nourishment (structural) and floodproofing (nonstructural) are examples of storm damage reduction projects constructed under this authority. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $5 million.

- *Section 208 – Clearing and Snagging Projects:* This section of the 1954 Flood Control Act authorizes the Corps to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers. Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

- *Section 206 – Floodplain Management Services:* This section of the 1960 Flood Control Act, as amended, authorizes the Corps to provide a full range of technical services and planning guidance necessary to support effective floodplain management. General technical assistance efforts include determining the following: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages, or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural floodplain resources; and flood loss potentials before and after the use of floodplain management measures. Types of studies conducted under FPMS include floodplain delineation, dam failure, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, floodproofing, and inventories of floodprone structures. When funding is available, this work is 100% federally funded.

In addition, the Corps also provides emergency flood assistance (under Public Law 84-99) after local and state funding have been used. This assistance can be used for both flood response and post-flood response. Corps assistance is limited to the preservation of life and improved property; direct assistance to individual homeowners or businesses is not permitted. In addition, the Corps can loan or issue supplies and equipment once local sources are exhausted during emergencies.

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 Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
(860) 424-3000
http://www.dep.state.ct.us/

The Connecticut DEEP provides technical assistance to sub-applicants for planning efforts and HMA projects. The Department 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.

- *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.

- *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.

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.

Division of Forestry – Prepares a daily Forest Fire Danger Report, maintains a fully-trained and equipped crew of fire fighters on call for assistance, and performs educational awareness regarding fires.

<u>Connecticut Department of Emergency Management and Homeland Security</u>
25 Sigourney Street, 6th Floor
Hartford, CT 06106-5042
(860) 256-0800
http://www.ct.gov/demhs/

DEMHS is the lead agency responsible for statewide 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. Additionally, the agency is available to provide technical assistance to sub-applicants during the planning process.

DEMHS operates and maintains the CT “Alert” emergency notification system powered by Everbridge. This system uses the state’s Enhanced 911 database for location-based notifications to the public for life-threatening emergencies. The database includes traditional wire-line telephone numbers and residents have the option to register other numbers on-line in addition to the land line.

DEMHS employs the *State Hazard Mitigation Officer*, who is in charge of hazard mitigation planning and policy; oversight of administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program, and has the responsibility of making certain that the State Natural Hazard Mitigation Plan is updated every three years.

Department of Construction Services
Office of the State Building Inspector
1111 Country Club Road
Middletown, CT 06457
(860) 685-8190
http://www.ct.gov/dcs/cwp/view.asp?a=4218&q=294226&dcsNav=%7C

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. ASFMP 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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APPENDIX A (ON COMPACT DISC)
DOCUMENTATION OF THE PLANNING PROCESS

APPENDIX A
PREFACE

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in Oxford 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 Agenda
HAZARD MITIGATION PLAN UPDATE FOR TOWN OF OXFORD
July 24, 2013

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1. <u>Purpose and Need for Hazard Mitigation Plan</u>
   a. Disaster Mitigation Act of 2000
   b. Status of Oxford's hazard mitigation plan

2. <u>Update on Hazard Mitigation Grant Programs (PDM, HMGP)</u>
   a. Congressional role
   b. Connecticut has funds to distribute under HMGP
   c. Types of projects that get funded

3. <u>What's New with Local Plan Updates and Approvals</u>
   a. HAZUS analysis
   b. Improved public involvement and outreach to neighboring towns
   c. Make plan maintenance more specific
   d. More emphasis on benefit-cost analysis for strategies
   e. Incorporate effects of recent disasters into plan
   f. Incorporation of hazard mitigation plan into other town plans

4. <u>Project Scope</u>
   a. Data collection, outreach
   b. Update vulnerability analysis
   c. Revisit strategies and update plan
   d. DESPP/DEMHS and FEMA review and approval

5. <u>Project Schedule</u>

6. <u>Review of Hazards and Events from 2007-2013 (Table attached)</u>

7. <u>Review of Table of Strategies from Last Plan</u>

8. <u>Data Collection Needs</u>

9. <u>Outreach and Public Involvement</u>
   a. Public meeting vs. surveymonkey survey
   b. Letters to surrounding communities

10. <u>Next Steps</u>

11. <u>Matching Grant</u>

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN UPDATE
Data Collection Meeting for Oxford
July 24, 2013

A. Welcome & Introductions

The following individuals attended the data collection meeting:

- Scott Pelletier, Fire Chief / Emergency Management Director
- George Temple, First Selectman
- Anna Rycenga, Zoning Enforcement Officer
- Wayne Watt, Public Works Director
- Andrew Ferrillo, Inland Wetlands Officer
- Kathleen O'Neil, Grant Administrator / Writer
- Gordon Gramolini, Building Official
- William Johnson, Planning and Zoning Commission
- Scott Bighinatti, Milone & MacBroom, Inc. (MMI)

B. Description and Need for Hazard Mitigation Plans / Disaster Mitigation Act of 2000

Mr. Bighinatti briefly described the basis for the natural hazard planning process and possible outcomes, including the role of the updated plan in grant application support for the municipalities within the region. Mr. Bighinatti noted that with three declared disasters in the past few years there are opportunities for grants under HMGP through the State. The updated plan will address flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failure, and wildfires. These hazards were discussed along with critical facilities and development trends.

C. Critical Facilities

- Critical facilities include the police station, fire station, airport, ambulance, schools, public works, gas transmission lines and metering stations. The Public Works Garage is the Emergency Operations Center (EOC), and the Center Fire Department is the backup EOC.
- Oxford Airport is a regional supply distribution point. This makes Oxford a regional hub during emergencies. This was the case during Irene, when other communities came to Oxford for supplies.
- An improved EOC is critical from a local and regional perspective. The current EOC is a 10-foot by 10-foot room that is inadequately-sized for emergency response activities and is not suited for long-term emergency management activities such as during the power outages resulting from Irene and Alfred.

- Furthermore, Oxford needs a climate-controlled storage facility to store emergency food supplies and equipment. The current storage space is too small and not climate controlled which cuts down on the shelf life of food supplies.
- Shelters include Oxford High School, Quaker Farms School, Great Oak Middle School, Center Fire Department (backup EOC), and at Senior Housing. These facilities have generators. The Town Hall also has areas that could be used for sheltering, but the facility does not have a generator.
- The shelters had not been utilized since the mid-1980's prior to Irene. While the primary shelter could not be utilized during the storms, the backup shelters provided ample space for Oxford's needs. Oxford also offered pet sheltering.
- Oxford needs more portable pumps to perform pumpouts.
- Oxford has a fire boat, but they are looking for a new one.
- Oxford has portable generators that they can setup with people who have special needs. This allows those residents to stay at home instead of coming to a shelter.
- Oxford does not have established evacuation routes. Evacuations are managed on a case-by-case basis.
- Private communities often have one-way roads, but they typically have two modes of egress or emergency egress points. Oxford attempts to ensure that there is more than one mode of egress into new developments such that there are very few new roads with one mode of egress. However, there are many cul-de-sacs located throughout Oxford.
- A subdivision on Moose Hill will have only one mode of egress.
- Emergency communications within and around Oxford have been recently upgraded.

D. Development Trends

- Lots of new developments with some redevelopment occurring. Three age-restricted (55+) housing developments are in the works. Affordable housing projects and a new shopping center are also proposed. Many of the new projects are being designed and approved in Phases since builders are hesitant to commit to a full-buildout because of the economic downturn.
- Oxford Greens is a large development that is currently in construction – it will have generators and underground utilities.
- Underground utilities are strongly encouraged whenever possible although there may not be a regulation for it. Oxford has lots of ledge so putting utilities underground is not always possible.
- Projects located within the floodplain are reviewed by Oxford's engineer (a private consulting firm) to ensure compliance with Oxford's floodplain regulations.
- Most redevelopment is occurring along the Housatonic River. Many older structures exist in this area that predate most building codes and the NFIP. While Oxford allows redevelopment to occur within the original footprint of the building, a long-standing problem has been that expansions have occurred without permits.
- Many residents have installed generators since the 2011 storms.

- Maintaining stream buffers is a priority for Oxford that has the secondary benefit of mitigating flood damage. This is mostly accomplished through the Inland Wetlands review.

E. Flooding

- In general, the flooding problems noted in the 2006 plan are still valid and appropriate to include in the update.
- Oxford wants residents along the Housatonic River to elevate their homes. Kathleen is currently writing three grant applications for home elevations in this area.
- Oxford would also like to acquire properties in this area and convert to open space. Two of the three homes that are potential elevations may be amenable to acquisitions.
- Anna would like signage showing flood levels for areas downstream of Stevenson Dam.
- Oxford encourages residents to purchase flood insurance but homes without mortgages are not required to do so.
- Many new flooding problems are related to drainage from recent developments. Ridge Street, Wyatt Road, Academy Road, Oneil Road, Dutton Road, Park Road, East Hill Road, Edmunds Road, and Route 188 all have areas with new drainage issues. Higher intensity rainfall and the use of outdated drainage computations may also be playing a role in the new drainage issues. Great Hill Road and Echo Valley Road near Haynes Materials are also floodprone.
- The Little River and Eightmile Brook continue to have areas with flooding issues.
- Most drainage complaints are sent to Wayne and tracked by hand.
- The two scour-critical bridges that were known were on the Little River at Route 42 and at Route 67.
- The Park Road Bridge is a one-lane, historic bridge that is floodprone. Mitigating the bridge has been difficult because it is a historic structure.
- The Dutton Road Bridge is also floodprone and may also be one lane.
- Oxford is interested in joining the Community Rating System to lower the cost of flood insurance for their residents.

F. Wind

- Power was lost during Irene and Alfred for about eight days each event. Some homes with supply lines down on private property were out longer.
- Tree damage and damage to power lines were the biggest impact during Irene, Alfred, and Sandy.
- Oxford has several crews that are capable of performing ground-level tree maintenance and plenty of saws and other equipment is available. Elevated tree work is contracted out. Oxford would like to acquire a boom truck such that they would no longer need to rely on contractors for elevated tree work.
- CL&P assigned a liaison to Oxford who communicates with Public Works. Oxford can present concerns and request assistance through the liaison. The trouble is that there is

limited communication back to Oxford, and Oxford does not know what resources are available. Oxford is forced to do much of its own trimming during emergencies, which can be problematic if lines are not de-energized. The best results when dealing with CL&P came when they simply assigned a crew to Oxford and Town staff could direct them as needed.

- CL&P began widespread trimming in the Park Road area, but did not trim in other areas that were planned.
- Public Works would like a larger budget dedicated to tree trimming.
- The Public Works Garage is located within a "wind corridor" where high winds are possible but has not sustained damage.
- Recurring tree damage occurs on Pinesbridge Road. Large pine trees snap and fall during high wind events and damage utilities in the area.

G. Winter Storms

- Oxford has an established plan for dealing with ice and snow issues. Personnel are familiar with the plan and are very efficient at responding.
- Oxford has established plowing routes. Access to and from critical facilities is not an issue.
- Drifting snow has not been an issue in recent years. Only a few locations occasionally see drifts. Jacks Hill Road used to see 12- to 13-foot drifts, but that has not happened recently.
- Oxford is very hilly, so most areas receive treatment in the winter to prevent icing.

H. Dams

- Oxford has many dams. The most prominent dam is the Stevenson Dam on the Housatonic River.
- Anna indicated that many dams that are not considered significant (Class B) or high (Class C) hazard by the Connecticut DEEP are considered locally to be hazardous.

I. Wildfires

- Oxford has public water supply in many areas. The Fire Marshal encourages new developments to connect to public water whenever possible.
- New developments in outlying areas are either fitted with dry hydrants or are required to install underground storage tanks.
- State lands are the most difficult places to fight wildfires since the State lands in Oxford have few roads allowing access. Oxford will often be the first responders to such fires, but Connecticut DEEP will take over once they arrive.
- Oxford has all-terrain vehicles and other equipment for fighting off-road fires.
- Oxford has mutual aid agreements with all of its neighbors.

J. Actions Taken by Oxford on 2006 Plan Recommendations

MMI reviewed a worksheet of the 15 previous plan recommendations with Oxford staff. Recommendations were listed as “Completed”, “Deferred” (and list the reasoning for deferment), or “Deleted” (and list the reasoning for deleting the strategy). For example, a project may be deferred if there was simply no budget to perform the activity, or deleted if such an activity is not needed at the present time or is unlikely to be acted upon. Previous recommendations that have become existing capabilities will be removed from the recommendations section.

<u>All Hazards</u>

- Improve emergency communications system between police, fire, EMS, and public works. *This has been completed.*
- Complete licensing of repeater/voting receiver communication system with FCC. *This has been completed.*
- Evaluate the hazard-resistant nature of all critical facilities. *This is performed annually and is a capability.*
- Review town roadway system to identify critical risks such as long cul-de-sacs and evaluate alternative access. *This is performed annually and is a capability.*
- Maintain emergency personnel training as well as maintaining and updating emergency equipment. *This is done as needed and is a capability.*
- Develop a plan to evaluate standby power supplies at critical facilities and then pursue installation of generators. *This has been completed. Evaluations continue annually as a capability.*

<u>Flooding</u>

- Improve system of notifying residents of flooding and controlled releases on the Housatonic River. *This has been completed with the institution of the CodeRED emergency notification system.*
- Pursue funding to mitigate flood hazards at properties in Under the Rocks Park (elevations, acquisitions, levees). *This is in progress and is to be a recommendation in the plan update.*
- Pursue funding and complete public works projects to mitigate flood hazards in the vicinity of the Little River. *No progress to date. Deferred to the plan update.*
- Evaluate potential flood mitigation projects; conduct engineering study to prioritize culvert and small bridge replacement projects. *No progress to date. Deferred to plan update.*
- Develop a Flood Audit Program. *This recommendation will be deleted as conducting flood audits at all floodprone properties is believed to be too expensive.*
- Evaluate the potential of obtaining flood hazard areas to preserve as open space. *The Town has a wish list of open space to be acquired. However, the ability to obtain such*

properties is subject to availability and is reviewed year-to-year. This recommendation should be included in the plan update.

<u>Wind</u>

- ❑ Evaluate and consider burying powerlines underground. *This is too expensive for existing utilities and the recommendation should be deleted.*

<u>Winter Storms</u>

- ❑ Review plans for snow removal to assure critical facilities are given priority. *This has been completed, is reviewed annually, and is a capability.*
- ❑ Review communication with CL&P to assure efficient response to downed lines. *This is ongoing and should be included in the plan update.*

K. Public Outreach

Staff indicated that they want to both have an online survey and hold a public meeting. George indicated that Oxford should do as much outreach as possible. MMI will administer the survey, and the public meeting will be given by Chief Scott with the assistance of Kathleen following the results of the survey. The public meeting may occur as part of a Board of Selectman meeting.

L. Future Acquisitions

- ❑ Chief Scott will forward MMI a list with addresses (where possible) or general locations such that the facilities may be mapped for the plan.
- ❑ Chief Scott will acquire an electronic copy of the Emergency Action Plan for Stevenson dam from First Light and forward to MMI.
- ❑ Chief Scott will forward a list of other Emergency Action Plans / Emergency Operations Plans for dams within or upstream of Oxford he has on file.
- ❑ Anna will get the number of generators installed from Gordon and forward to MMI.
- ❑ Anna will get the number of building permits per year since 2007 from Gordon and forward to MMI.
- ❑ Anna will forward Oxford’s flood damage prevention ordinance and other flood regulations to MMI.
- ❑ Anna will forward a list of known floodprone areas (not listed above) and those areas that are reported through drainage complaints.
- ❑ Anna will forward a list of dams Oxford staff consider to be hazardous, including general location and the reasoning behind this assessment to MMI for inclusion in the plan.
- ❑ Anna and Kathleen have numerous pictures of flooding that they will forward to MMI.
- ❑ Kathleen will provide MMI with a general description of the proposed elevation projects along the Housatonic River.

- ❑ Wayne will forward a list of scour critical bridges and other bridges that are susceptible to flooding.

Press Release for Waterbury Republican American

<u>Greater Waterbury Region Updating Plans for Mitigation of Natural Hazards</u>

When Waterbury and twelve surrounding towns prepared "hazard mitigation plans" in 2007 and 2008, municipal officials struggled to remember damaging natural hazards such as floods and hurricanes. Aside from a few nor'easters and strong thunderstorms, the region had not experienced a threatening hurricane or memorable flood since Tropical Storm Floyd hit the state in 1999.

Now, with hazard mitigation plan updates underway, the 13 towns of the Central Naugatuck Valley Region (Waterbury and Beacon Falls, Bethlehem, Cheshire, Middlebury, Naugatuck, Oxford, Prospect, Southbury, Thomaston, Watertown, Wolcott, and Woodbury) have a lot more to talk about. Tropical Storm Irene, October snowstorm Alfred, Superstorm Sandy, and Winter Storm Nemo are recent events that caused severe damage in the region and resulted in Federal disaster declarations in 2011, 2012, and 2013. Flooding, heavy snow, wind, and downed power lines have caused damage to property, closed schools and businesses, and jeopardized the health and safety of the citizens of the Waterbury region.

Meanwhile, the nation is beginning to understand the ramifications of the Biggert-Waters Act of 2012. This Act will cause unprecedented increases in the flood insurance policies for millions of Americans, including many home and business owners in the Waterbury region who own structures in FEMA's delineated floodplains. Now more than ever, municipalities are looking for opportunities to mitigate flooding and the disasters that cause flooding (such as hurricanes). Meanwhile, other natural hazards are increasingly on our radar due to events in recent memory such as the Bridgeport and Springfield tornadoes and the Virginia earthquake of August 2011 that was felt throughout Connecticut.

The 13 towns of the Central Naugatuck Valley Regional planning area are in different stages of the hazard mitigation plan update process. Watertown, Woodbury, and Oxford are participating in an internet-based survey to gather public input. The survey can be accessed at https://www.surveymonkey.com/s/hazardmitigationplanupdate.

Waterbury, Cheshire, Prospect, and Wolcott have already hosted surveys and a public meeting, but the public still have time to participate in the planning process. The remaining six communities (Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston) will begin the planning process in September and will be hosting informational meetings as well as internet-based surveys. The updated plans will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, landslides, and dam failure.

Mr. Sam Gold, Assistant Director of the Council of Governments Central Naugatuck Valley (COGCNV) is helping to coordinate the updates to the 13 plans. Residents and business owners are encouraged to contact Mr. Gold at comments@cogcnv.org with ideas for the hazard mitigation plans. Please put "Hazard Mitigation Plan" in the email subject line and the name of your town body of the email.

-End-

Engineering, Planning
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MILONE & MACBROOM®

July 29, 2013

Mr. Doug Colter
Building Official
Town of Beacon Falls
10 Maple Avenue
Beacon Falls, CT 06403

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Colter:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Beacon Falls relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

Please take a moment to share your thoughts for the following:

1. Do the towns of Oxford and Beacon Falls face any shared hazards that could be addressed by both communities? Examples could be flooding downstream of the Seymour Reservoirs or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do the towns of Oxford and Beacon Falls currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
Associate
davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

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Engineering, Planning
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MILONE & MACBROOM®

July 29, 2013

Mr. Scott Schatzlein, Town Engineer
Town of Monroe
7 Fan Hill
Monroe, CT 06468

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Schatzlein:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Monroe relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

We understand that you are the representative that will be working on the hazard mitigation plan update for Monroe (with Greater Bridgeport Regional Council) and, therefore, will have the most valuable input for the update of the Oxford hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Do Oxford and Monroe face any shared hazards that could be addressed by both communities? Examples could be flooding along the Housatonic River or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do Oxford and Monroe currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
Associate
davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

1452-11-jl2513-7-ltr.docx

July 29, 2013

Mr. George Benson
Director of Planning and Land Use
Town of Newtown
Newtown Municipal Center
3 Primrose Street
Newtown, CT 06470

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Benson:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Newtown relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

Please take a moment to share your thoughts for the following:

1. Do Oxford and Newtown face any shared hazards that could be addressed by both communities? Examples could be flooding along the Housatonic River (Lake Zoar) or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do Oxford and Newtown currently cooperate on any of the following:
    - Local emergency communications or response
    - Road maintenance, drainage system maintenance, public works, etc.
    - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

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Associate
davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

1452-11-jl2513-8-ltr.docx

Engineering, Planning
Landscape Architecture
and Environmental Science
MILONE & MACBROOM®

July 29, 2013

Mr. Michael Maglione
Emergency Management Director
City of Shelton
54 Hill Street
Shelton, CT 06484

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Maglione:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the City of Shelton relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

Please take a moment to share your thoughts for the following:

1. Do Oxford and Shelton face any shared hazards that could be addressed by both communities? Examples could be flooding along the Housatonic River or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do Oxford and Shelton currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
Associate
davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

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Engineering, Planning
Landscape Architecture
and Environmental Science

MILONE & MACBROOM®

July 29, 2013

Mr. Tom Eighmie, Emergency Management Director
Town of Seymour
1 First Street
Seymour, CT 06483

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Tom:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Seymour relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

Please take a moment to share your thoughts for the following:

1. Do the towns of Oxford and Seymour face any shared hazards that could be addressed by both communities? Examples could be flooding along the Little River or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do the towns of Oxford and Seymour currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM	Scott Bighinatti, CFM
Associate	Senior Environmental Scientist
davem@miloneandmacbroom.com	scottb@miloneandmacbroom.com

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Engineering, Planning
Landscape Architecture
and Environmental Science

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July 29, 2013

Mr. James Stewart, P.E.
Director of Public Works
Borough of Naugatuck
229 Church Street
Naugatuck, CT 06770

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Stewart:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Borough of Naugatuck relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

We understand that you are the representative that will be working on the hazard mitigation plan update for Naugatuck and, therefore, will have the most valuable input for the update of the Oxford hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Do Oxford and Naugatuck face any shared hazards that could be addressed by both communities? Examples could be flooding along Long Meadow Pond Brook or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do Oxford and Naugatuck currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with water, electric, and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
Associate
davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

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Engineering, Planning
Landscape Architecture
and Environmental Science

MILONE & MACBROOM®

July 29, 2013

Mr. Daniel Norton, Director
Public Works Department
Town of Middlebury
1212 Whittemore Road
Middlebury, CT 06762

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Mr. Norton:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Middlebury relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

We understand that you are the representative that will be working on the hazard mitigation plan update for Middlebury and, therefore, will have the most valuable input for the update of the Oxford hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Do the towns of Oxford and Middlebury face any shared hazards that could be addressed by both communities? Examples could be flooding near the airport or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do the towns of Oxford and Middlebury currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with electric and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
Associate
davem@miloneandmacbroom.com

Scott Bighinatti
Senior Environmental Scientist
scottb@miloneandmacbroom.com

1452-11-jl2513-5-ltr.docx

July 29, 2013

Mr. Tom Crowe, Public Works Director
Town of Southbury
501 Main Street South
Southbury, CT 06488

RE: Town of Oxford Hazard Mitigation Plan Update
MMI #1452-11

Dear Tom:

Milone & MacBroom, Inc. (MMI) is working with the Town of Oxford to update the hazard mitigation plan that was approved by the Federal Emergency Management Agency (FEMA) in 2006. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, the Town of Oxford and MMI are interested in coordinating with the Town of Southbury relative to hazards that could cross municipal boundaries such as flooding as well as strategies for hazard mitigation that could be addressed by the two communities.

We understand that you are the representative that will be working on the hazard mitigation plan update for Southbury and, therefore, will have the most valuable input for the update of the Oxford hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Do the towns of Oxford and Southbury face any shared hazards that could be addressed by both communities? Examples could be flooding along the Eightmile River or windstorms that damage power lines that cross the town boundary.
2. Can you think of any strategies for hazard mitigation that could benefit both communities?
3. Do the towns of Oxford and Southbury currently cooperate on any of the following:
   - Local emergency communications or response
   - Road maintenance, drainage system maintenance, public works, etc.
   - Communications with water, electric, and other utility providers

You may contact either of the undersigned via email or telephone. A written response is not necessary. Thank you for your time.

Very truly yours,

MILONE & MACBROOM, INC.

David Murphy, P.E., CFM
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davem@miloneandmacbroom.com

Scott Bighinatti, CFM
Senior Environmental Scientist
scottb@miloneandmacbroom.com

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Board | Announcements

Update of Oxford Hazard Mitigation Plan

Posted by David Murphy , August 15, 2013 at 09:07 AM

Tropical Storm Irene, October snowstorm Alfred, and Superstorm Sandy are recent events that caused severe damage and resulted in Federal disaster declarations. Flooding, heavy snow, wind, and downed power lines cause damage to property, disrupt our daily routines, close our schools and businesses, and jeopardize the health and safety of the citizens of Oxford.

What can be done to minimize our vulnerabilities to natural hazards? The Town of Oxford is updating its hazard mitigation plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life, and the costs that are shared by all. The plan will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, and dam failure. The plan will outline the steps that Oxford can take to mitigate for future natural hazards.

In order to gain input to the hazard mitigation plan, the town has developed an internet-based survey. Residents and business owners are invited to take the survey and offer ideas for minimizing the damage that occurs and the costs that are borne by our town. Please go to https://www.surveymonkey.com/s/hazardmitigationplanupdate

For more information, please contact Oxford's Emergency Management Director or the Council of Governments Central Naugatuck Valley, or leave a comment in the survey.

From Swallow Falls Patch

Manny's 10 Favorite Food Jokes
Make your belly ache with these sweet jokes.

Comments

+ Leave a Comment

Leave a comment

Post comment

Boards

All Boards »

Make an announcement, speak your mind, or sell something

Post

9-11 Memorial Ceremony
Please join Oxford First Selectman George R. Temple for a 9-11 Memorial Ceremony at noon, Wedn...
Town Square September 06, 2013 at 11:32 AM
joanne pelton

John Kerry is a shameful disgrace
I watched with shock and awe as Sec. John Kerry went before the senate committee to brazenly a...
Opinion September 06, 2013 at 07:54 AM
1 Linda Czaplinski

VoicesNEWS.COM
VOICES the Newspaper • VOICES Weekender

COMMUNITY NEWS

Mitigation Updates Underway

Print Page

Published:
Wednesday, August 28, 2013 7:07 AM EDT

OXFORD — When Waterbury and 12 surrounding towns prepared hazard mitigation plans in 2007 and 2008, municipal officials struggled to remember damaging natural hazards such as flood and hurricanes.

Aside from a few nor'easters and strong thunderstorms, the region had not experienced a threatening hurricane or memorable flood since Tropical Floyd in 1999.

Now, with hazard mitigation plan updates underway, the 13 towns of the Central Naugatuck Valley Region — Waterbury and Beacon Falls, Bethlehem, Cheshire, Middlebury, Naugatuck, Oxford, Prospect, Southbury, Thomaston, Watertown, Wolcott and Woodbury — have much to discuss.

Tropical Storm Irene, October snowstorm Alfred, Superstorm Sandy and Winter Storm Nemo are recent events that caused severe damage in the region and have resulted in Federal disaster declarations in 2011, 2012 and 2013.

Flooding, heavy snow, wind and downed power lines have caused damage to property, closed schools and businesses and jeopardized health and safety of citizens in the Waterbury region.

Meanwhile, the nation is beginning to understand the ramification of the Biggert-Waters Act of 2012.

The act will cause unprecedented increases in the flood insurance policies for millions of Americans including many home and business owners in the Waterbury region, who own structures in FEMA's delineated floodplains.

Now more than ever, municipalities are looking for opportunities to mitigate flooding and flood-causing disasters, like hurricanes.

The 13 towns of the Central Naugatuck Valley Regional planning area are each in different stages of the hazard mitigation plan update process. Watertown, Woodbury and Oxford, for example, are participating in an internet-based survey to gather public input.

Those interested in survey participation may visit www.surveymonkey.com/s/hazardmitigationplanupdate.

While Waterbury, Cheshire, Prospect and Wolcott have already hosted surveys and a public meeting, residents still have time to participate in the planning process.

The remaining six communities, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston, will begin the planning process in September, followed by informational meetings and internet-based surveys.

The updated plans will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, landslides and dam failure.

Assistant Director of the Council of Governments Central Naugatuck Valley, Sam Gold, is helping to coordinate the updates to the 13 plans.

Those seeking further information or interested in providing ideas for the hazard mitigation plans, may contact Mr. Gold at comments@cogcnv.org, and are asked to write "Hazard Mitigation Plan" in the email subject line and the name of your town in the body of the email.

TOWN OF OXFORD

S.B. Church Memorial Town Hall
486 Oxford Road, Oxford, Connecticut 06478-1298

INFORMATIONAL HEARING

BOARD OF SELECTMEN

An Informational Hearing will be held on Wednesday, September 25, 2013 at 7:00 PM at the S. B. Church Memorial Town Hall, 486 Oxford Road, for the following purpose:

1. To discuss a proposed update to the *Town of Oxford's Hazardous Mitigation Plan* and to receive verbal as well as written public comment relating to the Plan.

George R. Temple, Esq.
First Selectman

INFORMATIONAL HEARING BOARD OF SELECTMEN

Published:
Wednesday, September 18, 2013 7:07 AM EDT

An Informational Hearing will be held on Wednesday, September 25, 2013 at 7:00 PM at the S. B. Church Memorial Town Hall, 486 Oxford Road, for the following purpose:

1. To discuss a proposed update to the Town of Oxford's Hazardous Mitigation Plan and to receive verbal as well as written public comment relating to the Plan.

George R. Temple, Esq.

First Selectman

TOWN OF OXFORD

S.B. Church Memorial Town Hall
486 Oxford Road, Oxford, Connecticut 06478-1298
www.Oxford-CT.gov

Board of Selectmen

INFORMATIONAL HEARING

Wednesday, September 25, 2013
Town Hall, 7:00 PM

Call To Order:

The Informational Hearing was held on Wednesday, September 25, 2013 at 7:00 PM at the S.B. Church Memorial Town Hall, 486 Oxford Road, Oxford, CT for the purpose of discussing a proposed update to the *Town of Oxford's Hazardous Mitigation Plan* and to receive verbal and written public comment related to the plan.

Present:

Scott Pelletier, Fire Marshal and Anna Rycenga, ZEO.

The Information Hearing opened at 7:00 PM. It was noted that the Legal Notice appeared in the Voices on September 18, 2013.

In addition, Press Releases were on the Oxford Patch, Voices and the Waterbury Republican Newspapers.

Public Comment/Questions:

There was no public participation, comment, or questions received.

Power Point Presentation:

The following Power Point was presented:

Hazard Mitigation Plan Update
Oxford, Connecticut

PDM
PRE-DISASTER MITIGATION

HMGP
HAZARD MITIGATION GRANT PROGRAM

Presented by:
Scott Pelletier, Fire Marshal
& Anna Rycenga, ZEO

September 25, 2013

David Murphy, P.E., CFM
Milone & MacBroom, Inc.

MILONE & MACBROOM®

Purpose and Need for Hazard Mitigation Plan

- **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
- **Status of Oxford's Plan**
  - Developed 2005-2006
  - Adopted and Approved December 2006
  - Expired 2011

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Update on Hazard Mitigation Grant Programs

- Local communities 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)
- Connecticut has >$20M to distribute under HMGP

PDM PRE-DISASTER MITIGATION

HMGP HAZARD MITIGATION GRANT PROGRAM

FMA FLOOD MITIGATION ASSISTANCE

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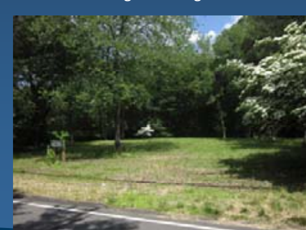
Update on Hazard Mitigation Grant Programs

- Grants can be used for:
  - Building acquisitions or elevations
  - Culvert replacements
  - Drainage projects
  - Riverbank stabilization
  - Landslide stabilization
  - Wind retrofits
  - Seismic retrofits
  - Snow load retrofits
  - Standby power supplies for critical facilities

This home in Trumbull was acquired and demolished using a FEMA grant



MILONE & MACBROOM®

What is a Natural Hazard?

- An extreme natural event that poses a risk to people, infrastructure, and resources



MILONE & MACBROOM®

What is a Natural Hazard?

- An extreme natural event that poses a risk to people, infrastructure, and resources



MILONE & MACBROOM®

Long-Term Goals of Hazard Mitigation

- Reduce loss of life and damage to property and infrastructure
- Reduce the costs to residents and businesses (taxes, insurance, repair costs, etc.)
- 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

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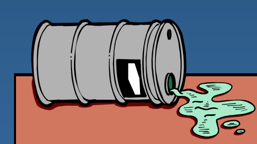
What a Hazard Mitigation Plan Does Not Address

- Terrorism and Sabotage

- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



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Components of Hazard Mitigation Plan Update Process

- Review natural hazards that could occur in the Town
- Review the vulnerability of structures and populations and identify critical facilities and areas of concern
- Incorporate effects of federally declared disasters that occurred after the last plan was developed:
  - ✓ March 2010 floods
  - ✓ Winter snow loads/collapsing roofs in January 2011
  - ✓ Hurricane Irene in August 2011
  - ✓ Winter Storm Alfred in October 2011
  - ✓ Hurricane Irene in October 2012
  - ✓ Winter Storm Nemo in February 2013

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Components of Hazard Mitigation Plan Update Process

- Assess adequacy of mitigation measures currently in place such as regulations and emergency services
- Evaluate the prior mitigation measures that were conceived to reduce risks and vulnerabilities
- Develop recommendations for new mitigation actions
- Develop goals that connect to the strategies and actions
- Improve outreach to neighboring towns
- Show how the plan will be incorporated into other city plans

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Hazards Included in the Previous Plan

- Flooding
- Hurricanes and tropical storms
- Summer storms and tornadoes
- Winter storms and nor'easters
- Earthquakes
- Wildfires
- Dam failure
- Landslides

Flood Damage at Riggs Street After June 2006 Storms

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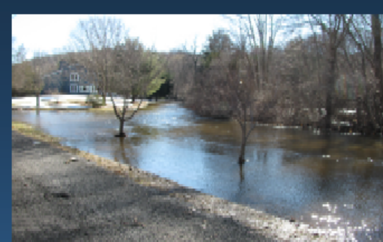
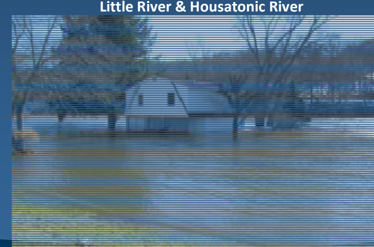
Flooding

- Housatonic River
- Little River
- 4 Mile Brook
- 5 Mile Brook
- 7 Mile Brook
- 8 Mile Brook
- Swan Lake
- Riggs Street Brook
- Little Brook



Little River & Housatonic River



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Drainage-Related Flooding

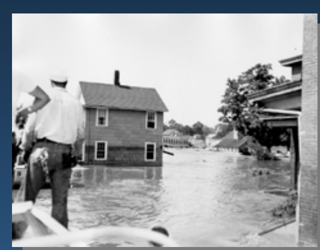
- Various parts of the town are vulnerable
- Storm drainage systems may be undersized or absent

Housatonic River

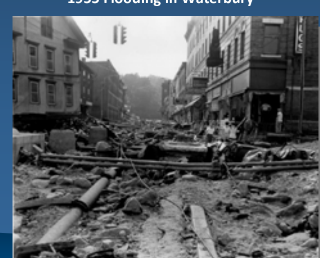
MILONE & MACBROOM®

Hurricanes and Tropical Storms

- Winds
- Heavy rain / flooding



1955 Flooding in Waterbury



Typical Irene Damage in Connecticut

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Summer Storms and Tornadoes

- Tornadoes
  - Wethersfield in 2009
  - Bridgeport in 2010
  - Springfield in 2011
- Downbursts
- Lightning
- Heavy rain
- Hail

Springfield Tornado photos courtesy of the Hartford Courant

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Winter Storms and Nor'easters

- Blizzards and nor'easters
- Heavy snow and drifts
- Freezing rain / ice
- Downed trees

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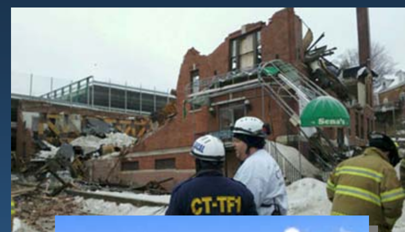
Winter Storms and Nor'easters

- Collapsed Buildings in 2011



Photos courtesy of the Hartford Courant

MILONE & MACBROOM®

Earthquakes

- Chester, CT experienced a magnitude 2.0 earthquake on March 11, 2008
- Virginia earthquake in 2011
- Can cause dam failure, shaking, liquefaction, slides/slumps

Photos courtesy of FEMA

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Wildfires

- Fire
- Heat
- Smoke
- April is the month of maximum risk in Connecticut

Photos courtesy of FEMA and the Town of Sherman, CT

MILONE & MACBROOM®

Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life or millions of dollars in property damage
- Many registered dams in the city
- New dam safety legislation passed in 2013

Recent dam failure in Sherman, CT

MILONE & MACBROOM®

Landslides

- Several areas of the town have been susceptible such as Riggs Street

Riggs Street After June 2006 Storms

MILONE & MACBROOM®

Review of Hazard Mitigation Strategies

MILONE & MACBROOM®

Hazard Mitigation Strategies in the Previous Plan

- Develop a checklist that cross-references regulations and codes related to flood damage prevention that may be applicable to a proposed project
- Coordinate with neighboring towns regarding new subdivisions that could impact properties within Oxford
- Require watershed-based engineering studies for new subdivisions or sizeable developments showing both the upstream and downstream drainage impacts
- Clear brush and growth that could possibly inhibit flood flows in the floodplain Housatonic River
- Purchase private land in the 100-year floodplain and convert to greenways and parks
- Perform watershed studies where necessary

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Hazard Mitigation Strategies in the Previous Plan

- Install a drainage system where necessary
- Increase tree limb maintenance and inspections
- Continue to require that utilities be placed underground in new developments and
- pursue funding to place them underground in existing developed areas
- Acquire additional funding for the sand/salt storage facility
- Consider property acquisitions to reduce the number of people potentially affected by the limited plowing services available in this neighborhood
- Continue to encourage two modes of egress into every neighborhood by the creation of through streets

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Hazard Mitigation Strategies in the Previous Plan

- Consider adding earthquakes to the list of hazards covered by the Emergency Operations Plan
- Consider preventing residential development in areas of, on, above, or below steep slopes
- Consider preserving areas of steep slopes as protected open space through acquisition or modified zoning
- Secure mitigation funding
- Ensure that local utility providers are aware of landslide potential and have responder teams ready to repair damage to their utilities caused by landslides
- Consider expanding and over-sizing drainage systems in the vicinity of steep slopes

MILONE & MACBROOM®

Hazard Mitigation Strategies in the Previous Plan

- Continue to require or conduct regular inspections of all Class C dams, with upkeep and maintenance as required
- Consider implementing inspections of municipally-owned Class A, AA, B, and BB dams
- Work with the DEEP to ensure that Class C dams have up to date emergency operations plans and dam failure analyses
- Perform or update dam failure analysis for dams
- Perform any necessary repairs to dams
- Water Pollution Control Authority to identify and upgrade those portions of the water supply systems that are substandard from the standpoint of adequate pressure and volume for fire-fighting
- Innovative solutions to fire protection should be explored where it is not feasible to extend a conventional water system

MILONE & MACBROOM®

Next Steps

- Incorporate input from the public
- Refine hazard vulnerabilities and risks as needed
- Delete, carry forward, or modify prior mitigation strategies
- Develop new mitigation strategies
- Prepare the draft update for review by the town and the public
- Adopt and implement the plan

MILONE & MACBROOM®

Questions & Input

MILONE & MACBROOM®

Adjournment:

The Informational Hearing was adjourned at 7:15 PM.

Respectfully submitted,
Anna Rycenga, ZEO

WEB EXTRAS

TODAY AT REP-AM.COM

>> IN THE RED ZONE View a photo galleries and video highlights from the Oxford-Notre Dame of Fairfield and Cheshire-West Haven games. Also, watch a video from the Pomperaug-New Milford game.

>> UCONN FOOTBALL Watch a video of Coach P. talking about the team's energy heading into today's game at Buffalo.

>> SENIOR BOWLING Watch a video report on the Sky Top Lanes senior league.

High **70**
Low **45**

Plenty of sun today; Dress for chilly weather tonight. Page **8A**

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6 34373 12494 2

Read it at rep-am.com

Coppa. The league, which meets every Friday afternoon, has one rule: Nobody under 60 is allowed. See story on Page 3B.

VISIT REP-AM.COM FOR A VIDEO ON THE LEAGUE

Ready for nature's nastiness

Towns need plans to be eligible for funds

BY QUANNAH LEONARD
REPUBLICAN-AMERICAN

In Watertown, whenever the Steele Brook rises, it first floods The Gowans-Knight Co. Inc. on Knight Street.

That business, which builds and refurbishes fire trucks, floods before Bradshaw Chrysler Jeep on Main Street and well before Watertown Plaza off Route 63, said Charles Berger Jr., Watertown's town engineer. The Gowans-Knight Co. is at the lowest point along Steele Brook, he said.

It's a tiny brook and then it's a nightmare, said Day Palmer, vice president of The Gowans-Knight Co. Every

See **FLOOD**, *Page* **7A**

DARLENE DOUTY REPUBLICAN-AMERICAN

Day Palmer, vice president of Gowans-Knight Co. in Watertown, holds a photo taken when the business was flooded after tropical storm Lee in 2011. Cities and towns in Greater Waterbury are updating their plans to mitigate natural hazards.

Keno ge step clo to appr

Legislators s OK of video

BY MARK PAZNIO
©THE CONNECTICUT M

The Connecticut took a step Thursda bringing keno to bar rants and other out year, while legisl Hartford began a stu feasibility of int video slots to pari-m cilities in Bridgep Haven and Windsor

Keno seems a su The General Asseml ed its authorization

See **KENO**,

LOTTERY

Keno is ex to expand tery's netw vendors by as 600 new

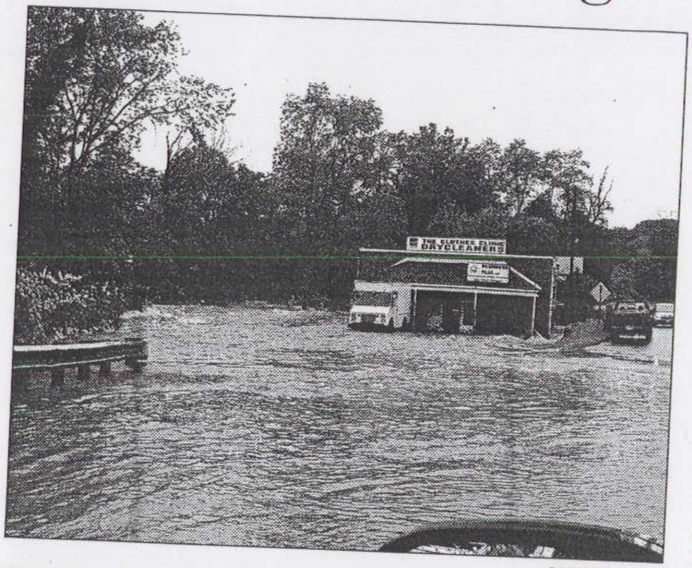
FLOOD: Plans in various stages

Continued from Page One

time it rains, the business has to be on alert, so it can be ready to move trucks and other equipment, she said outside her business Thursday morning.

"We understand that the town is trying to correct the problem, but the amount of money it's going to cost to correct the problem is probably ... it's never going to happen," Palmer said. "So therefore, every time we have a flood, we do more things when we're doing our repairs to make it not affect us as much."

Reducing the persistent flooding along Steele Brook is just one example of the projects in Greater Waterbury that could qualify for federal hazard mitigation funds through the Federal Emergency Management Agency. To be eligible for those funds, though, communities must have an approved natural hazard mitigation plan, state and local officials said.



CONTRIBUTED

Flooding along Steele Brook in Watertown spills over and floods this business on Riverside Street in 2011. Cities and towns in Greater Waterbury are updating their plans to mitigate natural hazards. Communities must do this to be eligible for FEMA funds for certain projects.

WATERTOWN AND 12 other towns in the Central Naugatuck Valley Region have plan updates underway, with the municipalities at different stages of the process, said David Murphy, managing project engineer in water resources with Milone & MacBroom, Cheshire, the consulting firm hired to write the plans. The updated plans will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, landslides and dam failure.

Watertown, Woodbury and Oxford have completed a first draft, which is in the reviewing process, said Murphy, project manager.

Waterbury, Cheshire, Prospect and Wolcott finished drafts in the spring, and already have done surveys and hosted a public meeting. Some of those communities are now reviewing the drafts, he said.

The remaining six towns, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston,

small portion is set aside for addressing future known issues, he said.

Scott Devico, spokesman for the state Division of Emergency Management and Homeland Security, said the state division provides assistance and recommendations on hazard mitigation plans if asked by towns. It's a joint venture with the state Department of Energy and Environmental Protection, he said.

In Waterbury, the city has applied for FEMA hazard mitigation funding to pay for drainage improvements at the Chase Building on Grand Street. Waterbury can't receive that funding until the city's plan is updated, Murphy said.

The project cost estimate is $221,000, said Lou Spina, the city's provisional director of public works. The project entails installing a storm drain that would connect to an existing storm drain system on Leavenworth Street, said Mark Pronovost, Waterbury's city engineer.

During an intense storm, water builds up in a low spot in that parking area. Workers from streets and public works typically will put down about 40 to 50 sandbags to protect the basement, Spina said. He

proofing, Berger said.

Watertown has applied to FEMA for hazard mitigation grant funds to flood proof all businesses along Steele Brook that are subject to significant flooding, he said. That application is under review, he said.

Total project costs for that option is about $1.9 million, Berger said. If approved, FEMA would pay 75 percent, or about $1.5 million. Property owners would be responsible for 25 percent.

Berger said the plan update is a reinforcement of what the town knows it needs to address as far as hazard mitigation, as well as looking for new ideas.

"The whole goal is to be prepared as we can, take as many steps as we can ahead of time and be prepared to react afterward if something gets significantly damaged," Berger said.

At The Gowans-Knight Co., Day has pictures in her office of the flooding that occurred on site when Storm Lee hit in 2011. The company got two-and-a-half feet of water, she said.

The company has spent $150,000 in the last two years to protect itself against flooding, Palmer said. That doesn't

KENO: L

Continued from Page One

the Malloy administration is negotiating profit-sharing terms with tribal casinos and, now, the lottery's board has authorized developing the infrastructure necessary to produce the game by June 1, 2014.

The odds are less certain for the introduction of video slot machines at three pari-mutuel facilities. The study was initiated by lawmakers in those communities who say slots might be necessary to hang onto gambling revenues in the face of growing competition in New York and Massachusetts.

The confluence of the day's events underlined the importance and the volatility of the gambling industry in the Northeast, where a rapid expansion of casinos and other betting facilities is undercutting Connecticut's two tribal casinos, Foxwoods and Mohegan Sun.

"The fact of the matter is the state of Connecticut is in the gaming industry, and we've been seeing revenues continue to drop," said Sen. Andres Ayala, D-Bridgeport, as lawmakers began their public look at video slots.

From a high of $718 million in 2006, the state saw its annual gambling income drop to $612 million last year. The revenue comes primarily from two sources: the shrinking slots revenue from the tribal casinos and the growing profits of the lottery.

Keno represents a twofold expansion for the lottery: It is a new game, and it also is slides and dam failure.

Watertown, Woodbury and Oxford have completed a first draft, which is in the reviewing process, said Murphy, project manager.

Waterbury, Cheshire, Prospect and Wolcott finished drafts in the spring, and already have done surveys and hosted a public meeting. Some of those communities are now reviewing the drafts, he said.

The remaining six towns, Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury and Thomaston, have started the planning process and have or will host informational meetings and online surveys sometime soon, he said.

Towns in the Litchfield Hills Council of Elected Officials region have begun to update their plans, and those in the Northwestern Connecticut Council of Governments have just started their first mitigation plans, Murphy said.

Samuel Gold, acting executive director of the Council of Governments Central Naugatuck Valley, which is coordinating the updates, said the hazard mitigation plans are only good for five years.

WHEN A NATURAL DISASTER OCCURS, and when a disaster is declared in Connecticut, a small portion of FEMA funds are available to address known hazards that could be a future problem, Gold said. Most money is spent for recovery, while a

phy said.

The project cost estimate is $221,000, said Lou Spina, the city's provisional director of public works. The project entails installing a storm drain that would connect to an existing storm drain system on Leavenworth Street, said Mark Pronovost, Waterbury's city engineer.

During an intense storm, water builds up in a low spot in that parking area. Workers from streets and public works typically will put down about 40 to 50 sandbags to protect the basement, Spina said. He said the city is trying to avoid any expensive damage and to keep the building online to conduct city business.

Watertown has its first draft posted on the town website, www.watertownct.org. for public comment.

Berger said the town doesn't have a preferred alternative yet for the Steele Brook flood mitigation project.

WATERTOWN HAS CONDUCTED A NUMBER OF STUDIES and has been looking at a number of alternatives over the years, he said. Those alternatives range from buying out people who are in the flood plain and relocating their businesses to a flood-free site, to more of a structural project, where the town would build flood walls and pump stations to try to protect properties where they are now.

And in between those alternatives are several more alternatives, including flood

prepared as we can, take as many steps as we can ahead of time and be prepared to react afterward if something gets significantly damaged," Berger said.

At The Gowans-Knight Co., Day has pictures in her office of the flooding that occurred on site when Storm Lee hit in 2011. The company got two-and-a-half feet of water, she said.

The company has spent $150,000 in the last two years to protect itself against flooding, Palmer said. That doesn't include the $7,000 it paid to repair pavement damaged by flooding, she said.

The business now stores everything six inches to a foot-and-a-half off the floor in the shop. It also has installed an interior mezzanine for securing welding equipment and bought two additional sets of lifts for lifting up fire trucks.

"We are doing our own hazard mitigation because we know it's just going to keep happening and we can't afford to move somewhere else," Palmer said. "Because the cost of moving is astronomical, even though we've looked into it numerous times."

Residents and business owners can email ideas about the plans to the Council of Governments Central Naugatuck Valley at comments@cogcnv.org.

Contact Quannah Leonard at qleonard@rep-am.com, on Facebook at RA The Valley or on Twitter @RA_Quannah.

Keno represents a twofold expansion for the lottery: It is a new game, and it also is

SPY: Violators allowed to retire

Continued from Page One

prosecution, Ellard's letter said. In some cases, U.S. prosecutors declined to take action but in nearly every case the employees were allowed to retire without punishment.

In one case, a worker was suspended without pay then retired; in another case, a worker's promotion was canceled; in two cases, military employees suffered a reduction in rank, extra duty and brief reduction in salary for two months.

Public concerns about how telephone and Internet surveillance data is handled by the NSA have intensified in the wake of leaks about the

TODAY'S POLL

VOTE ONLINE AT REP-AM.COM

If you had access to the technology, would you spy on a spouse, boyfriend or girlfriend?

FIND RESULTS OF YESTERDAY'S QUESTION ON PAGE 2A.

correct internal problems that led to the NSA's accidental collection of 56,000 emails and other communications by Americans, and they insisted that willful abuse of surveillance data by officials is almost non-existent.

Grassley, who had asked Ellard last month to provide more information about the 12

his foreign girlfriend's telephone number in 2004. The official also tried to retrieve data about his own phone but was prevented because internal mechanisms prevented queries on domestic phone numbers without authorization. The matter was referred to the Justice Department. The official retired in 2012 before internal disciplinary action could be taken.

In another case, the foreign girlfriend of a U.S official reported her suspicions that the official was listening to her telephone calls.

An internal investigation found that the official had made internal surveillance queries on the phones of nine

APPENDIX B
RECORD OF MUNICIPAL ADOPTION

TOWN of OXFORD
OXFORD TOWN HALL
486 OXFORD ROAD
OXFORD, CT 06478-1298

A RESOLUTION ADOPTING
THE TOWN OF OXFORD HAZARD MITIGATION PLAN UPDATE, 2014

WHEREAS, the Town of Oxford has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of those natural hazards profiled in the plan (e.g. *flooding, high wind, thunderstorms, winter storms, earthquakes, dam failure, and wildfires)*, resulting in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Town of Oxford has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its Hazard Mitigation Plan Update, 2014 under the requirements of 44 CFR 201.6; and

WHEREAS, public and committee meetings were held between July, 2013 and September, 2013 regarding the development and review of the Hazard Mitigation Plan Update, 2014; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for the Town of Oxford; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact the Town of Oxford, with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this Plan will make the Town of Oxford eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by the Board of Selectmen:

1. The Plan is hereby adopted as an official plan of the Town of Oxford;

2. The respective officials identified in the mitigation strategy of the Plan are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and Plan maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as a part of this resolution for a period of five (5) years from the date of this resolution.

4. An annual report on the progress of the implementation elements of the Plan shall be presented to the Board of Selectmen by the Emergency Management Director.

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of the Town of Oxford this 2nd day of July, 2014.

George R. Temple, First Selectman

APPENDIX C
MITIGATION WORKSHEET FOR SUGGESTED ACTIONS

Mitigation Action Progress Report Form

Progress Report Period	From Date:	To Date:
Action/Project Title		
Responsible Agency		
Contact Name		
Contact Phone/Email		
Project Status	❏ Project completed ❏ Project canceled ❏ Project on schedule ❏ Anticipated completion date:________ ❏ Project delayed Explain ________	

Summary of Project Progress for this Report Period

1. What was accomplished for this project during this reporting period?

2. What obstacles, problems, or delays did the project encounter?

3. If uncompleted, is the project still relevant? Should the project be changed or revised?

4. Other comments

APPENDIX D (ON COMPACT DISC)
HAZUS-MH SOFTWARE OUTPUT

Hazus-MH: Flood Event Report

Region Name:	Oxford
Flood Scenario:	100-Year - Eightmile Brook
Print Date:	Thursday, August 01, 2013

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

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). 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 flood loss estimates provided in this report were based on a region that included 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 33 square miles and contains 172 census blocks. The region contains over 3 thousand households and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 4,080 buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 89.61% of the buildings (and 73.68% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religion	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	34,459	88.0%
Commercial	2,553	6.5%
Industrial	1,704	4.4%
Agricultural	304	0.8%
Religion	133	0.3%
Government	0	0.0%
Education	0	0.0%
Total	**39,153**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 3 schools, 3 fire stations, 1 police station and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Oxford
Scenario Name:	100-Year - Eightmile Brook
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

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 scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

	1-10		11-20		21-30		31-40		41-50		Substantially	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	3	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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, Finishes comprises 47% of the total, Structure comprises 31% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 1 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 0 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.09 million dollars, which represents 0.22 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.09 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 80.68% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.05	0.00	0.00	0.00	0.05
	Content	0.02	0.01	0.00	0.00	0.04
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.07**	**0.02**	**0.00**	**0.00**	**0.09**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.07**	**0.02**	**0.00**	**0.00**	**0.09**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Total Study Region	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Flood Event Report

Region Name: Oxford

Flood Scenario: 100- Year - Fivemile Brook

Print Date: Thursday, August 01, 2013

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

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General Description of the Region

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Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

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Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religion	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	43,000	88.1%
Commercial	4,164	8.5%
Industrial	882	1.8%
Agricultural	65	0.1%
Religion	706	1.4%
Government	0	0.0%
Education	0	0.0%
Total	**48,817**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 3 schools, 3 fire stations, 1 police station and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Oxford
Scenario Name:	100- Year - Fivemile Brook
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

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 scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

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	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	3	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 2 tons of debris will be generated. Of the total amount, Finishes comprises 43% of the total, Structure comprises 34% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 0 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 0 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.01 million dollars, which represents 0.03 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.01 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 100.00% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.01	0.00	0.00	0.00	0.01
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.01**	**0.00**	**0.00**	**0.00**	**0.01**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.01**	**0.00**	**0.00**	**0.00**	**0.01**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Total Study Region	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Flood Event Report

Region Name: Oxford

Flood Scenario: 100-Year - Housatonic River

Print Date: Thursday, August 01, 2013

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

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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 (FEMA) and the National Institute of Building Sciences (NIBS). 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 flood loss estimates provided in this report were based on a region that included 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 33 square miles and contains 172 census blocks. The region contains over 3 thousand households and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 4,080 buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 89.61% of the buildings (and 73.68% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religion	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	86,816	89.2%
Commercial	7,366	7.6%
Industrial	2,258	2.3%
Agricultural	195	0.2%
Religion	706	0.7%
Government	0	0.0%
Education	0	0.0%
Total	**97,341**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 3 schools, 3 fire stations, 1 police station and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Oxford
Scenario Name:	100-Year - Housatonic River
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 23 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the scenario. There are an estimated 20 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	3	13.04	20	86.96
Total	**0**		**0**		**0**		**0**		**3**		**20**	

Table 4: Expected Building Damage by Building Type

	1-10		11-20		21-30		31-40		41-50		Substantially	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	3	13.04	20	86.96

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	3	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 1,544 tons of debris will be generated. Of the total amount, Finishes comprises 22% of the total, Structure comprises 44% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 62 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 31 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 41 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 8.56 million dollars, which represents 8.80 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 8.56 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 92.64% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	5.43	0.18	0.07	0.00	5.69
	Content	2.50	0.26	0.09	0.01	2.85
	Inventory	0.00	0.01	0.01	0.00	0.02
	Subtotal	**7.93**	**0.45**	**0.18**	**0.01**	**8.56**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**7.93**	**0.45**	**0.18**	**0.01**	**8.56**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Total Study Region	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Flood Event Report

Region Name: Oxford

Flood Scenario: 100-Year - Little River

Print Date: Thursday, August 01, 2013

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

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The flood loss estimates provided in this report were based on a region that included 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 33 square miles and contains 172 census blocks. The region contains over 3 thousand households and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 4,080 buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 89.61% of the buildings (and 73.68% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religion	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	144,384	57.5%
Commercial	77,822	31.0%
Industrial	18,460	7.4%
Agricultural	2,261	0.9%
Religion	4,827	1.9%
Government	2,561	1.0%
Education	810	0.3%
Total	**251,125**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 3 schools, 3 fire stations, 1 police station and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Oxford
Scenario Name:	100-Year - Little River
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

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 scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building	1-10		11-20		21-30		31-40		41-50		Substantially	
Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	3	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 111 tons of debris will be generated. Of the total amount, Finishes comprises 68% of the total, Structure comprises 18% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 4 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 28 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 6 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 4.87 million dollars, which represents 1.94 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 4.83 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 17.90% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.59	0.65	0.10	0.09	1.43
	Content	0.29	2.32	0.20	0.53	3.34
	Inventory	0.00	0.02	0.03	0.01	0.06
	Subtotal	**0.87**	**3.00**	**0.34**	**0.62**	**4.83**
Business Interruption						
	Income	0.00	0.01	0.00	0.00	0.01
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.01	0.00	0.03	0.03
	Subtotal	**0.00**	**0.02**	**0.00**	**0.03**	**0.04**
ALL	**Total**	**0.87**	**3.02**	**0.34**	**0.65**	**4.87**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Total Study Region	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Flood Event Report

Region Name: Oxford

Flood Scenario: 100-Year - Riggs Street Brook

Print Date: Thursday, August 01, 2013

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

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The flood loss estimates provided in this report were based on a region that included 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 33 square miles and contains 172 census blocks. The region contains over 3 thousand households and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 4,080 buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 89.61% of the buildings (and 73.68% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religion	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	56,754	90.7%
Commercial	3,937	6.3%
Industrial	1,235	2.0%
Agricultural	243	0.4%
Religion	406	0.6%
Government	0	0.0%
Education	0	0.0%
Total	**62,575**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are 3 schools, 3 fire stations, 1 police station and no emergency operation centers.

Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	Oxford
Scenario Name:	100-Year - Riggs Street Brook
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

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 scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**0**		**0**		**0**		**0**		**0**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	3	0	0	0
Hospitals	0	0	0	0
Police Stations	1	0	0	0
Schools	3	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 4 tons of debris will be generated. Of the total amount, Finishes comprises 100% of the total, Structure comprises 0% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 5 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 0.08 million dollars, which represents 0.13 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 0.08 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 89.29% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	0.05	0.00	0.00	0.00	0.05
	Content	0.02	0.00	0.00	0.00	0.03
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.08**	**0.00**	**0.00**	**0.00**	**0.08**
Business Interruption						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.00	0.00	0.00	0.00	0.00
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
ALL	**Total**	**0.08**	**0.00**	**0.00**	**0.00**	**0.08**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Total Study Region	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Thursday, July 18, 2013

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 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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:	UN-NAMED-1938-4
Type:	Historic
Max Peak Gust in Study Region:	105 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 88 buildings will be at least moderately damaged. This is over 2% of the total number of buildings in the region. There are an estimated 2 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	25	81.95	4	13.12	1	3.21	0	1.56	0	0.15
Commercial	226	86.52	28	10.77	6	2.35	1	0.35	0	0.00
Education	4	87.74	1	10.59	0	1.60	0	0.08	0	0.00
Government	5	89.44	1	9.33	0	1.19	0	0.04	0	0.00
Industrial	94	87.49	11	10.24	2	1.92	0	0.33	0	0.02
Religion	12	86.65	2	11.84	0	1.44	0	0.07	0	0.00
Residential	2,990	81.77	590	16.14	72	1.97	3	0.08	2	0.04
Total	**3,356**		**636**		**82**		**5**		**2**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	15	88.01	2	10.12	0	1.79	0	0.08	0	0.00
Masonry	164	83.46	25	12.78	6	3.22	1	0.48	0	0.05
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	159	88.05	17	9.34	4	2.18	1	0.42	0	0.00
Wood	2,750	81.92	541	16.12	62	1.84	2	0.07	1	0.04

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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	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 four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 23,392 tons of debris will be generated. Of the total amount, 18,602 tons (80%) is Other Tree Debris. Of the remaining 4,791 tons, Brick/Wood comprises 28% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 53 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 3,455 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 14.3 million dollars, which represents 1.55 % 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 14 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 85% 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
Property Damage						
	Building	9,265.12	769.40	263.59	121.84	10,419.95
	Content	2,391.96	161.84	132.96	31.09	2,717.84
	Inventory	0.00	3.77	23.20	2.67	29.65
	Subtotal	**11,657.09**	**935.01**	**419.75**	**155.60**	**13,167.44**
Business Interruption Loss						
	Income	0.00	151.46	4.36	11.98	167.80
	Relocation	353.85	135.79	18.33	22.04	530.01
	Rental	142.77	84.03	3.38	1.91	232.10
	Wage	0.00	114.99	7.44	85.39	207.83
	Subtotal	**496.63**	**486.27**	**33.52**	**121.31**	**1,137.74**
Total						
	Total	**12,153.71**	**1,421.29**	**453.27**	**276.91**	**14,305.18**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

School Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	0.00
Total	**3**	**0.00**
Study Region	**3**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Police Station Facility Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Fire Station Facility Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Debris Summary Report:

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	1,336	0	3,455	18,602	23,392
Total	**1,336**	**0**	**3,455**	**18,602**	**23,392**
Study Region Total	**1,336**	**0**	**3,455**	**18,602**	**23,392**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : Oxford
Scenario : UN-NAMED-1938-4

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: GLORIA

Print Date: Thursday, July 18, 2013

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 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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:	GLORIA
Type:	Historic
Max Peak Gust in Study Region:	75 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	31	99.49	0	0.49	0	0.02	0	0.00	0	0.00
Commercial	259	99.41	1	0.57	0	0.02	0	0.00	0	0.00
Education	5	99.42	0	0.58	0	0.00	0	0.00	0	0.00
Government	6	99.42	0	0.59	0	0.00	0	0.00	0	0.00
Industrial	106	99.40	1	0.60	0	0.00	0	0.00	0	0.00
Religion	14	99.53	0	0.46	0	0.01	0	0.00	0	0.00
Residential	3,647	99.75	9	0.25	0	0.00	0	0.00	0	0.00
Total	**4,068**		**11**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	17	99.35	0	0.65	0	0.00	0	0.00	0	0.00
Masonry	195	99.33	1	0.63	0	0.03	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	180	99.38	1	0.61	0	0.01	0	0.00	0	0.00
Wood	3,349	99.77	7	0.22	0	0.01	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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 571 tons of debris will be generated. Of the total amount, 458 tons (80%) is Other Tree Debris. Of the remaining 113 tons, Brick/Wood comprises 35% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible 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 building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 73 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.8 million dollars, which represents 0.09 % 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. 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 96% 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
Property Damage						
	Building	682.26	26.73	5.55	3.25	717.78
	Content	96.53	0.00	0.00	0.00	96.53
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**778.79**	**26.73**	**5.55**	**3.25**	**814.32**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.58	0.21	0.00	0.01	0.80
	Rental	0.75	0.00	0.00	0.00	0.75
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1.33**	**0.21**	**0.00**	**0.01**	**1.56**
Total						
	Total	**780.12**	**26.93**	**5.56**	**3.26**	**815.87**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

School Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Police Station Facility Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Fire Station Facility Functionality:

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Debris Summary Report:

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	40	0	73	458	571
Total	**40**	**0**	**73**	**458**	**571**
Study Region Total	**40**	**0**	**73**	**458**	**571**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : Oxford
Scenario : GLORIA

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Thursday, July 18, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

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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 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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 : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	31	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	261	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	6	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	107	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	14	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	3,656	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**4,080**		**0**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building	None		Minor		Moderate		Severe		Destruction	
Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	17	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	196	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	181	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	3,357	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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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, 0 tons (0%) is Other Tree Debris. Of the remaining 0 tons, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible 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 building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 0 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) 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.

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 0% 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
Property Damage						
	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
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Business Interruption Loss						
	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
	Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total						
	Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Thursday, July 18, 2013

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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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 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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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Occupancy	Exposure ($1000)	Percent of Tot
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Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	31	99.84	0	0.16	0	0.00	0	0.00	0	0.00
Commercial	260	99.79	1	0.21	0	0.00	0	0.00	0	0.00
Education	5	99.78	0	0.22	0	0.00	0	0.00	0	0.00
Government	6	99.77	0	0.23	0	0.00	0	0.00	0	0.00
Industrial	107	99.77	0	0.23	0	0.00	0	0.00	0	0.00
Religion	14	99.82	0	0.18	0	0.00	0	0.00	0	0.00
Residential	3,656	99.99	0	0.01	0	0.00	0	0.00	0	0.00
Total	**4,079**		**1**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 20 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	17	99.74	0	0.26	0	0.00	0	0.00	0	0.00
Masonry	196	99.80	0	0.19	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	181	99.76	0	0.24	0	0.00	0	0.00	0	0.00
Wood	3,357	99.99	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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 81 tons of debris will be generated. Of the total amount, 70 tons (86%) is Other Tree Debris. Of the remaining 11 tons, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible 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 building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 11 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) 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.

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 100% 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
Property Damage						
	Building	20.04	0.00	0.00	0.00	20.04
	Content	16.96	0.00	0.00	0.00	16.96
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**37.00**	**0.00**	**0.00**	**0.00**	**37.00**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.03	0.00	0.00	0.00	0.03
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.03**	**0.00**	**0.00**	**0.00**	**0.03**
Total						
	Total	**37.03**	**0.00**	**0.00**	**0.00**	**37.03**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Thursday, July 18, 2013

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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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.

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There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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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Occupancy	Exposure ($1000)	Percent of Tot
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Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	31	99.33	0	0.64	0	0.03	0	0.00	0	0.00
Commercial	259	99.28	2	0.69	0	0.03	0	0.00	0	0.00
Education	5	99.30	0	0.70	0	0.00	0	0.00	0	0.00
Government	6	99.30	0	0.70	0	0.00	0	0.00	0	0.00
Industrial	106	99.25	1	0.74	0	0.01	0	0.00	0	0.00
Religion	14	99.45	0	0.54	0	0.01	0	0.00	0	0.00
Residential	3,642	99.61	14	0.38	0	0.01	0	0.00	0	0.00
Total	**4,063**		**17**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 50 - year Event

Building	None		Minor		Moderate		Severe		Destruction	
Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	17	99.21	0	0.79	0	0.00	0	0.00	0	0.00
Masonry	194	99.14	2	0.81	0	0.05	0	0.00	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	180	99.25	1	0.73	0	0.02	0	0.00	0	0.00
Wood	3,345	99.64	12	0.36	0	0.01	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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 715 tons of debris will be generated. Of the total amount, 571 tons (80%) is Other Tree Debris. Of the remaining 144 tons, Brick/Wood comprises 37% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible 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 building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 90 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 1.0 million dollars, which represents 0.11 % 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. 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 96% 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
Property Damage						
	Building	843.60	33.36	7.29	3.78	888.04
	Content	143.46	0.00	0.00	0.00	143.46
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**987.06**	**33.36**	**7.29**	**3.78**	**1,031.50**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.82	0.41	0.01	0.02	1.27
	Rental	1.05	0.00	0.00	0.00	1.05
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1.88**	**0.41**	**0.01**	**0.02**	**2.33**
Total						
	Total	**988.94**	**33.78**	**7.31**	**3.81**	**1,033.82**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: Probabilistic 100-year Return Period

Print Date: Thursday, July 18, 2013

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

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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 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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 7 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	30	96.57	1	2.88	0	0.40	0	0.15	0	0.00
Commercial	254	97.36	6	2.36	1	0.27	0	0.02	0	0.00
Education	5	97.63	0	2.30	0	0.06	0	0.00	0	0.00
Government	6	97.88	0	2.08	0	0.04	0	0.00	0	0.00
Industrial	104	97.55	2	2.32	0	0.11	0	0.02	0	0.00
Religion	14	97.62	0	2.31	0	0.06	0	0.01	0	0.00
Residential	3,523	96.37	127	3.47	6	0.15	0	0.00	0	0.00
Total	**3,936**		**137**		**7**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	17	97.61	0	2.34	0	0.05	0	0.00	0	0.00
Masonry	189	96.30	6	3.22	1	0.44	0	0.04	0	0.00
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	177	97.61	4	2.17	0	0.20	0	0.02	0	0.00
Wood	3,239	96.48	114	3.39	4	0.13	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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 13,057 tons of debris will be generated. Of the total amount, 10,770 tons (82%) is Other Tree Debris. Of the remaining 2,287 tons, Brick/Wood comprises 13% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 12 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 1,986 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 3.8 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 4 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 92% 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
Property Damage						
	Building	2,934.93	150.45	35.92	19.57	3,140.87
	Content	465.72	20.38	7.66	2.53	496.30
	Inventory	0.00	0.38	1.39	0.20	1.97
	Subtotal	**3,400.65**	**171.22**	**44.97**	**22.30**	**3,639.14**
Business Interruption Loss						
	Income	0.00	22.68	0.39	2.96	26.03
	Relocation	87.53	16.22	1.53	1.92	107.20
	Rental	40.87	10.38	0.39	0.18	51.81
	Wage	0.00	8.06	0.65	6.96	15.67
	Subtotal	**128.40**	**57.34**	**2.96**	**12.02**	**200.71**
Total						
	Total	**3,529.05**	**228.55**	**47.93**	**34.32**	**3,839.86**

Appendix A: County Listing for the Region

Connecticut
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name:	Oxford
Hurricane Scenario:	Probabilistic 200-year Return Period
Print Date:	Thursday, July 18, 2013

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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):

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Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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 42 buildings will be at least moderately damaged. This is over 1% 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 : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	27	88.32	3	8.90	1	1.86	0	0.85	0	0.07
Commercial	239	91.55	18	7.08	3	1.21	0	0.16	0	0.00
Education	5	92.48	0	6.88	0	0.62	0	0.02	0	0.00
Government	6	93.54	0	6.03	0	0.43	0	0.01	0	0.00
Industrial	99	92.21	7	6.77	1	0.85	0	0.16	0	0.01
Religion	13	91.96	1	7.47	0	0.54	0	0.03	0	0.00
Residential	3,218	88.02	401	10.97	36	0.98	1	0.02	0	0.01
Total	**3,606**		**431**		**40**		**1**		**1**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	16	92.63	1	6.66	0	0.69	0	0.02	0	0.00
Masonry	175	89.07	17	8.82	4	1.83	1	0.26	0	0.02
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	168	92.62	11	6.14	2	1.06	0	0.19	0	0.00
Wood	2,960	88.16	367	10.92	30	0.89	1	0.02	0	0.01

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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 17,355 tons of debris will be generated. Of the total amount, 13,946 tons (80%) is Other Tree Debris. Of the remaining 3,409 tons, Brick/Wood comprises 25% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 34 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 2,551 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 9.2 million dollars, which represents 1.00 % 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.

The total property damage losses were 9 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 87% 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
Property Damage						
	Building	6,312.29	456.62	144.93	68.93	6,982.77
	Content	1,414.03	75.39	63.31	15.80	1,568.53
	Inventory	0.00	1.74	11.35	1.35	14.44
	Subtotal	**7,726.32**	**533.74**	**219.59**	**86.08**	**8,565.73**
Business Interruption Loss						
	Income	0.00	86.26	1.98	6.79	95.03
	Relocation	207.80	74.15	7.55	10.79	300.30
	Rental	91.41	46.16	1.39	0.96	139.91
	Wage	0.00	67.43	3.39	46.22	117.04
	Subtotal	**299.22**	**273.99**	**14.30**	**64.76**	**652.27**
Total						
	Total	**8,025.53**	**807.74**	**233.89**	**150.84**	**9,218.00**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name:	Oxford
Hurricane Scenario:	Probabilistic 500-year Return Period
Print Date:	Thursday, July 18, 2013

Disclaimer:
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- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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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Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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 242 buildings will be at least moderately damaged. This is over 6% of the total number of buildings in the region. There are an estimated 10 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	21	67.60	7	21.41	2	7.08	1	3.42	0	0.49
Commercial	192	73.63	49	18.62	17	6.63	3	1.12	0	0.01
Education	4	75.08	1	18.57	0	5.84	0	0.51	0	0.00
Government	5	77.81	1	17.01	0	4.87	0	0.32	0	0.00
Industrial	80	74.79	19	17.80	7	6.25	1	1.09	0	0.08
Religion	10	73.82	3	20.60	1	5.18	0	0.41	0	0.00
Residential	2,506	68.54	942	25.76	183	5.00	16	0.45	10	0.26
Total	**2,818**		**1,021**		**210**		**22**		**10**	

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	75.27	3	17.68	1	6.43	0	0.62	0	0.00
Masonry	138	70.49	40	20.46	15	7.55	3	1.29	0	0.21
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	137	75.56	30	16.42	12	6.63	2	1.37	0	0.01
Wood	2,304	68.64	870	25.90	161	4.78	14	0.43	8	0.25

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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	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 four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 48,790 tons of debris will be generated. Of the total amount, 38,843 tons (80%) is Other Tree Debris. Of the remaining 9,947 tons, Brick/Wood comprises 27% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 107 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 7,261 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 31.4 million dollars, which represents 3.41 % 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 31 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 83% 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
Property Damage						
	Building	18,335.45	1,794.74	680.24	281.99	21,092.42
	Content	6,210.90	514.92	401.98	92.20	7,220.00
	Inventory	0.00	12.13	67.84	6.94	86.92
	Subtotal	**24,546.35**	**2,321.79**	**1,150.07**	**381.13**	**28,399.34**
Business Interruption Loss						
	Income	0.00	261.03	9.56	19.46	290.05
	Relocation	1,230.34	329.67	54.45	52.66	1,667.12
	Rental	423.40	196.58	8.46	4.12	632.56
	Wage	0.00	208.46	16.29	169.94	394.69
	Subtotal	**1,653.73**	**995.74**	**88.76**	**246.19**	**2,984.42**
Total						
	Total	**26,200.08**	**3,317.54**	**1,238.82**	**627.32**	**31,383.76**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

Hazus-MH: Hurricane Event Report

Region Name: Oxford

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Thursday, July 18, 2013

Disclaimer:
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- Connecticut

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 33.35 square miles and contains 2 census tracts. There are over 3 thousand households in the region and has a total population of 9,821 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 921 million dollars (2006 dollars). Approximately 90% of the buildings (and 74% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 4,080 buildings in the region which have an aggregate total replacement value of 921 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

Occupancy	Exposure ($1000)	Percent of Tot
Residential	678,534	73.7%
Commercial	164,676	17.9%
Industrial	54,103	5.9%
Agricultural	5,384	0.6%
Religious	8,845	1.0%
Government	4,756	0.5%
Education	4,645	0.5%
Total	**920,943**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are 3 schools, 3 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 560 buildings will be at least moderately damaged. This is over 14% of the total number of buildings in the region. There are an estimated 40 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

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	15	48.96	9	29.58	4	13.58	2	6.62	0	1.26
Commercial	143	54.92	68	26.04	40	15.48	9	3.52	0	0.03
Education	3	56.11	1	26.04	1	15.19	0	2.66	0	0.00
Government	4	59.32	1	24.74	1	13.93	0	2.01	0	0.00
Industrial	60	55.94	26	24.75	17	15.45	4	3.67	0	0.21
Religion	8	55.55	4	29.25	2	13.17	0	2.03	0	0.00
Residential	1,896	51.86	1,281	35.05	377	10.30	63	1.72	39	1.07
Total	**2,128**		**1,392**		**441**		**78**		**40**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	10	56.03	4	24.25	3	16.53	1	3.19	0	0.00
Masonry	104	53.10	54	27.42	30	15.38	7	3.41	1	0.69
MH	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	103	56.70	41	22.76	29	16.11	8	4.38	0	0.05
Wood	1,741	51.85	1,191	35.48	336	10.01	55	1.64	34	1.03

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

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
Fire Stations	3	0	0	3
Police Stations	1	0	0	1
Schools	3	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 four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. 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 91,197 tons of debris will be generated. Of the total amount, 72,283 tons (79%) is Other Tree Debris. Of the remaining 18,914 tons, Brick/Wood comprises 29% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 218 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 13,457 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

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 10 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 9,821) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 69.8 million dollars, which represents 7.58 % 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 70 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 83% 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
Property Damage						
	Building	38,115.07	4,141.92	1,605.78	617.33	44,480.10
	Content	15,238.87	1,557.00	1,052.16	240.87	18,088.89
	Inventory	0.00	33.32	170.70	15.07	219.09
	Subtotal	**53,353.94**	**5,732.25**	**2,828.64**	**873.26**	**62,788.09**
Business Interruption Loss						
	Income	0.87	259.38	18.95	17.47	296.68
	Relocation	3,621.78	776.50	134.76	119.58	4,652.63
	Rental	1,175.29	463.77	18.86	9.98	1,667.90
	Wage	2.05	216.33	31.83	149.15	399.35
	Subtotal	**4,799.99**	**1,715.98**	**204.40**	**296.19**	**7,016.55**
Total						
	Total	**58,153.93**	**7,448.22**	**3,033.04**	**1,169.45**	**69,804.64**

Appendix A: County Listing for the Region

Connecticut

- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
New Haven	9,821	678,534	242,409	920,943
Total	**9,821**	**678,534**	**242,409**	**920,943**
Study Region Total	**9,821**	**678,534**	**242,409**	**920,943**

School Functionality: 10 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

School Functionality: 20 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

School Functionality: 50 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

School Functionality: 100 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

School Functionality: 200 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region	**3**	**100.00**

School Functionality: 500 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	0.00
Total	**3**	**0.00**
Study Region	**3**	**0.00**

School Functionality: 1000 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	0.00
Total	**3**	**0.00**
Study Region	**3**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Police Station Facility Functionality: 10 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 20 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 50 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 100 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 200 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 500 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Police Station Facility Functionality: 1000 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	1	100.00
Total	**1**	**100.00**
Study Region Total	**1**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Fire Station Facility Functionality: 10 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 20 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 50 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 100 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 200 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 500 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Fire Station Facility Functionality: 1000 - year Event

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	100.00
Total	**3**	**100.00**
Study Region Total	**3**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Debris Summary Report: 10 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
Study Region Total	**0**	**0**	**0**	**0**	**0**

Debris Summary Report: 20 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	0	0	11	70	81
Total	**0**	**0**	**11**	**70**	**81**
Study Region Total	**0**	**0**	**11**	**70**	**81**

Debris Summary Report: 50 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	54	0	90	571	715
Total	**54**	**0**	**90**	**571**	**715**
Study Region Total	**54**	**0**	**90**	**571**	**715**

Debris Summary Report: 100 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	301	0	1,986	10,770	13,057
Total	**301**	**0**	**1,986**	**10,770**	**13,057**
Study Region Total	**301**	**0**	**1,986**	**10,770**	**13,057**

Debris Summary Report: 200 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	858	0	2,551	13,946	17,355
Total	**858**	**0**	**2,551**	**13,946**	**17,355**
Study Region Total	**858**	**0**	**2,551**	**13,946**	**17,355**

Debris Summary Report: 500 - year Event

July 18, 2013

All values are in tons.

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	2,685	1	7,261	38,843	48,790
Total	**2,685**	**1**	**7,261**	**38,843**	**48,790**
Study Region Total	**2,685**	**1**	**7,261**	**38,843**	**48,790**

Debris Summary Report: 1000 - year Event

July 18, 2013 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
New Haven	5,422	35	13,457	72,283	91,197
Total	**5,422**	**35**	**13,457**	**72,283**	**91,197**
Study Region Total	**5,422**	**35**	**13,457**	**72,283**	**91,197**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Hazus-MH: Earthquake Event Report

Region Name: Oxford

Earthquake Scenario: East Haddam 6.4

Print Date: September 16, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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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 33.34 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,821 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 920 (millions of dollars). Approximately 90.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 255 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 920 (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 84% 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 facilities (HPL). 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 3 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 7 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 0 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 255.00 (millions of dollars). This inventory includes over 28 kilometers of highways, 23 bridges, 402 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	23	55.00
	Segments	7	151.80
	Tunnels	0	0.00
		Subtotal	**206.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	1	38.00
		Subtotal	**48.60**
		Total	**255.40**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.00**
Waste Water	Distribution Lines	NA	2.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.40**
Natural Gas	Distribution Lines	NA	1.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.60**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**8.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	East Haddam 6.4
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.40
Latitude of Epicenter	41.50
Earthquake Magnitude	6.40
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 172 buildings will be at least moderately damaged. This is over 4.00 % of the buildings in the region. There are an estimated 1 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	(%)
Agriculture	24	0.69	5	0.92	2	1.48	0	2.26	0	2.25
Commercial	195	5.73	39	7.61	23	14.91	4	22.12	1	27.32
Education	4	0.11	1	0.14	0	0.28	0	0.38	0	0.56
Government	4	0.13	1	0.17	1	0.37	0	0.50	0	0.70
Industrial	79	2.31	16	3.12	10	6.82	2	9.80	0	12.64
Other Residential	382	11.24	60	11.77	24	15.70	4	19.97	0	20.55
Religion	11	0.32	2	0.37	1	0.63	0	0.95	0	1.15
Single Family	2,699	79.45	388	75.90	91	59.80	8	44.02	1	34.83
Total	**3,397**		**511**		**152**		**19**		**2**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,920	85.97	414	81.02	88	58.21	6	32.32	0	15.09
Steel	148	4.36	32	6.22	23	15.16	4	21.52	1	29.45
Concrete	32	0.94	6	1.19	4	2.83	0	2.52	0	2.80
Precast	9	0.26	1	0.26	1	0.79	0	1.80	0	0.35
RM	60	1.78	7	1.27	5	3.51	1	5.92	0	0.64
URM	222	6.53	50	9.76	29	18.83	7	35.25	1	51.42
MH	5	0.16	1	0.27	1	0.66	0	0.67	0	0.25
Total	**3,397**		**511**		**152**		**19**		**2**	

*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

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	3	0	0	3

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	With Functionality > 50 % After Day 7
Highway	Segments	7	0	0	7	7
	Bridges	23	0	0	23	23
	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	1	0	0	1	1
	Runways	1	0	0	1	1

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	201	12	3
Waste Water	121	6	1
Natural Gas	80	2	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	3,343	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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 56.00% 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 120 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 2 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 9,821) 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	2	0	0	0
	Total	**2**	**0**	**0**	**0**
2 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	1	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	**2**	**0**	**0**	**0**
5 PM	Commercial	1	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	1	0	0	0
	Total	**2**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 17.35 (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 16.10 (millions of dollars); 22 % 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 50 % 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
Income Losses							
	Wage	0.00	0.01	0.77	0.04	0.04	0.85
	Capital-Related	0.00	0.00	0.85	0.02	0.00	0.89
	Rental	0.12	0.05	0.38	0.01	0.01	0.58
	Relocation	0.45	0.03	0.50	0.08	0.08	1.15
	Subtotal	**0.57**	**0.10**	**2.51**	**0.15**	**0.13**	**3.47**
Capital Stock Losses							
	Structural	1.05	0.05	0.65	0.20	0.11	2.07
	Non_Structural	4.57	0.28	1.93	0.61	0.25	7.64
	Content	1.42	0.07	0.86	0.35	0.13	2.83
	Inventory	0.00	0.00	0.02	0.07	0.00	0.09
	Subtotal	**7.05**	**0.40**	**3.45**	**1.24**	**0.49**	**12.63**
	Total	**7.62**	**0.50**	**5.96**	**1.39**	**0.62**	**16.10**

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	151.77	$0.00	0.00
	Bridges	55.00	$0.36	0.66
	Tunnels	0.00	$0.00	0.00
	Subtotal	**206.80**	**0.40**	
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	**0.00**	**0.00**	
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	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	10.65	$0.80	7.53
	Runways	37.96	$0.00	0.00
	Subtotal	**48.60**	**0.80**	
	Total	**255.40**	**1.20**	

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	4.00	$0.05	1.29
	Subtotal	**4.02**	**$0.05**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.40	$0.03	1.08
	Subtotal	**2.41**	**$0.03**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.60	$0.01	0.55
	Subtotal	**1.61**	**$0.01**	
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	**8.04**	**$0.09**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	9,821	678	242	920
Total State		**9,821**	**678**	**242**	**920**
Total Region		**9,821**	**678**	**242**	**920**

School Functionality

September 16, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	63.90
Total	**3**	**63.90**
Region Total	**3**	**63.90**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Police Station Facilities Functionality

September 16, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	1	62.70
Total	**1**	**62.70**
Region Total	**1**	**62.70**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Fire Station Facilities Functionality

September 16, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	3	64.70
Total	**3**	**64.70**
Region Total	**3**	**64.70**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Hazus-MH: Earthquake Event Report

Region Name: Oxford

Earthquake Scenario: Haddam 5.7

Print Date: July 18, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

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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 33.34 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,821 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 920 (millions of dollars). Approximately 90.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 255 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 920 (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 84% 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 facilities (HPL). 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 3 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 7 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 0 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 255.00 (millions of dollars). This inventory includes over 28 kilometers of highways, 23 bridges, 402 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	23	55.00
	Segments	7	151.80
	Tunnels	0	0.00
		Subtotal	**206.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	1	38.00
		Subtotal	**48.60**
		Total	**255.40**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.00**
Waste Water	Distribution Lines	NA	2.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.40**
Natural Gas	Distribution Lines	NA	1.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.60**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**8.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Haddam 5.7
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.55
Latitude of Epicenter	41.47
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 72 buildings will be at least moderately damaged. This is over 2.00 % of the 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	(%)
Agriculture	28	0.74	2	0.87	1	1.32	0	1.86	0	1.53
Commercial	230	6.17	21	7.46	9	13.53	1	18.68	0	20.30
Education	4	0.12	0	0.14	0	0.25	0	0.31	0	0.42
Government	5	0.14	0	0.17	0	0.31	0	0.37	0	0.44
Industrial	94	2.53	8	3.00	4	5.77	0	7.21	0	7.91
Other Residential	422	11.33	35	12.41	11	17.29	2	22.68	0	25.43
Religion	12	0.33	1	0.40	0	0.70	0	1.07	0	1.30
Single Family	2,930	78.64	213	75.54	39	60.82	3	47.82	0	42.66
Total	**3,726**		**281**		**65**		**7**		**1**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,167	85.00	223	79.16	36	55.94	2	30.91	0	14.15
Steel	183	4.92	16	5.69	7	11.39	1	12.25	0	13.07
Concrete	38	1.02	3	1.11	1	2.11	0	1.21	0	1.30
Precast	10	0.27	1	0.29	1	0.93	0	2.05	0	0.24
RM	67	1.79	4	1.39	3	3.92	0	5.98	0	0.23
URM	254	6.83	34	12.03	16	24.97	3	47.09	0	70.94
MH	7	0.18	1	0.33	0	0.74	0	0.51	0	0.07
Total	**3,726**		**281**		**65**		**7**		**1**	

*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

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	3	0	0	3

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	7	0	0	7	7
	Bridges	23	0	0	23	23
	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	1	0	0	1	1
	Runways	1	0	0	1	1

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	201	3	1
Waste Water	121	2	0
Natural Gas	80	1	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	3,343	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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 67.00% 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 40 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 1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 9,821) 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	1	0	0	0
	Total	**1**	**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	**1**	**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	**1**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 7.27 (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 6.67 (millions of dollars); 19 % 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 54 % 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
Income Losses							
	Wage	0.00	0.00	0.26	0.01	0.02	0.29
	Capital-Related	0.00	0.00	0.29	0.01	0.00	0.30
	Rental	0.05	0.02	0.14	0.00	0.00	0.23
	Relocation	0.19	0.02	0.18	0.03	0.03	0.44
	Subtotal	**0.24**	**0.04**	**0.87**	**0.05**	**0.05**	**1.25**
Capital Stock Losses							
	Structural	0.49	0.02	0.23	0.07	0.04	0.85
	Non_Structural	2.05	0.12	0.78	0.26	0.10	3.31
	Content	0.60	0.03	0.38	0.15	0.06	1.22
	Inventory	0.00	0.00	0.01	0.03	0.00	0.04
	Subtotal	**3.13**	**0.18**	**1.39**	**0.51**	**0.20**	**5.41**
	Total	**3.38**	**0.22**	**2.26**	**0.56**	**0.25**	**6.67**

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	151.77	$0.00	0.00
	Bridges	55.00	$0.04	0.08
	Tunnels	0.00	$0.00	0.00
	Subtotal	**206.80**	**0.00**	
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	**0.00**	**0.00**	
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	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	10.65	$0.53	4.96
	Runways	37.96	$0.00	0.00
	Subtotal	**48.60**	**0.50**	
	Total	**255.40**	**0.60**	

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	4.00	$0.01	0.37
	Subtotal	**4.02**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.40	$0.01	0.31
	Subtotal	**2.41**	**$0.01**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.60	$0.00	0.16
	Subtotal	**1.61**	**$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	**8.04**	**$0.02**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	9,821	678	242	920
Total State		**9,821**	**678**	**242**	**920**
Total Region		**9,821**	**678**	**242**	**920**

School Functionality

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	75.20
Total	**3**	**75.20**
Region Total	**3**	**75.20**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Police Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	1	73.80
Total	**1**	**73.80**
Region Total	**1**	**73.80**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Fire Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	3	76.00
Total	**3**	**76.00**
Region Total	**3**	**76.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Hazus-MH: Earthquake Event Report

Region Name:	Oxford
Earthquake Scenario:	Portland 5.7
Print Date:	July 18, 2013

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.

Table of Contents

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 33.34 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,821 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 920 (millions of dollars). Approximately 90.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 255 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 920 (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 84% 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 facilities (HPL). 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 3 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 7 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 0 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 255.00 (millions of dollars). This inventory includes over 28 kilometers of highways, 23 bridges, 402 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	23	55.00
	Segments	7	151.80
	Tunnels	0	0.00
		Subtotal	**206.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	1	38.00
		Subtotal	**48.60**
		Total	**255.40**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.00**
Waste Water	Distribution Lines	NA	2.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.40**
Natural Gas	Distribution Lines	NA	1.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.60**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**8.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Portland 5.7
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.60
Latitude of Epicenter	41.60
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Hazus estimates that about 74 buildings will be at least moderately damaged. This is over 2.00 % of the 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	(%)
Agriculture	27	0.74	3	0.87	1	1.33	0	1.87	0	1.56
Commercial	229	6.16	22	7.49	9	13.64	1	18.77	0	20.75
Education	4	0.12	0	0.14	0	0.25	0	0.31	0	0.43
Government	5	0.14	0	0.17	0	0.31	0	0.37	0	0.46
Industrial	94	2.52	9	3.02	4	5.85	0	7.29	0	8.21
Other Residential	421	11.33	36	12.39	12	17.25	2	22.61	0	25.36
Religion	12	0.33	1	0.40	0	0.69	0	1.06	0	1.29
Single Family	2,924	78.66	218	75.52	41	60.67	3	47.72	0	41.94
Total	**3,718**		**288**		**67**		**7**		**1**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,161	85.02	228	79.20	37	55.88	2	30.95	0	13.38
Steel	182	4.91	17	5.74	8	11.59	1	12.45	0	13.63
Concrete	38	1.02	3	1.11	1	2.13	0	1.21	0	1.27
Precast	10	0.27	1	0.29	1	0.93	0	2.04	0	0.26
RM	66	1.79	4	1.38	3	3.91	0	5.97	0	0.22
URM	253	6.81	34	11.95	17	24.80	3	46.85	0	71.18
MH	7	0.18	1	0.33	1	0.75	0	0.53	0	0.06
Total	**3,718**		**288**		**67**		**7**		**1**	

*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

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	3	0	0	3

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	7	0	0	7	7
	Bridges	23	0	0	23	23
	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	1	0	0	1	1
	Runways	1	0	0	1	1

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	201	3	1
Waste Water	121	2	0
Natural Gas	80	1	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	3,343	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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 67.00% 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 40 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 1 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 9,821) 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	1	0	0	0
	Total	**1**	**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	**1**	**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	**1**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 7.59 (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 6.92 (millions of dollars); 19 % 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 54 % 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
Income Losses							
	Wage	0.00	0.00	0.27	0.01	0.02	0.30
	Capital-Related	0.00	0.00	0.30	0.01	0.00	0.31
	Rental	0.06	0.02	0.15	0.00	0.00	0.24
	Relocation	0.20	0.02	0.18	0.03	0.03	0.45
	Subtotal	**0.25**	**0.04**	**0.91**	**0.05**	**0.05**	**1.31**
Capital Stock Losses							
	Structural	0.50	0.02	0.24	0.07	0.04	0.88
	Non_Structural	2.11	0.13	0.82	0.27	0.11	3.43
	Content	0.62	0.03	0.39	0.16	0.06	1.27
	Inventory	0.00	0.00	0.01	0.03	0.00	0.04
	Subtotal	**3.23**	**0.18**	**1.46**	**0.53**	**0.21**	**5.62**
	Total	**3.49**	**0.23**	**2.36**	**0.59**	**0.26**	**6.92**

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	151.77	$0.00	0.00
	Bridges	55.00	$0.05	0.09
	Tunnels	0.00	$0.00	0.00
	Subtotal	**206.80**	**0.00**	
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	**0.00**	**0.00**	
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	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	10.65	$0.59	5.54
	Runways	37.96	$0.00	0.00
	Subtotal	**48.60**	**0.60**	
	Total	**255.40**	**0.60**	

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	4.00	$0.02	0.38
	Subtotal	**4.02**	**$0.02**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.40	$0.01	0.31
	Subtotal	**2.41**	**$0.01**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.60	$0.00	0.16
	Subtotal	**1.61**	**$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	**8.04**	**$0.03**	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	9,821	678	242	920
Total State		**9,821**	**678**	**242**	**920**
Total Region		**9,821**	**678**	**242**	**920**

School Functionality

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	74.80
Total	**3**	**74.80**
Region Total	**3**	**74.80**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Police Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	1	73.40
Total	**1**	**73.40**
Region Total	**1**	**73.40**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Fire Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	3	75.90
Total	**3**	**75.90**
Region Total	**3**	**75.90**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Hazus-MH: Earthquake Event Report

Region Name: Oxford

Earthquake Scenario: Stamford 5.7

Print Date: July 18, 2013

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.

Table of Contents

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 33.34 square miles and contains 2 census tracts. There are over 3 thousand households in the region which has a total population of 9,821 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 4 thousand buildings in the region with a total building replacement value (excluding contents) of 920 (millions of dollars). Approximately 90.00 % of the buildings (and 74.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 255 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 4 thousand buildings in the region which have an aggregate total replacement value of 920 (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 84% 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 facilities (HPL). 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 3 schools, 3 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 7 dams identified within the region. Of these, 3 of the dams are classified as 'high hazard'. The inventory also includes 0 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 255.00 (millions of dollars). This inventory includes over 28 kilometers of highways, 23 bridges, 402 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	23	55.00
	Segments	7	151.80
	Tunnels	0	0.00
		Subtotal	**206.80**
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	0	0.00
		Subtotal	**0.00**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	1	10.70
	Runways	1	38.00
		Subtotal	**48.60**
		Total	**255.40**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	4.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**4.00**
Waste Water	Distribution Lines	NA	2.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.40**
Natural Gas	Distribution Lines	NA	1.60
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.60**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	0	0.00
		Subtotal	**0.00**
		Total	**8.00**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Stamford 5.7
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.60
Latitude of Epicenter	41.15
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 66 buildings will be at least moderately damaged. This is over 2.00 % of the 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	(%)
Agriculture	28	0.74	2	0.89	1	1.36	0	1.89	0	1.51
Commercial	231	6.17	20	7.65	8	13.90	1	18.97	0	20.20
Education	4	0.12	0	0.14	0	0.25	0	0.31	0	0.41
Government	5	0.14	0	0.17	0	0.32	0	0.38	0	0.45
Industrial	95	2.53	8	3.10	4	5.99	0	7.45	0	7.97
Other Residential	425	11.33	33	12.52	10	17.50	1	22.80	0	25.10
Religion	12	0.33	1	0.40	0	0.68	0	1.03	0	1.21
Single Family	2,948	78.64	199	75.13	36	59.99	3	47.18	0	43.14
Total	**3,749**		**264**		**60**		**6**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,186	84.98	208	78.67	33	54.85	2	30.10	0	15.15
Steel	184	4.92	15	5.83	7	11.60	1	12.21	0	12.36
Concrete	38	1.02	3	1.12	1	2.09	0	1.14	0	1.13
Precast	10	0.27	1	0.30	1	0.97	0	2.13	0	0.20
RM	67	1.79	4	1.42	2	4.01	0	6.03	0	0.16
URM	257	6.85	33	12.31	15	25.63	3	47.79	0	70.94
MH	7	0.17	1	0.36	1	0.84	0	0.60	0	0.07
Total	**3,749**		**264**		**60**		**6**		**0**	

*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

		# Facilities		
Classification	**Total**	**At Least Moderate Damage > 50%**	**Complete Damage > 50%**	**With Functionality > 50% on day 1**
Hospitals	0	0	0	0
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	3	0	0	3

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	7	0	0	7	7
	Bridges	23	0	0	23	23
	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	1	0	0	1	1
	Runways	1	0	0	1	1

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	201	3	1
Waste Water	121	2	0
Natural Gas	80	1	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	3,343	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 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 67.00% 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 40 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 9,821) 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	1	0	0	0
	Total	**1**	**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	**1**	**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	**1**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 6.75 (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 6.25 (millions of dollars); 19 % 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 52 % 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
Income Losses							
	Wage	0.00	0.00	0.25	0.01	0.01	0.28
	Capital-Related	0.00	0.00	0.28	0.01	0.00	0.29
	Rental	0.05	0.02	0.14	0.00	0.00	0.22
	Relocation	0.17	0.01	0.17	0.03	0.03	0.41
	Subtotal	**0.22**	**0.04**	**0.85**	**0.05**	**0.04**	**1.20**
Capital Stock Losses							
	Structural	0.45	0.02	0.22	0.07	0.04	0.80
	Non_Structural	1.86	0.11	0.76	0.25	0.10	3.08
	Content	0.53	0.03	0.37	0.16	0.05	1.13
	Inventory	0.00	0.00	0.01	0.03	0.00	0.04
	Subtotal	**2.84**	**0.16**	**1.35**	**0.51**	**0.19**	**5.04**
	Total	**3.06**	**0.20**	**2.20**	**0.56**	**0.23**	**6.25**

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	151.77	$0.00	0.00
	Bridges	55.00	$0.05	0.09
	Tunnels	0.00	$0.00	0.00
	Subtotal	**206.80**	**0.10**	
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	**0.00**	**0.00**	
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	**0.00**	**0.00**	
Bus	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	10.65	$0.43	3.99
	Runways	37.96	$0.00	0.00
	Subtotal	**48.60**	**0.40**	
	Total	**255.40**	**0.50**	

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	4.00	$0.01	0.34
	Subtotal	**4.02**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	2.40	$0.01	0.29
	Subtotal	**2.41**	**$0.01**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.60	$0.00	0.15
	Subtotal	**1.61**	**$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	**8.04**	**$0.02**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%

Appendix A: County Listing for the Region

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	New Haven	9,821	678	242	920
Total State		**9,821**	**678**	**242**	**920**
Total Region		**9,821**	**678**	**242**	**920**

School Functionality

July 18, 2013

	Count	Functionality (%)
Connecticut		
New Haven	3	75.70
Total	**3**	**75.70**
Region Total	**3**	**75.70**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Police Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	1	76.80
Total	**1**	**76.80**
Region Total	**1**	**76.80**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

Fire Station Facilities Functionality

July 18, 2013

	Count	Functionality(%) At Day 1
Connecticut		
New Haven	3	74.30
Total	**3**	**74.30**
Region Total	**3**	**74.30**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.