TOWN OF BETHLEHEM
HAZARD MITIGATION PLAN UPDATE

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MMI #2097-11

Prepared For:

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ACKNOWLEDGEMENTS & CONTACT INFORMATION

This plan update was prepared under the direction of the Town of Bethlehem. The following individuals should be contacted with questions or comments regarding the plan:

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The consulting firm of Milone & MacBroom, Inc. (MMI) prepared the subject plan update, building upon the initial work completed in 2009. The following individual at MMI may be contacted 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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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	Division 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

Town of Bethlehem Hazard Mitigation Plan Update
Executive Summary

When the initial Hazard Mitigation Plan for the Town of Bethlehem was developed in 2008 and adopted and approved in 2009, the town had not been struck by a major disaster in many years. Widespread property damage caused by a natural hazard event had not occurred since Tropical Storm Floyd in 1999. In the years since the first Hazard Mitigation Plan was adopted and approved, a number of severe storms have occurred, resulting in presidential disaster declarations in Connecticut. These include flooding of March 2010, winter storms of January 2011, Tropical Storm Irene of August 2011, Winter Storm Alfred of October 2011, "Superstorm" Sandy of August 2012, Winter Storm Nemo of February 2013, and the winter storms of January-February 2015.

These storms have tested the resilience of Bethlehem, demonstrating that the town has considerable capacity to recover from storms. However, the town remains at risk from flooding. There are not any repetitive loss properties in Bethlehem, but several homes are located in areas of flood risk and the town's bridge and culvert infrastructure is believed insufficient in limited areas. The town also remains at risk to localized or widespread power outages caused by wind and snow events that damage utility lines, as well as nonresidential and residential structural damage from heavy snow loads.

The town believes that recent state legislation regarding significant and high hazard dams will help address dam safety. Wind and snow hazards from hurricanes, tropical storms, thunderstorms, nor'easters, and other storms will continue to be addressed by preventive methods (such as tree limb trimming) that have been improved over the last few years based on experience with storms Irene and Alfred as well as other events.

Bethlehem continues to experience a very slow pace of development and growth. The town intends to continue carefully regulating development especially as related to areas of risk to natural hazards. In light of the recent disasters, the primary goal of this hazard mitigation plan is the same as it was in 2009: to reduce the loss of or damage to life, property, infrastructure, and natural resources from natural disasters. This includes the reduction of public and private costs. Going forward, the town intends to focus on a number of strategies carried forward from the first Hazard Mitigation Plan, while also focusing on a handful of new strategies such as the consideration of constructing a community center that can serve as a shelter that can accommodate overnight evacuees.

When this plan is next updated in 2020, the town intends to revisit issues related to land development if moderate development occurs over the next few years. The next plan will also review the town's efforts relative to capital improvement planning and the conditions of Long Meadow Pond Dam; and will report on the status of any mitigation efforts pursued by the town between 2015 and 2020. These mitigation actions and strategies are listed in Appendix A.

1.0 INTRODUCTION

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 Bethlehem, Connecticut. The town's previous HMP was adopted by the Board of Selectmen and approved by the Federal Emergency Management Agency (FEMA) in spring 2009 and is on file at the FEMA Region I office. The HMP expired in April 2014. 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. The subject plan update was funded through HMGP.

Pre-Disaster Mitigation (PDM) Program

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

Flood Mitigation Assistance (FMA) Program

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

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 NFIF 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 HMA Unified Guidance document dated 2015.

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
Generators	X	X	
Localized Flood Reduction Projects	X	X	X
Non-Localized Flood Reduction Projects	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		
Advance Assistance	X		
5% Initiative Projects	X		
Miscellaneous/Other	X	X	X

Source: Table 3 – HMA Unified Guidance document, 2015

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

Developing, adopting, and implementing this hazard mitigation plan is expected to address the following secondary goals:

- ***Increase access to and awareness of funding sources for hazard mitigation projects.*** Certain funding sources, such as the Pre-Disaster Mitigation Grant Program and the Hazard Mitigation Grant Program, will be available if the hazard mitigation plan is in place and approved.

- ***Identify mitigation initiatives to be implemented if and when funding becomes available.*** This HMP will identify a number of mitigation strategies and 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 Bethlehem's development through inter-departmental and inter-municipal coordination.

- ***Improve the mechanisms for pre- and post-disaster decision making efforts.*** This plan emphasizes actions that can be taken now to reduce or prevent future disaster damages. If the actions identified in this plan are implemented, damage from future hazard events can be minimized, thereby easing recovery and reducing the cost of repairs and reconstruction.

- ***Improve the ability to implement post-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 Town's ability to implement and maintain mitigation strategies.

These priorities have not changed since the initial Hazard Mitigation Plan was adopted in 2009.

1.3 *Identification of Hazards and Document Overview*

As stated in Section 1.1, the term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. Based on a review of the 2014 *Connecticut Natural Hazard Mitigation Plan Update* and correspondence with local officials, the following have been identified as natural hazards that can potentially affect the Town of Bethlehem:

- Flooding
- Hurricanes and Tropical Storms
- Summer Storms (including lightning, hail, and heavy winds) and Tornadoes
- Winter Storms
- Earthquakes
- Dam Failure
- Wildfires

These are the same hazards that were addressed in the initial Bethlehem Hazard Mitigation Plan. They were reviewed during the development of the 2014 *Connecticut Hazard Mitigation Plan Update* (adopted January 2014) and Bethlehem's plan contributed to the Hazard Identification and Risk Assessment (HIRA) presented in the Connecticut Hazard Mitigation Plan Update. Thus, the plans are consistent. The only hazard given attention in the Connecticut Hazard Mitigation Plan Update but not addressed in the Bethlehem Hazard Mitigation Plan Update is drought; however, this is the lowest-ranked hazard of those discussed in the state's plan, with a medium-low composite risk score for Litchfield County. In addition, the statewide and countywide annual estimated loss (AEL) in the state plan for this hazard is $0. As such, its inclusion was considered not necessary in the Bethlehem Hazard Mitigation Plan Update.

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 and 1-3 provide summaries of the hazard events and hazard effects that impact the Town of Bethlehem, and include criteria for characterizing the locations impacted by the hazard, the frequency of occurrence of the hazards, and the magnitude or severity of the hazards.

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

This document begins with a general discussion of Bethlehem's community profile, including the physical setting, demographics, development trends, governmental structure, and sheltering capacity. Next, each chapter of this Plan is broken down into six or seven different parts. These are *Setting*; *Hazard Assessment*; *Historic Record*; *Existing Programs, Policies, and Mitigation Measures*; *Vulnerabilities and Risk Assessment*; and *Potential Mitigation Strategies and Actions*, and if necessary*, a Summary of Strategies and Actions.* These are described below.

- ***Setting*** addresses the general areas that are at risk from the hazard. General land uses are identified.

Table 1-2
Hazard Event Ranking

Natural Hazards	Location 1 = small 2 = medium 3 = large	Frequency of Occurrence 0 = unlikely 1 = possible 2 = likely 3 = highly likely	Magnitude/ Severity 1 = limited 2 = significant 3 = critical 4 = catastrophic	Rank
Winter Storms	3	3	2	8
Hurricanes	3	1	3	7
Summer Storms and Tornadoes	2	3	2	7
Earthquakes	3	1	2	6
Wildfires	1	2	1	4

- Each hazard may have multiple effects; for example, a hurricane causes high winds and flooding.
- Some hazards may have similar effects; for example, hurricanes and earthquakes may cause dam failure.

<u>Location</u>
1 = small: isolated to specific area during one event
2 = medium: multiple areas during one event
3 = large: significant portion of the town during one event

<u>Frequency of Occurrence</u>
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

<u>Magnitude/Severity</u>
1 = limited: injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant: injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical: injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic: multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

Table 1-3
Hazard Effect Ranking

Natural Hazard Effects	Location 1 = small 2 = medium 3 = large	Frequency of Occurrence 0 = unlikely 1 = possible 2 = likely 3 = highly likely	Magnitude/ Severity 1 = limited 2 = significant 3 = critical 4 = catastrophic	Rank
Nor'easter Winds	3	3	2	8
Snow	3	3	2	8
Blizzard	3	3	2	8
Hurricane Winds	3	1	3	7
Falling Trees/Branches	2	3	2	7
Riverine Flooding	2	2	2	6
Thunderstorm and Tornado Winds	2	2	2	6
Flooding from Dam Failure	1	1	3	6
Ice	2	2	2	6
Shaking	3	1	2	6
Lightning	1	3	1	5
Flooding from Poor Drainage	1	3	1	5
Hail	1	2	1	4
Fire/Heat	1	2	1	4
Smoke	1	2	1	4

- ❑ Some effects may have a common cause; for example, a hurricane causes high winds and flooding.
- ❑ Some effects may have similar causes; for example, hurricanes and nor'easters both cause heavy winds.

Location
1 = small: isolated to specific area during one event
2 = medium: multiple areas during one event
3 = large: significant portion of the town during one event

Frequency of Occurrence
0 = unlikely: less than 1% probability in the next 100 years
1 = possible: between 1 and 10% probability in the next year; or at least one chance in next 100 years
2 = likely: between 10 and 100% probability in the next year; or at least one chance in next 10 years
3 = highly likely: near 100% probability in the next year

Magnitude/Severity
1 = limited: injuries and/or illnesses are treatable with first aid; minor "quality of life" loss; shutdown of critical facilities and services for 24 hours or less; property severely damaged < 10%
2 = significant: injuries and/or illnesses do not result in permanent disability; shutdown of several critical facilities for more than one week; property severely damaged <25% and >10%
3 = critical: injuries and/or illnesses result in permanent disability; complete shutdown of critical facilities for at least two weeks; property severely damaged <50% and >25%
4 = catastrophic: multiple deaths; complete shutdown of facilities for 30 days or more; property severely damaged >50%

- ***Hazard Assessment*** describes the specifics of a given hazard, including general characteristics, and associated effects. Also defined are associated return intervals, probability and risk, and relative magnitude.

- ***Historic Record*** is a discussion of past occurrences of the hazard, and associated damages when available.

- ***Existing Capabilities*** provides an overview of the programs, policies, and mitigation measures that the Town of Bethlehem is currently undertaking to mitigate the given hazard. These may take the form of ordinances and codes, structural measures such as dams, or public outreach initiatives.

- ***Vulnerabilities and Risk Assessment*** focuses on the specific areas at risk to the hazard. Specific land uses in the given areas are identified. Critical buildings and infrastructure that would be affected by the hazard are identified.

- ***Potential Mitigation Strategies and Actions*** identifies mitigation alternatives, including those that may be the least cost effective or inappropriate for Bethlehem.

- ***Status of Strategies and Actions*** provides a status report regarding the specific strategies and actions listed in the previous plan.

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

1.4 Documentation of the Planning Process

The Town of Bethlehem was a member of the Council of Governments of the Central Naugatuck Valley (COGCNV), the regional planning body responsible for Bethlehem and twelve other member municipalities: Beacon Falls, Cheshire, Middlebury, Naugatuck, Oxford, Prospect, Southbury, Thomaston, Waterbury, Watertown, Wolcott, and Woodbury. All of these communities maintain single-jurisdiction hazard mitigation plans. The initial plans were developed under the guidance of COGCNV, but COGCNV no longer exists (it was merged into the new Naugatuck Valley Council of Governments) and the Town of Bethlehem prepared this updated plan under a grant held by the Town of Southbury.

The following individuals from the Town of Bethlehem provided information, data, studies, reports, and observations; and were involved in the development of the Plan:

Table 1-4
Local Plan Development Participants

Name	Department or Commission	Initial Plan?	First Update?
Michael Devine, Emergency Service Director	Emergency Management	Yes	Yes
Mark Piccirillo, Former Director of Public Works	Department of Public Works	Yes	No
John Swendsen, Public Works Director	Department of Public Works	No	Yes
Jean Donegan, Land Use Administrator	Land Use Department	Yes	Yes
Joel Skilton, Building Official	Building Department	No	Yes
Ken LeClerc, Fire Marshal	Building Department	No	Yes
Lenny Assard	First Selectmen	No	Yes
David Butkus	Board of Selectmen	No	Yes
David Deakin	Board of Selectmen	No	Yes
Carol Ann Brown	Board of Education, Regional School District #14	No	Yes

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the Town, as well as to identify areas that should be prioritized for hazard mitigation. The following is a list of meetings and field reconnaissance that were held to develop the initial Hazard Mitigation Plan and to update the plan in 2013-2015:

Initial Plan

- ***Field inspections were performed on February 13, 2008.*** Observations were made of flooding and problem areas within the Town after a period of heavy rain falling on frozen ground.

- ***A project meeting with Town officials was held March 4, 2008.*** Necessary documentation was collected, and problem areas within the Town were discussed.

- ***A public information meeting was held April 21, 2008 at 7:30 P.M.*** Preliminary findings were presented and public comments solicited.

Residents were invited to the public information meeting via newspaper, with three residents attending that were not Town personnel or a commission member. Similarly, eight municipal agencies and civic organizations were invited via a mailed copy of the press release that announced the public information meeting. These included the following:

- Long Meadow Lake Management Committee;
- Torrington Area Health District;
- United Way of Greater Waterbury;
- American Red Cross – Waterbury Area;
- Bethlehem Inland Wetlands Agency;

- ❑ Bethlehem Land Trust;
- ❑ Bethlehem Conservation Commission; and
- ❑ Bethlehem Planning Commission.

Of these organizations, the Long Meadow Lake Management Committee and the Bethlehem Conservation Commission were represented at the meeting. Residents were also encouraged to contact the COG with comments via newspaper articles. As another direct gauge of public interest, a review of Public Works Department complaint files was undertaken to document problems of public concern. Finally, the Connecticut DEP was routinely briefed and consulted throughout the development process.

It is important to note that COGCNV managed the Central Naugatuck Valley Emergency Planning Committee. This committee coordinates emergency services in the region. Fire, Police, EMS, Red Cross, emergency management directors, and other departments participate in these efforts. In June 2004, over 120 responders participated in the region's first tabletop exercise on biological terrorism. Area health directors, hospitals, and other health care professionals also meet monthly with the Health and Medical Subcommittee to share information, protocols, and training. Thus, local knowledge and experience gained through the Emergency Planning Committee activities was transferred by the COGCNV to the hazard mitigation planning process.

<u>First Update</u>

- ❑ ***Field inspections were performed in October 2013.***

- ❑ ***A project meeting with Town officials was held October 29, 2013.*** The update process was described, necessary documentation was collected, and hazard-prone areas within the Town were discussed.

- ❑ ***A public information meeting was held December 30, 2013 at 7:00 P.M.*** Public comments were solicited.

  Residents were invited to the December 30, 2013 public information meeting via newspaper, but few attended. During the meeting, the following comments were received:

  - The town hall roof was replaced in 2013. Attendees believe that it now meets current building codes for wind and snow load. A brief discussion about shelters and building codes proceeded. The town hopes to be able to use Nonnewaug High School (the regional school district’s high school) as a shelter. Attendees inquired whether the regional school district could apply for HMGP funds for a generator for the high school, or would one of the towns need to apply?

  - Attendees remarked that CT DOT would be unlikely to elevate the low-lying section of Route 132 as described in the first hazard mitigation plan. However, the strategy should remain, in case DOT someday has interest in this project. Mr. Murphy described the DOT’s climate change pilot program and remarked that several culverts in the county would be evaluated for appropriateness of capacities in the face of increasing precipitation intensities.

  - Attendees remarked that CL&P (now known as Eversource) and CT DOT are making progress with tree trimming along utility lines.

- Mr. Murphy described the ongoing flood insurance reform. Attendees are uncertain how many NFIP policies are in place in Bethlehem.

- Mr. Murphy asked attendees what could be done in the town to reduce hazard risks. The general consensus was that culverts and bridges would be inspected and then upgraded or replaced if needed.

- Mr. Devine asked whether upgrading of digital services would be eligible for mitigation funding. For example, does the town have the digital infrastructure in place to be able to react and respond to disasters accordingly? Mr. Murphy said that it's not eligible at this point, but any strategies should be included because (for example) standby power supplies were not eligible several years ago and are currently eligible.

❑ ***The Town of Bethlehem planning team reviewed the draft hazard mitigation plan update between May 2014 and March 2015.*** Written comments from the town were received in December 2014.

❑ ***DEMHS reviewed the draft hazard mitigation plan update in May 2015.***

<u>Newspaper Articles</u>

In addition to the public outreach described above, the Voices published a regional newspaper story about the plan update process and the need to remain eligible for potential hazard mitigation grants. The newspaper maintains readership in Bethlehem, Middlebury, Naugatuck, Southbury, Woodbury, and Oxford. The story, "Mitigation Updates Underway," was printed in the August 28, 2013 edition of the Voices. The article noted that all of the municipalities were in various stages of the planning process, and explained why the process was important. The article ended with a statement that residents and business owners could send ideas and comments for the plans to the COGCNV at comments@cogcnv.org.

Finally, the 13 former 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 former COGCNV communities. A copy is included in Appendix B. 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 could send ideas and comments for the plans to the COGCNV at comments@cogcnv.org.

Additional opportunities for the public to review this plan update will be implemented in advance of the public hearing to adopt this plan following receiving conditional approval from FEMA. The draft plan update that is sent for FEMA review will be posted on the Town website to provide opportunities for public review and comment. Comments will be incorporated into the final draft where applicable. The public and interested parties will be notified of the opportunity to review the Plan.

Appendix B contains copies of meeting minutes, field notes and observations, the public information meeting presentation for the initial plan, and other records that document the development of the Hazard Mitigation Plan.

1.5 *Coordination with Neighboring Communities*

Bethlehem has coordinated with neighboring municipalities in the past relative to hazard mitigation and emergency preparedness and will continue to do so. Table 1-5 provides a list of the communities that are adjacent to Bethlehem.

Table 1-5
Municipalities Adjacent to Bethlehem

Town	Hazard Mitigation Plan Status
Town of Morris	Multi-Jurisdiction Plan update under development
Town of Washington	Single Jurisdiction Plan adopted and approved 2014
Town of Watertown	Single Jurisdiction Plan update adopted and approved 2014
Town of Woodbury	Single Jurisdiction Plan update adopted and approved 2014

Input from neighboring communities was sought during the development of the initial HMP through outreach to the chief elected officials of those communities by way of the COGCNV involvement and the activity of the Central Naugatuck Valley Emergency Planning Committee described above in Section 1.4.

Adjacent communities were invited to participate in the update of this HMP in autumn 2013. Copies of the invitations are included in Appendix B. Watertown and Woodbury were in the process of updating their HMPs and were familiar with the need to invite adjacent communities. Mr. Larry Black of the Town of Watertown noted that some facilities that serve Watertown are located in Bethlehem and will sometimes require coordination. Specifically, the Bronson Lockwood Reservoir and Bethlehem Reservoir are owned by the Watertown Fire District.

The Horace Mann[1] "John Dorr Nature Laboratory" (owned by a private school) remains a concern for Bethlehem. The center is located in Washington yet access is through Bethlehem. The driveway is 1.3 miles long, and the town of Bethlehem is responsible for emergency response along this driveway. For example, calling 911 will ring through Bethlehem's dispatch. The center is very active, with many buses from the New York City area. As noted in Section 6.5, the Town of Washington has asked the Town of Bethlehem to be the first responder to this facility in case of emergency, as it is a 22 minute response time from Washington. However, the road leading in from Bethlehem is unpaved, narrow, and steep. Emergency personnel are worried that the facility could become isolated during a winter emergency. Close coordination will be necessary for the two communities to address emergency response and hazard mitigation in the context of the center's location and access.

[1] In 1965, Horace Mann established the John Dorr Nature Laboratory in Washington, Connecticut with a gift of 83 acres. The Laboratory now encompasses 275 acres of fields, streams, and ponds in which students can explore nature and engage in outdoor pursuits.

2.0 COMMUNITY PROFILE

2.1 Physical Setting

The Town of Bethlehem is located in Litchfield County. It is bordered by Woodbury to the south, Washington to the west, Morris to the north, and Watertown to the east. Refer to Figure 2-1 for a location schematic and Figure 2-2 for a location map.

Bethlehem is located within the western part of the crystalline uplands, or Western Highlands, of western Connecticut. This geologic feature consists of three belts of metamorphic rocks bounded to the west by the sediments and metamorphic rocks of the Hudson River valley and on the east by the Triassic sediments of the Connecticut River valley. The topography of the Town ranges from gently rolling terrain in the valleys to steep, hilly terrain in the upland areas. Elevations range from 450 feet above sea level along the Weekeepeemee River in the southwestern part of Town to over 1,130 feet above sea level on Todd Hill in the northwestern part of Town, based on the National Geodetic Vertical Datum of 1929. The hilly, elevated terrain of Bethlehem makes it particularly vulnerable to an array of natural hazards.

2.2 Existing Land Use

The Town of Bethlehem encompasses 19.6 square miles. Table 2-1 provides a summary of land use in Bethlehem by area. In addition, refer to Figure 2-3 for a map of generalized land use provided by the former COGCNV.

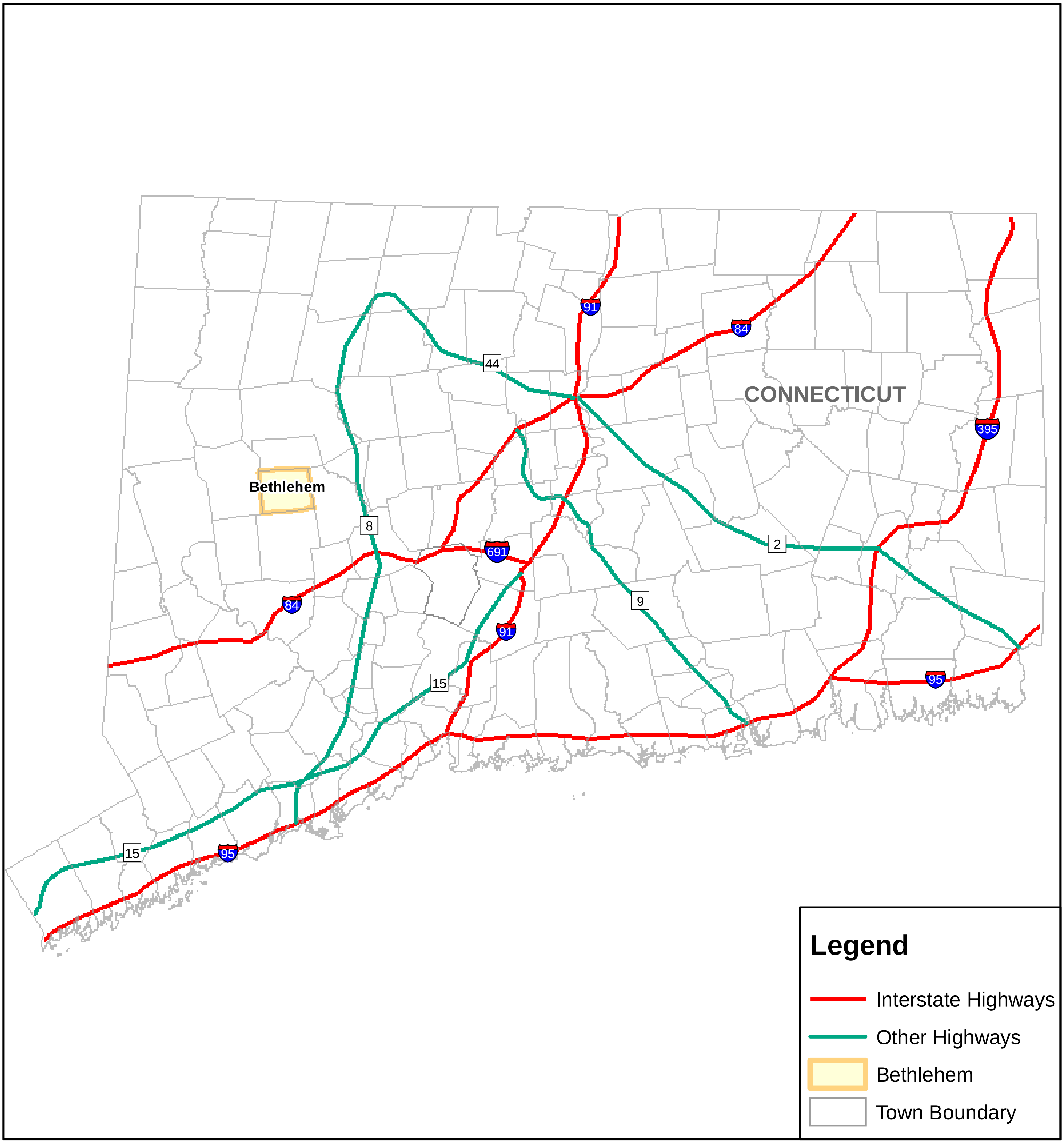
Table 2-1
Land Use by Area

Land Use	Area (acres)	Pct.
Vacant	5,707	45.4%
Residential - Low Density	2,977	23.7%
Agricultural	2,956	23.5%
Institutional	460	3.7%
Water	210	1.7%
Recreational	198	1.6%
Mining	25	0.2%
Commercial	25	0.2%
Residential - High Density	8	0.1%

Source: Council of Governments Central Naugatuck Valley, 2000

Bethlehem is characterized by its hills and soils that are typically unsuitable for large septic systems, both of which limit large development in much of the Town. A small commercial district is located in the center of the town at the intersection of East Street and Main Street (Route 61).

Figure 2-1: Bethlehem Location Map



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
For general planning purposes only. Delineations may not be exact.
June 2008

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Figure 2-2: Bethlehem in the CNVR

Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
For general planning purposes only. Delineations may not be exact.
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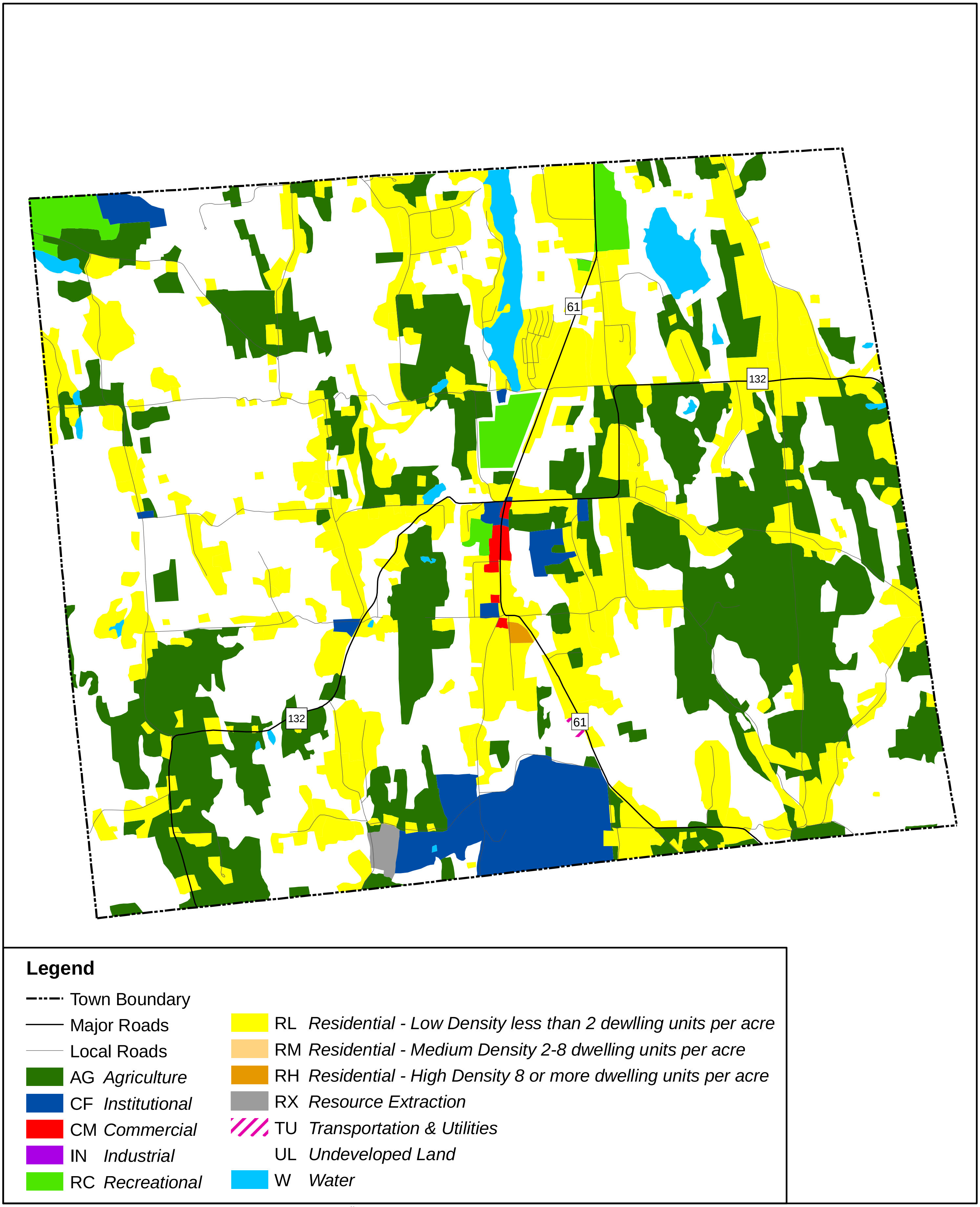
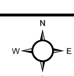
Figure 2-3: Bethlehem Generalized Land Use



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Land Use", COGCNV 2000
For general planning purposes only. Delineations may not be exact.
August 2008



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Outside of the commercial area, agricultural areas are interspersed with low density residential neighborhoods. Much of the undeveloped areas of Bethlehem are private forested areas or land trust properties.

2.3 Geology

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

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

Regionally, in terms of New England bedrock geology the Town of Bethlehem lies within the Eugeosyncline Sequence. Bedrock belonging to the Eugeosyncline Sequence are typically deformed, metamorphosed, and intruded by small to large igneous plutons.

The Town of Bethlehem's bedrock consists primarily of metasedimentary and metaigneous schists and granofels and secondarily of igneous granite and pegmatite. The bedrock alignment trends generally southwest to northeast through the Town. Refer to Figure 2-4 for a depiction of the bedrock geology in the Town of Bethlehem.

The three primary bedrock formations in the Town (from north to south) are Ratlum Mountain Schist, Rowe Schist, and Nonewaug Granite:

Bedrock Geology

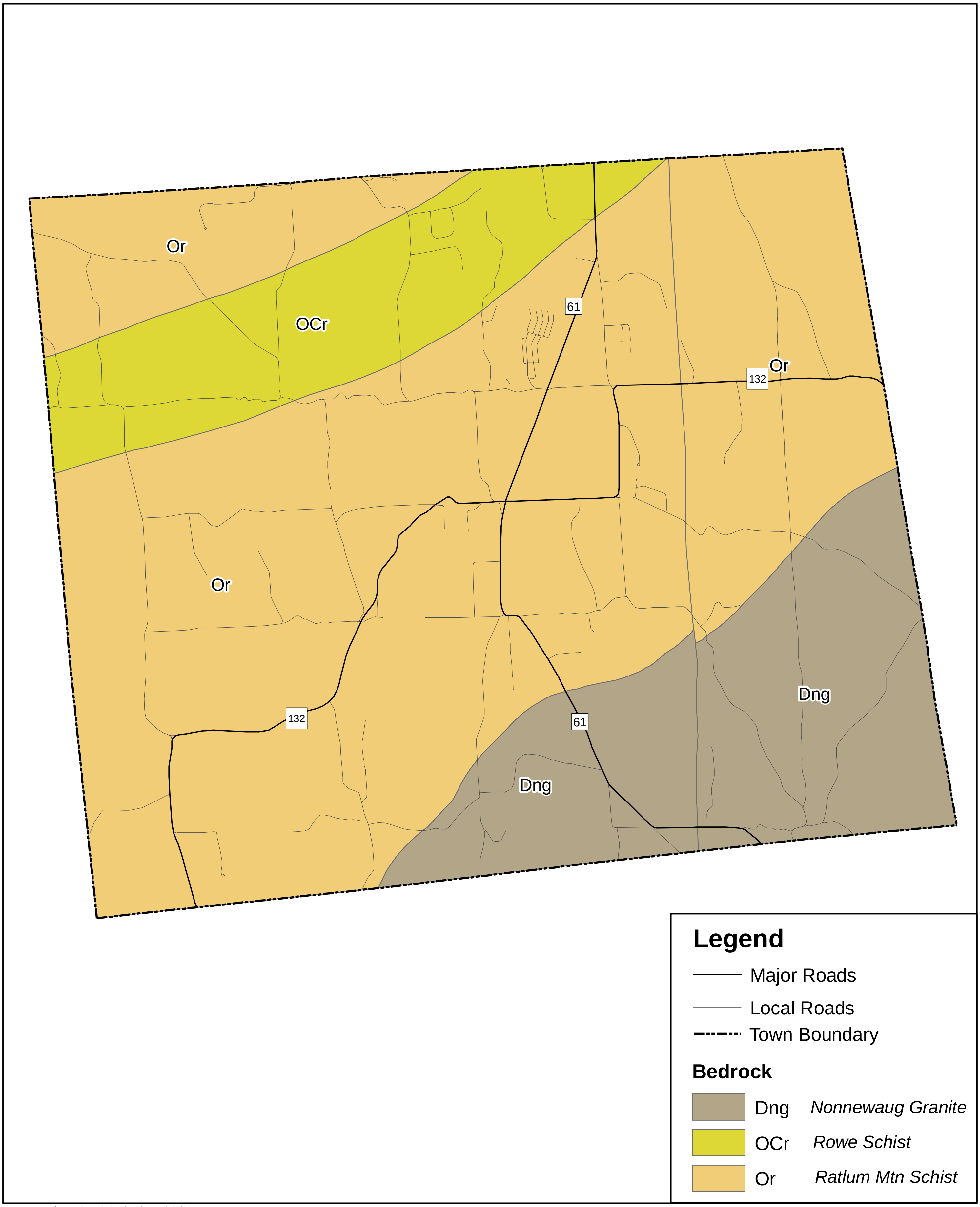
Connecticut bedrock geology is comprised of several "terranes." Terranes are geologic regions that reflect the role of plate tectonics in Connecticut's natural history.

The bedrock beneath the Town of Bethlehem is part of the Iapetos Terrane, comprised of remnants of the Iapetos Ocean that existed before Pangaea was formed. This terrane formed when Pangaea was consolidated, and its boundaries are coincident with the Eugeosyncline Sequence geologic province described above.

- The Ratlum Mountain Schist consists of gray, medium-grained schist and granofels.
- The Rowe Schist is a light-gray to silvery, fine to medium-grained schist.
- The Nonewaug Granite is a white to pink, fine to very coarse-grained granite with some parts pegmatitic.

One fault is mapped in the Town of Bethlehem. It is a high-angle, mostly Jurassic fault traversing south to north through the eastern part of Town. The fault extends from Newtown and runs into Massachusetts and is believed inactive. Bedrock outcrops can be difficult to find in Bethlehem due to the forested nature of the Town, although outcrops can be found at higher elevations and on hilltops.

Figure 2-4: Bethlehem Bedrock Geology



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Bedrock", DEP
For general planning purposes only. Delineations may not be exact.

June 2008

N W E S

0 0.5 1 Miles

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

Bethlehem 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. This area includes nearly all of Bethlehem with the exception of the river valleys associated with the Weekeepeemee River, Wood Creek, the Nonnewaug River and East Spring Brook. Stratified sand and gravel ("stratified drift") areas are associated with these watercourses. These deposits accumulated by glacial meltwater streams during the outwash period following the latest glacial recession. The remainder of Town is covered by small areas of swamp near the western and northwestern boundary, and by the ponds and reservoirs scattered throughout Bethlehem.

The amount of stratified drift present in the Town is important for several reasons. First, the stratified drift is currently used by water utilities in downstream Watertown to provide drinking water via pumping wells. Secondly, in regard to flooding, areas of stratified materials are generally coincident with inland floodplains. This is because these materials were deposited at lower elevations by glacial streams, and these valleys later were inherited by the larger of our present-day streams and rivers. However, smaller glacial till watercourses can also cause flooding, such as those in northern, eastern, and southeastern Bethlehem. The amount of stratified drift also has bearing on the relative intensity of earthquakes and the likelihood of soil subsidence in areas of fill. These topics will be discussed in later sections.

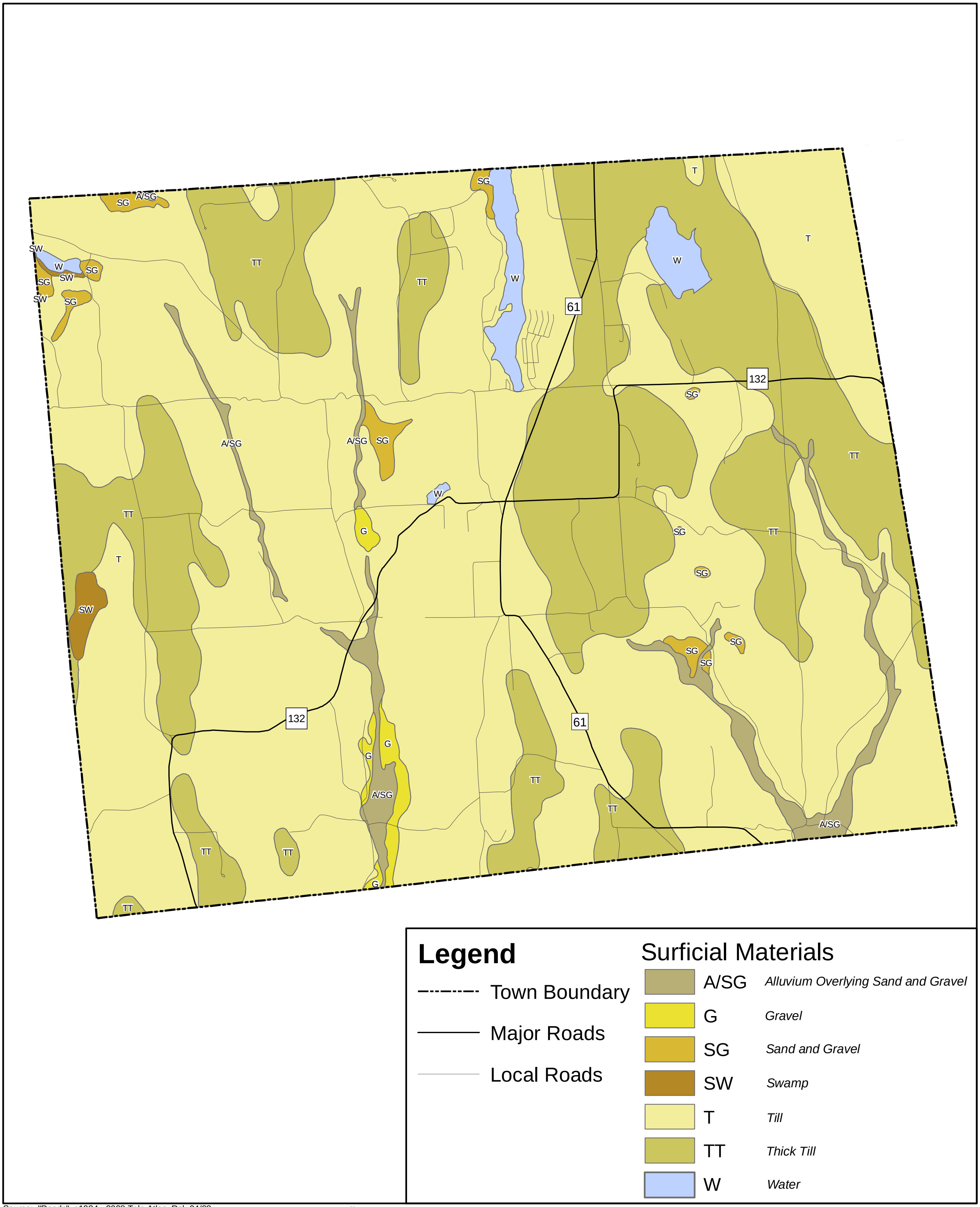
In terms of soil types, approximately 80% of the Town contains Paxton and Montauk fine sandy loams, Canton and Charlton soils, Charlton-Chatfield complex, extremely stony Ridgebury, Leicester, and Whitman soils, and Woodbridge fine sandy loam (Table 2-2). The remainder of the Town has soil types of consisting primarily of various fine to medium sandy loams, wetland soils, and urban land.

Table 2-2
Soils by Taxonomic Class

Soil Type	**Area (acres)**	**Pct.**
Paxton and Montauk fine sandy loams	3726	29.6%
Canton and Charlton soils	3169	25.2%
Charlton-Chatfield complex	1230	9.8%
Ridgebury, Leicester, and Whitman soils	1167	9.3%
Woodbridge fine sandy loam	1162	9.2%
Hollis-Chatfield-Rock outcrop complex	435	3.5%
Gloucester gravelly sandy loam	321	2.6%
Sutton fine sandy loam	275	2.2%
Water	228	1.85
Merrimac sandy loam	178	1.4%
Other (20 types)	684	5.4%
Total	**12575**	**100.0**

Source: 2005 Soil Survey Geographic (SSURGO) database for the State of Connecticut

Figure 2-5: Bethlehem Surficial Materials



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Surficial Materials", DEP
For general planning purposes only. Delineations may not be exact.
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N W E S

Miles
0 0.5 1

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The following soil descriptions are taken in part from the official series descriptions from the United States Department of Agriculture (USDA) website:

- The Paxton and Montauk series consists of very deep, well-drained loamy soils formed in lodgment till derived primarily from granitic materials. The soils are very deep to bedrock and moderately deep to a densic contact. They are nearly level to steep soils on upland till plains, hills, moraines, and drumlins. Slope ranges from zero to forty-five percent. Saturated hydraulic conductivity is moderately high or high in the solum and low to moderately high in the substratum.

- The Canton and Charlton soils consist of very deep, well- drained soils formed in a loamy mantle underlain by sandy till with stones and boulders often present. The soils are found on nearly level to steep glaciated plains, hills, and ridges. Slope ranges from zero to thirty-five percent. Saturated hydraulic conductivity is high in the solum and high or very high in the substratum.

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

- Extremely stony Ridgebury, Leicester, and Whitman Soils consist of very deep, somewhat poorly drained to very poorly drained formed in glacial till derived mainly from granite, gneiss, and schist. These soils are shallow to a densic contact. They are nearly level to gently sloping soils in low areas, such as depressions or drainageways, in uplands. Slope ranges from zero to fifteen percent. Saturated hydraulic conductivity ranges from moderately low to high in the solum and very low to moderately low in the substratum.

- The Woodbridge series consists of moderately well drained loamy soils formed in subglacial till. They are very deep to bedrock and moderately deep to a densic contact. They are nearly level to moderately steep soils on till plains, hills, and drumlins. Slope ranges from zero to twenty-five percent. Saturated hydraulic conductivity ranges from moderately low or moderately high in the surface layer and subsoil and low or moderately low in the dense substratum.

2.4 <u>Current Climate Conditions and Climate Change</u>

Bethlehem has an agreeable climate, characterized by moderate but distinct seasons. The average mean temperature is approximately 48 degrees, with summer temperatures in the mid-80s and winter temperatures in the upper 20's to mid-30s, Fahrenheit. Extreme conditions raise summer temperatures to near 100 degrees and winter temperatures to below zero. Median snowfall is just less than 46 inches per year as measured at Wigwam Reservoir weather station in Thomaston (NCDC, 2007). Median annual precipitation is 44 inches, spread evenly over the course of a year.

By comparison, average annual state-wide precipitation based on more than 100 years of record is nearly the same, at 45 inches. However, average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19th century (Miller et. al., 2002; NCDC, 2005). Likewise, total annual precipitation in the Town has increased over time.

Like many communities in the United States, Bethlehem experienced a moderate growth in population 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 such as flood damage reduction and design of flood conveyance systems.

CTDOT commenced a “Climate Change and Extreme Weather Pilot Project” in 2013 using a grant from the Federal Highway Administration. The project included vulnerability assessments of culverts and bridges in Litchfield County that are between six and 20 feet in length, with regard to flooding caused by increasing precipitation and extreme rainfall events. The assessment evaluated the existing storm event design standards, the recent (ten year) historic actual rainfall intensity and frequency, and evaluated the hydraulic capacity of these structures using the projected increases in rainfall based on best available data and studies. Litchfield County was selected due to the inland flood damages observed in the northwest corner of the state over the last few years. The scope of this project was identified in the Connecticut Climate Change Preparedness Plan which was a product of a statewide effort that took place from 2005 through 2011.

Along with the vulnerability assessment, the project included a process that assigns a criticality value to the risk of failure. This will assist the Department in prioritizing replacement and reconstruction efforts to these structures where they pose the greatest risk to human health and safety, public and private property loss, and the economic risk of replacement after failure versus proactive replacement. This project will add to the existing framework by providing a model process for assessing the hydraulic capacity of smaller structures in the rural urban fringe and the criticality of those assets in similar geographies.

2.5 Drainage Basins and Hydrology

The Town of Bethlehem drains to seven major watersheds corresponding with the Bantam River, Branch Brook, East Spring Brook, Nonnewaug River, Shepaug River, Sprain Brook, and the Weekeepeemee River. These drainage basins are described below and summarized in Table 2-3. Over eighty percent of the town drains to the Weekeepeemee River and East Spring Brook, both of which ultimately drain through the Pomperaug River to the Housatonic River. The remainder of the Town also drains to the Housatonic River, but does so via the Shepaug or Naugatuck Rivers. Bethlehem is also home to a number of lakes and ponds, including Long Meadow Pond, the Bronson Lockwood Reservoir, and the Watertown Reservoir.

Table 2-3
Drainage Basins

Drainage Basin	Area (sq. mi)	Percent of Town
Bantam River	0.20	1.0%
Branch Brook	0.72	3.6%
East Spring Brook	5.06	25.8%
Nonnewaug River	2.47	12.6%
Shepaug River	0.01	0.1%
Sprain Brook	0.27	1.4%
Weekeepeemee River	10.91	55.5%
Total	**19.64**	**100.0%**

Source: Drainage Basins, 2008 CT DEP GIS Data for Connecticut

Bantam River

A small section of Bethlehem's northwestern corner (approximately 1.0% of the Town) drains to the Bantam River in eastern Washington near Mt. Tom. The headwaters of the Bantam River are located in the area of the Litchfield Reservoir in Goshen. The Bantam River eventually drains into the Shepaug River in Washington. The subregional basin corresponding to the Bantam River drains 40.21 square miles of land across Washington, Morris, Bethlehem, Litchfield, Torrington, and Goshen, but only 0.20 square miles of this basin lie in the Town of Bethlehem.

Branch Brook

The Branch Brook drainage basin covers 0.72 square miles or 3.66% of the Town's land area in the northeastern corner of Bethlehem. It is the only basin in Bethlehem that drains to the Housatonic via the Naugatuck River, generally flowing to the east and southeast before entering the Naugatuck River in Mattatuck State Forest in Watertown. The upper reaches of this drainage basin are located in northeastern Morris and Litchfield, where Pitch Brook, Wigwam Brook, and their tributaries flow southward into Pitch Reservoir. In addition to the abovementioned tributaries, the Pitch Reservoir also receives water from a seven mile long aqueduct built in the 1920s from the Shepaug Reservoir on the border between the Towns of Litchfield and Warren.

The Branch Brook drainage basin is heavily utilized for water supply. Pitch Reservoir is the first of three major impoundments in the watershed. Downstream are the Morris Reservoir on the Morris-Litchfield town line and the Wigwam Reservoir on the Watertown-Thomaston boundary. All of these reservoirs as well as the aqueduct were constructed by the City of Waterbury in the first half of the twentieth century for water supply purposes.

The part of Bethlehem within this basin drains through two unnamed watercourses to Morris Brook, and eventually into the Wigwam Reservoir just below the Morris Reservoir Dam. Branch Brook begins downstream of the Wigwam Reservoir Dam, where it makes up the boundary between Watertown and Thomaston before flowing into the Naugatuck River. In all, the Branch

Brook basin drains 22.65 square miles of land in Thomaston, Watertown, Bethlehem, Morris, and Litchfield.

East Spring Brook

The East Spring Brook drainage basin covers 5.06 square miles or 25.77% of the land area of Bethlehem. The basin extends from the eastern part of Bethlehem into southern Morris, from where several small watercourses converge into the Bronson E. Lockwood Reservoir in northeastern Bethlehem. This reservoir covers 73.5 acres and is operated by the Watertown Fire District Water Department, though it is not currently used for water supply.

East Spring Brook begins as the outlet from this reservoir and flows generally south across eastern Bethlehem. The brook first flows south into the Watertown Reservoir, and is later joined by two unnamed tributaries just downstream of its crossing of Magnolia Hill Road. Several more unnamed tributaries meet East Spring Brook before its confluence with the Nonnewaug River in Woodbury, just to the south of the Bethlehem border. In total, East Spring Brook drains 5.85 square miles of land in the Towns of Woodbury, Bethlehem, and Morris.

Nonnewaug River

The southeastern corner of Bethlehem that does not drain to East Spring Brook drains directly to the Nonnewaug[2] River. This area covers 2.47 square miles or 12.57% of Bethlehem's total land area. The Nonnewaug River has its headwaters along the border between Bethlehem and Watertown. Several unnamed streams flow into Big Meadow Pond in western Watertown. The Nonnewaug River begins as the outlet from this pond and flows to the southwest into Bethlehem where it is joined by three unnamed tributaries before crossing the border into Woodbury where it is joined by East Spring Brook.

Downstream of the East Spring Brook, the Nonnewaug River flows southward into Woodbury where it passes by Hart's Wellfield, a major source of water supply for the Watertown Fire District. The river is joined by several tributaries in Woodbury before it joins with the Weekeepeemee River to form the Pomperaug River. In all, the Nonnewaug River drains 21.26 square miles of land in the Towns of Bethlehem, Watertown, Woodbury, and Middlebury.

Shepaug River

The smallest drainage basin in Bethlehem corresponds to the Shepaug River. It covers only 0.01 square miles in western Bethlehem, corresponding to 0.07% of the Town's total land area. This area drains west into Washington and into Mallory Brook, which meets up with the Shepaug River near the junction of Blackville Road and Route 47. The Shepaug River watershed is very large, draining 70.94 square miles of land from its confluence with the Housatonic River north to the Towns of Cornwall and Goshen.

Sprain Brook

Approximately 0.27 square miles or 1.38% of Bethlehem's land area on Bethlehem's western and southwestern boundaries drains to Sprain Brook. Sprain Brook has its headwaters in eastern

[2] The USGS and other sources spell the river "Nonewaug" rather than "Nonnewaug"

Washington, in a pond adjacent to the intersection of Nettleton Hollow Road and Carmel Hill Road. As it flows south out of this pond, Sprain Brook is fed by a number of unnamed tributaries on its way into Woodbury where it converges with the Weekeepeemee River near the junction of Routes 47 and 132. In all, the subregional basin corresponding to Sprain Brook drains 10.96 square miles of the Towns of Woodbury, Roxbury, Washington, and Bethlehem.

Weekeepeemee River

The drainage basin corresponding to the Weekeepeemee River covers 10.91 square miles, or 55.52% of Bethlehem's total land area. The basin covers almost the entire western half of the Town. The headwaters of the river form in a small swamp near the Bethlehem-Morris boundary. As the river flows southward, it is joined by the outlet stream from Long Meadow Pond, the largest body of water in Bethlehem at 110 acres in size.

Continuing downstream, the River passes under Route 132 and is joined by Wood Creek, a tributary that drains Zeiglers Pond in the northwest corner of Bethlehem. Several unnamed tributaries join the Weekeepeemee River before it crosses into Woodbury, where the river eventually joins with the Nonnewaug River to form the Pomperaug River. In total, the Weekeepeemee River basin drains 16.11 square miles of land across Woodbury, Washington, Bethlehem, and Morris.

2.6 Population and Demographic Setting

Table 2-2 provides population data from the year 2000 and 2010 census counts. The total CNV Region population as indicated in the 2010 Census is 287,768 persons. The total land area is 309 square miles, yielding a regional population density of 931 persons per square mile. By comparison, Waterbury has the highest population density in the region with 3,866 individuals per square mile, while Bethlehem has the lowest population density in the region with 186 individuals per square mile (Table 2-4).

Table 2-4
Population Density by Municipality, Region and State, 2000 and 2010

Municipality	Land Area (sq. miles)	Population 2000	Population Density, 2000	Population, 2010	Population Density, 2010
Beacon Falls	9.77	5,246	537	6,049	619
Bethlehem	19.36	3,422	177	3,607	186
Cheshire	32.90	28,543	868	29,261	889
Middlebury	17.75	6,451	363	7,575	427
Naugatuck	16.39	30,989	1,891	31,862	1,944
Oxford	32.88	9,821	299	12,683	386
Prospect	14.32	8,707	608	9,405	657
Southbury	39.05	18,567	475	19,904	510
Thomaston	12.01	7,503	625	7,887	657
Waterbury	28.55	107,271	3,757	110,366	3,866
Watertown	29.15	21,661	743	22,514	772
Wolcott	20.43	15,215	745	16,680	816
Woodbury	36.46	9,198	252	9,975	274

Municipality	Land Area (sq. miles)	Population 2000	Population Density, 2000	Population, 2010	Population Density, 2010
CNV Region	309.02	272,594	882	287,768	931
Connecticut	4844.80	3,405,565	703	3,574,097	738

Source: United States Census Bureau, 2000 Census of Population and Housing, Summary File 1; Census 2010, Profile of General Population and Housing Characteristics

The population of Bethlehem increased by 29% between 1960 and 1970, and increased again by 34% between 1970 and 1980, representing the last true surge in development in recent history. Population growth then slowed to 19% between 1980 and 1990 and slowed again to 11% between 1990 and 2000. Population growth in Town from 2000-2010 was only 5%. Based on analysis by the COGCNV, population growth in the region outside of Waterbury is estimated to be about 10% from 2005 to 2025, while the State of Connecticut is expected to grow about 5% during this same timeframe. According to Bethlehem's Plan of Conservation and Development, population growth in Town is forecast to be only about 1% per year from 2005 to 2020.

Bethlehem has populations of people who are elderly, linguistically isolated, and/or disabled. These are depicted by the three census blocks in Bethlehem on Figures 2-6, 2-7, and 2-8. The populations with these characteristics have numerous implications for hazard mitigation, as they may require special assistance or different means of notification before disasters occur. These will be addressed as needed in subsequent sections.

According the Connecticut Economic Resource Center, the median sales price of owner-occupied housing in the Town of Bethlehem in 2006 was $342,500, higher than the statewide median sales price of $275,000.

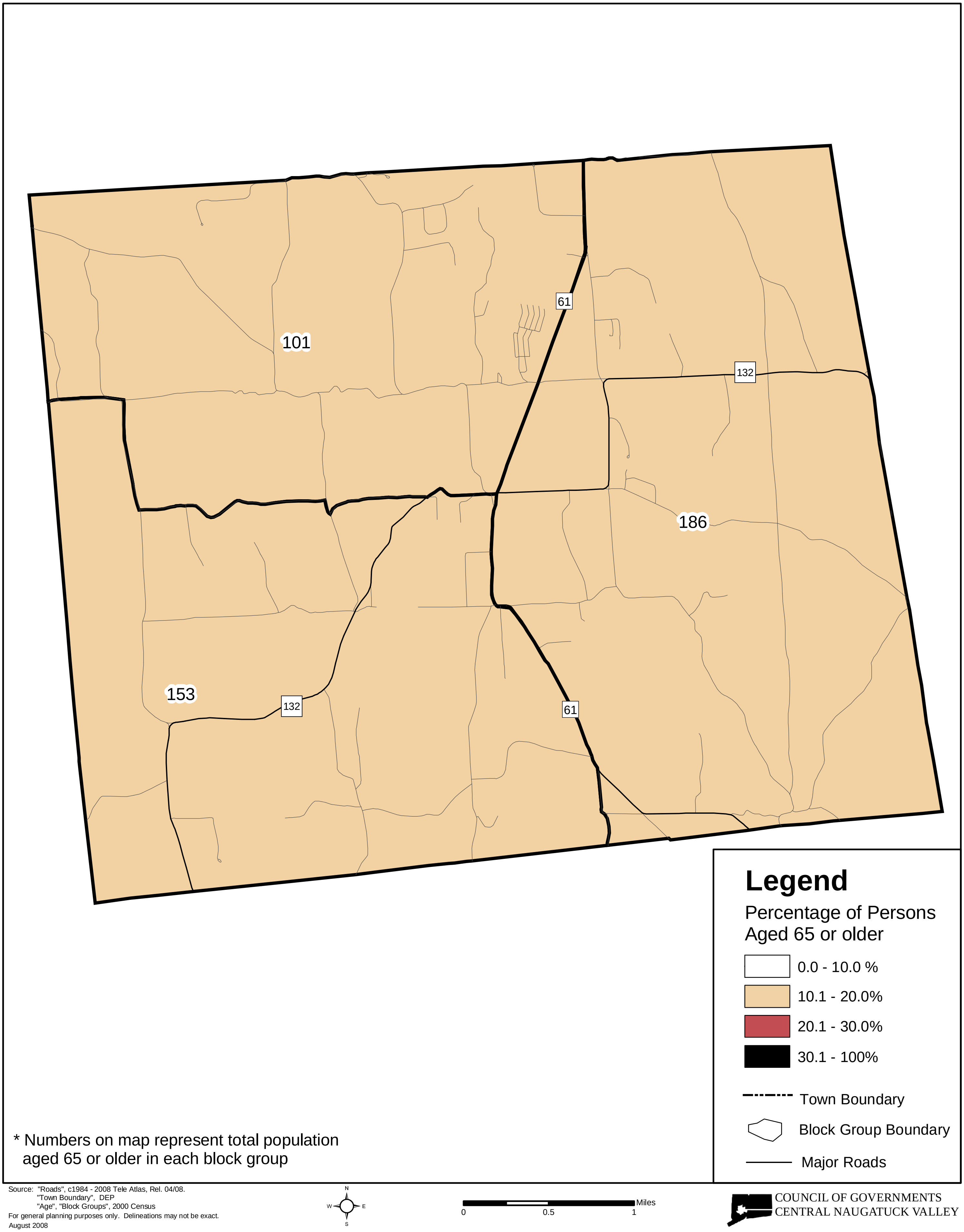
2.7 Governmental Structure

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

In addition to Board of Selectmen and the Town Meeting, there are boards, commissions and committees providing input and direction to Town administrators, while Town departments provide municipal services and day-to-day administration. Many of these commissions and departments play a role in hazard mitigation, including the Planning Commission, the Conservation Commission, the Inland Wetland Agency, the Long Meadow Lake Management Commission, the Highway Department / Department of Public Works, the Building Official, the Fire Department, and the Resident State Trooper.

The Highway Department/Department of Public Works is the principal municipal department that responds to problems caused by natural hazards. Complaints related to Town maintenance issues are routed to the Department of Public Works. These complaints are usually received via phone, fax, mail, or email and are recorded in a book. The complaints are investigated as necessary until remediation surrounding the individual complaint is concluded.

Figure 2-6: Bethlehem Elderly Population



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Age", "Block Groups", 2000 Census
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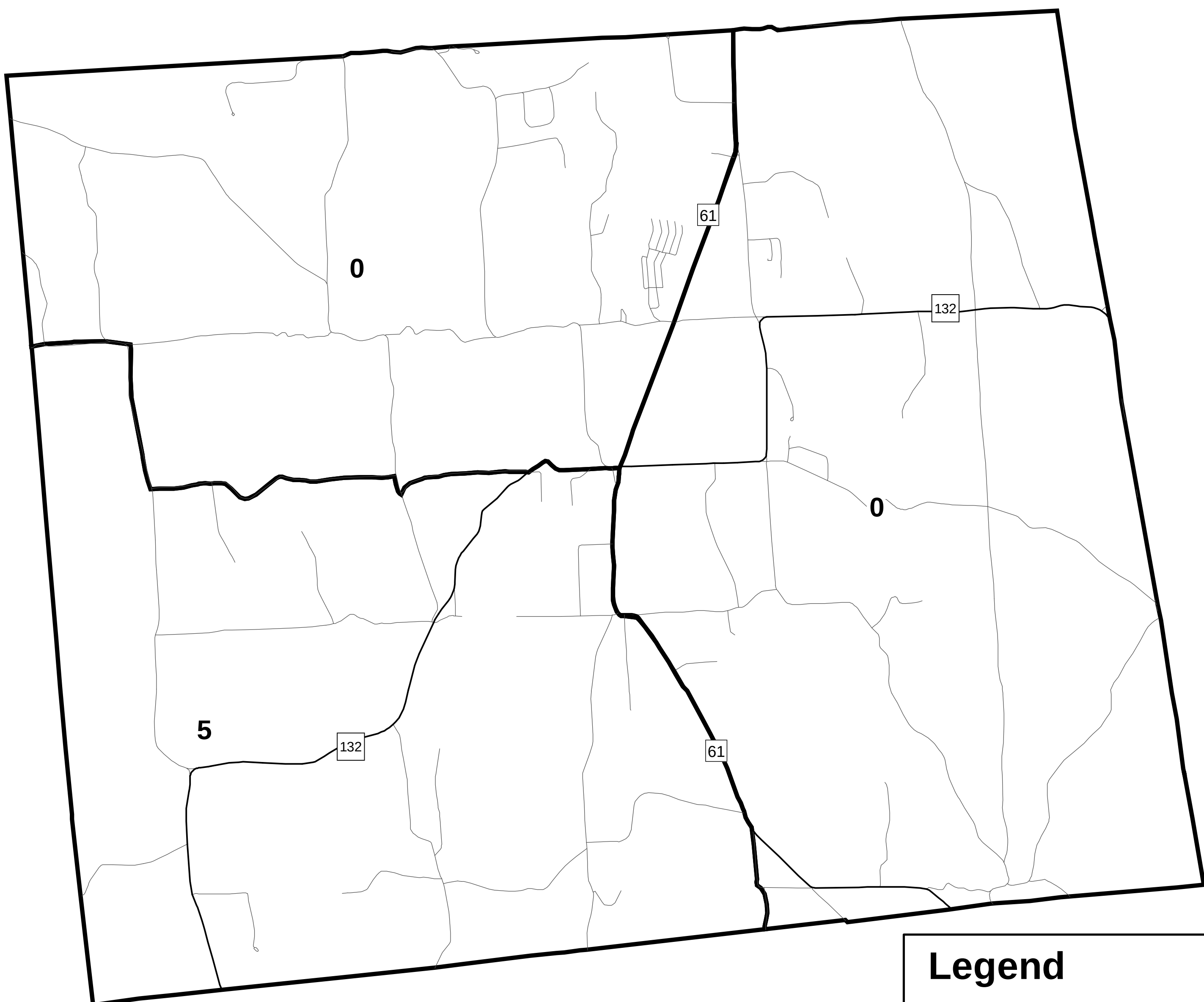
Figure 2-7: Bethlehem Linguistically Isolated Households



Legend

Percentage of Households Linguistically Isolated

- 0.0 - 4.9 %
- 5.0 - 9.9 %
- 10.0 - 14.9 %
- greater than 15%
- Town Boundary
- Block Group Boundary
- Major Roads

Data based on block group geography.
A linguistically isolated household is one in which no member 14 years old and over (1) speaks only English or (2) speaks a non-English language and speaks English "very well." In other words, all members 14 years old and over have at least some difficulty with English.

* Numbers on map represent total households that are linguistically isolated in each block group

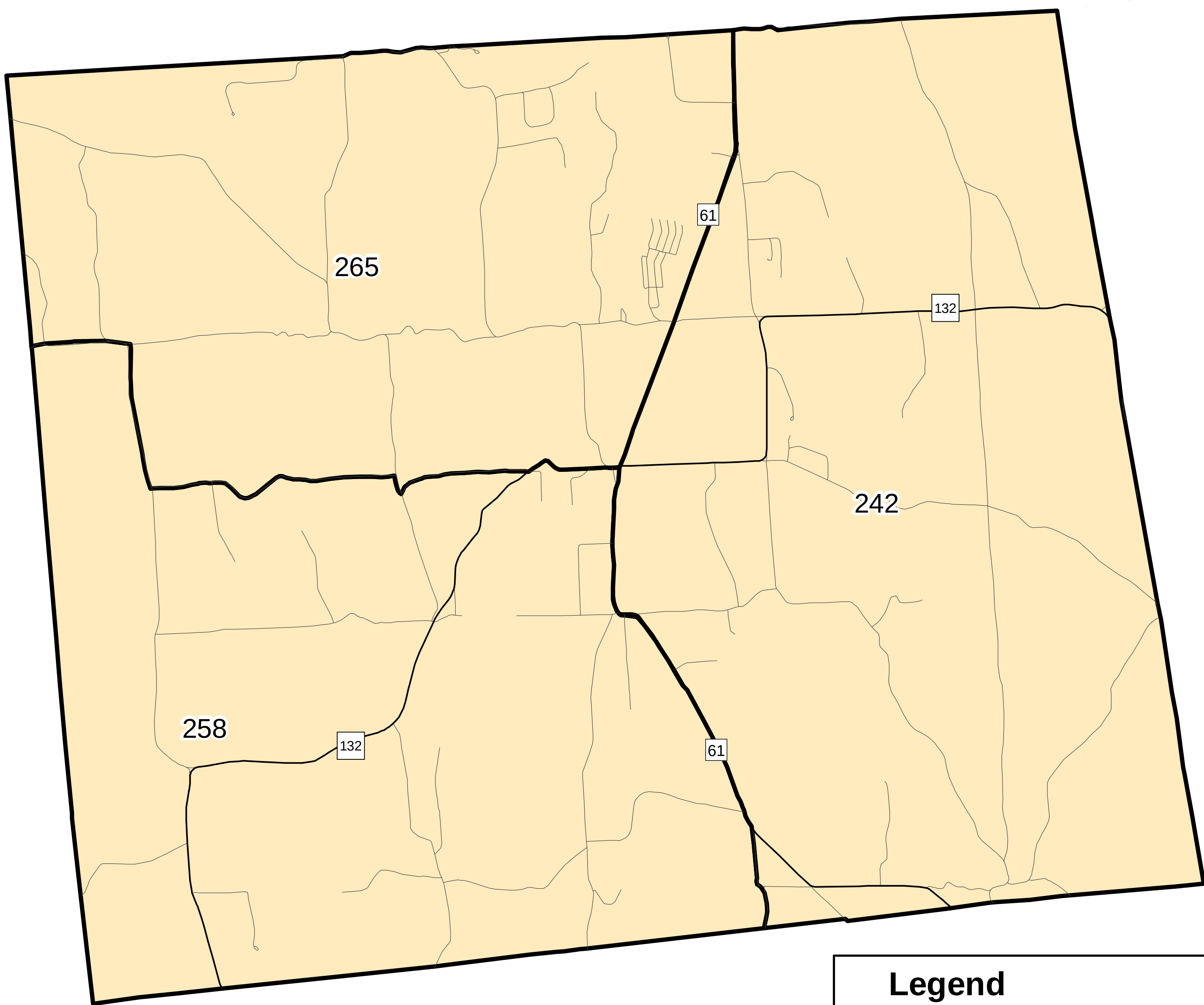
Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Linguistically Isolated", "Block Groups", 2000 Census
For general planning purposes only. Delineations may not be exact.
August 2008

N W E S

Miles
0 0.5 1

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

Figure 2-8: Bethlehem Disabilities Map



Legend

Total Disabilities Tallied of People Aged 5 and Older

- 0 - 200
- 201 - 400
- 401 - 600
- > 600
- Town Boundary
- Block Group Boundary
- Major Roads

Disabilities are categorized as sensory, physical, mental, self-care, go-outside-home, and employment

* Numbers on map represent total disabilities tallied for people aged 5 or older in each block group

Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Disability", "Block Groups", 2000 Census
For general planning purposes only. Delineations may not be exact.
August 2008

N W E S

0 0.5 1 Miles

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY

As the Town has an almost entirely residential tax base, funding of capital projects can be challenging. Bethlehem relies heavily on outside grants (such as the Small Town Economic Assistance Program, or STEAP) for many projects and upgrades, although the town is developing a capital improvement program.

2.8 ***Development Trends***

Bethlehem was settled in the early 1700s as a section of Woodbury known as North Purchase. The name Bethlehem was adopted in 1739, although it was originally spelled phonetically as Bethlem. The Town was granted an additional portion of Woodbury in 1741 and was officially incorporated in 1787. The Town remained largely agrarian until the early 20th century, with farms sited on hilltops and apples being one of the primary crops. Some light industry did operate in Town in the 1800s, using water to provide power to mills, hat factories, and leather manufacturing companies. These industries relocated to industrial centers by the 20th century.

The Town of Bethlehem has no zoning regulations which would specifically prohibit more intense forms of development within the Town limits. However, Bethlehem has almost no development currently ongoing due to the lack of public water and sewer systems. In addition, most of the soils in Bethlehem provide inadequate processing capacity for large on-site septic systems, making such systems prohibitively expensive. Residential development has been limited since the late 1980s, and most development applications are typically for very small (one to two lot) subdivisions. As of 1998, the total number of housing units in Bethlehem was increasing by approximately 12 per year.

The Town has several development regulations pertinent to hazard mitigation. Subdivisions featuring cul-de-sacs offer a single access point for emergency services, lengthening emergency response times and rendering those residential areas vulnerable if access is cut off by flooding or downed tree limbs. Thus, cul-de-sacs in new developments are discouraged and connectivity of roads is encouraged. The Town of Bethlehem requires a 50-foot right of way for local residential streets with a hammerhead located at the end of dead end streets, and dead end streets can have only 20 homes or fewer. In addition, utilities serving new developments must be installed underground wherever possible. Exceptions due to shallow bedrock are granted on a case-by-case basis.

Based on the Town's 2010 Plan of Conservation and Development, efforts are being made to preserve Bethlehem's small farming town charm and limit the impact of future development. Specifically, a farmland preservation program has been pursued as a measure to retain open space and agriculture. This, in turn, will limit development in areas vulnerable to natural hazards.

In the past five years since the adoption of the first HMP, commercial development has been slow paced. The largest development in the past few years has been the construction of two buildings for a proposed group home at 64 Double Hill Road. Four single family houses were constructed in 2013 and most permits are for single family residential renovations.

In summary, the Town of Bethlehem has continued to ensure that its very low pace of new development is sited and approved with minimal risk from natural hazards.

2.9 Critical Facilities and Sheltering Capacity

The Town considers its police, fire, governmental, and major transportation arteries to be its most important critical facilities, for these are needed to ensure that emergencies are addressed while day-to-day management of Bethlehem continues. Elderly housing facilities and group homes are included with critical facilities, as these house populations of individuals that would require special assistance during an emergency. In addition, Town personnel consider its communication utilities to be a critical facility. A list of critical facilities is provided in Table 2-5.

Table 2-5
Critical Facilities in Bethlehem

Type	Name	Address	Located in SFHA?
Emergency Medical	Ambulance Association	P.O. Box 401	No
Retirement Community	North Purchase Elderly Home	11 Jackson Lane	No
Group Home	Wellspring Foundation	84 Judge Lane	No
Group Home	Wellspring Foundation / Arch Bridge School	21 Arch Bridge Road	No
Group Home	Angelus House	158 Flanders Road	No
Group Home	Double Hill	Route 64	No
Group Home	52 Arrowhead Lane	52 Arrowhead Lane	No
Town Hall	Municipal Complex | Backup EOC	36 Main Street South	No
Public Works	Municipal Complex	36 Main Street South	No
Fire Department	Municipal Complex | Primary EOC	26 Main Street South	No
Police	Municipal Complex	36 Main Street South	No
Community Center; Day shelter for charging and warming	Memorial Hall	Main Street	No
School	Bethlehem Elementary	92 East Street	No
School (Private)	The Woodhall School	58 Harrison Lane	No
Day Care Center	Bethlehem Day Care	185 Main Street North	No
Other	Abbey Of Regina Laudis	273 Flanders Road	No
Temporary day shelter if the school is evacuated	Church of the Nativity	48 East Street	No
Commercial/Services	Various	Main Street South	No

Source: Council of Governments Central Naugatuck Valley; Town of Bethlehem

The town center, shelters, transportation, and communications are described in more detail below, along with a summary of the potential for these facilities to be impacted by natural hazards.

Town Center

The businesses and services located along Main Street South are considered a critical "facility" by the town. There is a need to keep the Main Street South services open as long as possible after a disaster due to the rural and isolated nature of the town, and these services must remain powered by electricity. The supply comes from the Carmel Hill substation near Woodbury. The entire length of utility lines from there to the downtown area cannot be placed underground and will remain vulnerable to wind and ice damage.

Shelters

Emergency shelters are considered to be an important subset of critical facilities, as they are needed in most emergency situations. Bethlehem lacks a true shelter. Memorial Hall can be used for warming and charging, but people cannot sleep there. Nonnewaug High School could eventually be a shelter for Bethlehem and Woodbury, but the facility lacks a generator. A renovation was approved but has been delayed. The Church of the Nativity at 92 East Street is a temporary day shelter in situations when children are evacuated from the school and brought to the church. The Fire Department can be used as shelter for small, short term events. A potential problem with the various shelters is that Memorial Hall and the Fire Department share the same driveway, which can create a conflict during emergencies.

The Town's other school buildings – Bethlehem Elementary and The Woodhall School – are not considered to be shelters but could be converted to additional shelter space in case of an emergency. Bethlehem Elementary School serves as an emergency supply distribution center. The Woodhall School is private and may only be available during a summer emergency. The Abby of Regina Laudis Priory is another potential shelter, but the Town only plans to ask to use it as a last resort out of respect for the cloistered nature of the facility. Other municipal buildings in the municipal complex, such as the Highway Department garage, have generators but are not considered to be shelter space.

In case of a power outage, it is anticipated that 10-20% of the population would relocate, although not all of those relocating would necessarily utilize the shelter facilities. Bethlehem utilizes its facilities on a temporary basis for providing shelter until hazards such as hurricanes diminish. The Nonnewaug High School located in Woodbury and regionally-located mass care facilities operated and paid for by the American Red Cross may also be available during recovery operations when additional sheltering services are necessary. During extended power outages, families in Bethlehem have also made use of the Wisdom House in Litchfield as a shelter as opposed to Town facilities.

Transportation

The Town of Bethlehem does not have any hospitals or medical centers. Instead, residents use the nearby facilities in Waterbury, New Milford, Southbury, or Torrington. As a means of accessing these facilities, Bethlehem residents travel along Route 61 or Route 132, the two major transportation arteries out of Town. Flanders Road is also a good evacuation route south into Woodbury.

Evacuation routes (Route 61 and Route 132) are regionally defined by the Regional Evacuation Plan. No local evacuation plan exists. Bethlehem residents must use state roads in surrounding Towns to access Route 8, a major north-south thoroughfare to Waterbury and Torrington, and Interstate 84.

Communications

The Town uses 9-1-1 for emergency notification and response. When the initial HMP was developed, it was believed that the overall communications system was outdated. The Town had the capability to communicate to DEMHS Region 5 and the State Trooper operates at 800 megahertz, so The Town possessed minor out-of-town communication capability by radio. The Town Communications Plan mentions the use of the Morris Fire House as a Command Center during emergencies, but radio communications were not possible with that facility.

When the initial HMP was developed, a communications study was underway to recommend an upgrade to the emergency notification system compatible with those in surrounding towns. In addition, the COGCNV was facilitating the possibility of instituting an enhanced emergency notification system in the area to further enhance emergency response. Some of the former COGCNV towns utilize CodeRED, whereas some of them (including Bethlehem) are now served by the CT Alert emergency notification system.

Potential Impacts from Natural Hazards

Critical facilities are rarely impacted by flooding in the Town of Bethlehem, as none of the facilities are located within floodplains. Route 132 a major east–west thoroughfare, has occasional flooding issues near Long Horizon Road and Sky Meadow Road. Such flooding slows emergency response times to nearby neighborhoods due to detours around this area.

None of the critical facilities in Bethlehem are any more susceptible to wind, summer storms, winter storms, or earthquakes than the rest of the Town. In addition, no critical facilities are located within a mapped dam failure inundation area. The only critical facility at potential risk is the Angelus House group home, which is located near the boundary of a wildfire risk area. The following sections will discuss each natural hazard in detail and include a description of populations at risk.

3.0 FLOODING

3.1 Setting

According to FEMA, most municipalities in the United States have at least one clearly recognizable flood-prone 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). Flood-prone areas are addressed through a combination of floodplain management criteria, ordinances, and community assistance programs sponsored by the NFIP and individual municipalities.

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

In general, flooding affects a small area of Bethlehem with moderate to frequent regularity. The areas impacted by overflow of river systems are generally limited to river corridors and floodplains. Indirect flooding that occurs outside floodplains and localized nuisance flooding along tributaries is a more common problem in the Town. This type of flooding occurs particularly along roadways as a result of inadequate drainage and other factors. The frequency of flooding in Bethlehem is considered highly likely for any given year, but flooding damage only has a limited effect because the town is only very lightly developed.

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.

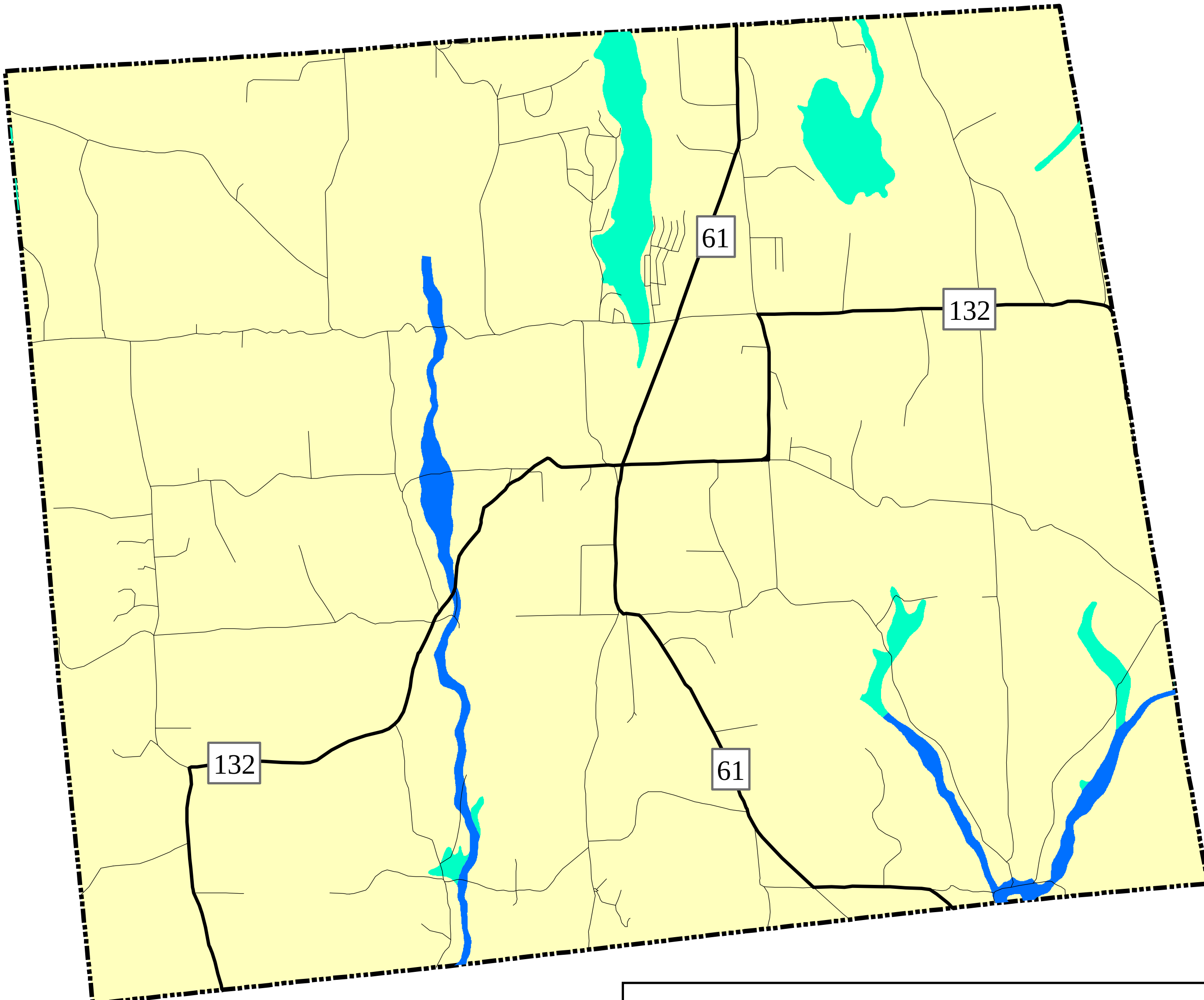
Flooding presents several safety hazards to people and property and can cause extensive damage and potential injury or loss of life. Floodwaters cause massive damage to the lower levels of buildings, destroying business records, furniture, and other sentimental papers and artifacts. In addition, floodwaters 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 100-year 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.

SFHAs in Bethlehem are delineated on a Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS). An initial Flood Hazard Boundary Map was identified on February 21, 1975. The FIRM delineates areas within Bethlehem that are vulnerable to flooding and was originally published on June 4, 1990. The Town's FIRM has not been updated and is the current effective map. The FIS was originally published on June 4, 1990 and also has not been updated. Refer to Figure 3-1 for the areas of Bethlehem susceptible to flooding based on FEMA flood zones. Table 3-1 describes the various zones depicted on the FIRM panel for Bethlehem.



Legend

Bethlehem Boundary

State Routes

Local Roads

Flood Zones

1% Annual Chance of Flooding w/o Elevations

1% Annual Chance of Flooding with Elevations

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

Figure 3-1: FEMA Flood Zones in Bethlehem

LOCATION:
Bethlehem, CT

N

Bethlehem Natural Hazard Mitigation Plan Update

MXD: P:\2097-11\Design\GIS\Maps\Bethlehem\2013_Figure3-1_FEMAFlood.mxd

Map By: JDW
MMI#: 2097-11
Original: 07/05/2013
Revision: 7/25/2013
Scale: 1 inch = 0.75 mile

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Table 3-1
FIRM Zone Descriptions

Zone	Description
A	An area inundated by 100-year flooding, for which no base flood elevations (BFEs) have been determined.
AE	An area inundated by 100-year flooding, for which BFEs have been determined.
Area Not Included	An area that is located within a community or county that is not mapped on any published FIRM.
X	An area that is determined to be outside the 100- and 500-year floodplains.
X500	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.

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

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

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

3.3 Historic Record

In most every season of the year throughout its recorded history, the Town of Bethlehem has experienced various degrees of flooding. 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 FEMA FIS, major historic floods have occurred in Bethlehem in March 1913, November 1927, March 1936, September 1938, and August 1955. In terms of damage to the Town of Bethlehem, the most severe of these was damage associated with the August 1955 hurricane and flood which had a recurrence interval of 200 years as measured at the USGS gauging station on Shepaug River in Roxbury. This flood was the result of high intensity rainfall falling on saturated ground.

According to the NCDC Storm Events Database, there have been 58 flooding events and 17 flash flood events in Litchfield County since 1993. The following are descriptions of more recent examples of floods in and around the Town of Bethlehem as described in the NCDC Storm Events Database, and based on correspondence with municipal officials.

- July 28, 1994: A heavy rain storm began in the early morning hours and continued into the afternoon, producing three to five inches of rain along the Interstate 84 corridor. The storm caused localized street flooding in Thomaston and Washington.

- August 21, 1994: A flash flood caused approximately $5 million in property damage in Litchfield County. Two bridges washed out and approximately 40 miles of Town roads were damaged in Bethlehem, with six miles being severely damaged. Many residents reported basement flooding, but there was no significant damage to buildings or utilities.

- January 19, 1996: An intense area of low pressure over the Mid-Atlantic region produced unseasonably warm temperatures, resulting in the rapid melting of one to three feet of snow. This melting combined with one to three inches of rainfall to produce flooding across Litchfield County, particularly along small streams. This flooding caused approximately $300,000 in property damage.

- July 13, 1996: The remnants of Hurricane Bertha tracked northeast over Connecticut, producing three to five inches of rain across Litchfield County. The storm resulted in minimal property damage, but caused flooding in several roads and streams, and the strong winds accompanying the storm caused scattered power outages when water-laden tree branches were downed on wires.

- September 16, 1999: Torrential record rainfall preceding the remnants of Tropical Storm Floyd caused widespread urban, small stream, and river flooding. Fairfield County was declared a disaster area, along with Litchfield and Hartford Counties. Initial cost estimates for damages to the public sector was $1.5 million for those three counties. These estimates do not account for damages to the private sector and are based on information provided by the Connecticut Office of Emergency Management. Serious wide-spread flooding of low-lying and poor drainage areas resulted in the closure of many roads and basement flooding across Fairfield, New Haven, and Middlesex Counties.

- December 17, 2000: Unseasonably warm and moist air tracked northward from the Gulf of Mexico, bringing a record-breaking rainstorm to Litchfield County. The storm produced two to four inches of rain, strong winds, and combined with melting snow to produce flooding conditions. The bulk of the rainfall occurred in a short interval of time, with some localities receiving an inch per hour. In Torrington, the Naugatuck River washed construction equipment downstream, and widespread street flooding was reported in Litchfield. Trees were reported down in Bethlehem.

- June 17, 2001: The remnants of Tropical Storm Allison combined with a slow-moving cold front to produce torrential rainfall over much of Litchfield County. Two to six inches of rain fell in a short time in the central and southeastern portions of the county, causing a total of $55,000 in property damage. Roads were washed out in the Town of Bethlehem, and numerous small streams overflowed and roads flooded in Woodbury.

- October 2005: Although the consistent rainfall of October 7-15, 2005 caused flooding and dam failures in most of Connecticut (most severely in northern Connecticut), the precipitation intensity and duration was such that only minor flooding occurred in Bethlehem.

- June 2, 2006: Up to eight inches of heavy rainfall caused widespread damage in Waterbury, Wolcott, and Prospect. The storm caused slumps and drainage failures throughout Waterbury and several streets were flooded in all three municipalities.

- April 15-16, 2007: A spring nor'easter dropped over six inches of rain in the Central Naugatuck Valley, causing widespread flooding.

- February 13, 2008: Precipitation began as snow on February 12 and transitioned to sleet and then rain on February 13. Rainfall from 1.5 to 4 inches fell on top of two to three inches of snow, which led to flooding across the area.

- February and March 2011: Minor flooding occurred along the Pomperaug River tributaries in Bethlehem, although severe flooding occurred downstream along the Pomperaug River in Woodbury and Southbury.

- August 29, 2011: Tropical Storm Irene produced heavy rainfall between five and 10 inches within a 12-hour period. The rainfall resulted in widespread flash flooding and river flooding across the southern part of Litchfield County, and a major disaster declaration was declared (FEMA-4023-DR). Tropical Storm Irene caused an average power outage in Bethlehem of two days. Approximately 40,000 yards of debris were generated.

Flooding was substantial during Tropical Storm Irene. Downstream of Long Meadow Pond dam, a section of Lake Drive washed out at twin culverts, and Munger Lane overtopped. The private dam at March Farms held up. The Arrowhead Lane area along the Weekeepeemee River was evacuated as a precaution. The Falls Road culvert was lost at the Nonnewaug River, and culverts overtopped at Nonnewaug Road (East Spring Brook). The Kasson Road section of Route 132 downstream of the Bronson Lockwood Reservoir fared well because the reservoir was intentionally drawn down prior to Irene.

3.4 Existing Capabilities

The Town of Bethlehem has in place a number of measures to prevent flood damage. These include regulations, codes, and ordinances preventing encroachment and development near floodways.

Regulations, Codes, and Ordinances

The Town of Bethlehem First Selectman serves as the NFIP administrator and oversees the enforcement of NFIP regulations with the assistance of the Building Official and Emergency Management Director. The Town Planning Commission uses the 100-year flood lines from the FIRM and FIS delineated by FEMA as the official maps and report for determining special flood hazard areas. Ordinances require that all structures in flood hazard areas have their lowest floor be above established flood elevations. Site plan standards require that all proposals be consistent with the need to minimize flood damage, that public facilities and utilities be located and constructed to minimize flood damage, and that adequate drainage is provided. The Bethlehem Inland Wetlands Agency also reviews new developments and existing land uses on and near wetland courses.

Regulations, codes, and ordinances that apply to flood hazard mitigation in conjunction with and in addition to NFIP regulations include:

- ***Flood Damage Prevention Ordinance*** (Chapter 84 of the Town of Bethlehem Code). This section of the Town code promotes the public health, safety and general welfare and minimizes public and private losses due to flood conditions by establishing standards and elevations for construction and renovations in flood hazard areas. Chapter 84 of the Bethlehem code is essentially the local version of the NFIP regulations. One foot of freeboard is required for new residential construction and substantial improvements in the SFHA.

- ***Earth Materials Ordinance*** (Chapter 75 of the Town of Bethlehem Code) This ordinance regulates excavation and/or deposition of any materials in wetlands or floodplains and notes that activities in these areas must be regulated by the Inland Wetlands Agency of Bethlehem.

The Plan of Conservation and Development (POCD) was updated in 2010 with aspects of the previous Hazard Mitigation Plan goals and strategies.

- ***Land Use Policy 1*** (Section VIII of the 2010 Bethlehem POCD).

  - (A)(1) Preserve environmentally sensitive natural resources by regulating encroachment by development on these resources to the extent permitted by statutes. Whenever possible, opportunities to join open space easements should be encouraged.
  - (A)(3) Permanently set aside lands through acquisition by the Town or a land trust, or through the use of conservation restrictions within the meaning of section 47-42a of the Connecticut General Statutes.
  - (A)(4) Avoid any development in the central ridge along Main Street area unless such development would reduce impact on wetlands and water quality or balance the effect development by mitigation.
  - (A)(5) Preserve the quality of surface water supplies both in Bethlehem and in surrounding communities by encouraging limited development in critical water supply watersheds.

- ***Additional Evidence*** (Chapter 84-20 the Bethlehem Subdivision Regulations Section 2.4.2 C of). This section authorizes the Planning Commission to request additional information if needed such that "proper provision will be made for protective flood control measures in areas contiguous to brooks, rivers, or other bodies of water subject to flooding".

- ***Decision*** (Section 2.4.5 of the Bethlehem Subdivision Regulations). This section notes that approval of a subdivision application is contingent upon "presentation of a copy of a permit or copy of declaratory ruling or permit from the inland wetlands regulating agency of the Town of Bethlehem, authorizing construction of any roads, drainage, or other improvements or any grading that constitute a regulated activity affecting wetlands and/or watercourses".

- ***Natural Features*** (Section 3.6 of the Bethlehem Subdivision Regulations). This section authorizes the Commission to ask for alternative designs that demonstrate that all reasonable care has been taken to preserve the natural features of the tract, such as by avoiding cuts and fills which may cause erosion or damage to water resources, avoiding construction near or that alters watercourses, by avoiding excavation or filling of wetlands, floodplains, and other land subject to flooding, and by providing for preservation of wetlands and watercourses through easement.

- ***Terrain*** (Section 3.7.2 of Bethlehem Subdivision Regulations). Section 3.7.2 notes that "construction of homes, driveways, and sub-surface sewage disposal systems should not be proposed in areas with severe limitation for development," such as wetlands, floodplains, and watercourses.

- ***Inland Wetlands and Watercourses Regulations***. (Chapter 27 of the Bethlehem Inland Wetlands Agency) This document defines in detail the Town of Bethlehem's regulations regarding development near wetlands, watercourses, and water bodies that are sometimes coincident with floodplains. Section 2 defines "Regulated Activities" covered by the Regulations. Section 6 states that no person may conduct or maintain a regulated activity without obtaining a permit. Section 7 outlines the application requirements.

- ***Aquifer Protection Area (APA) Regulations.*** (Chapter 27-5 Article II of the Bethlehem Subdivision Inland Wetlands Agency) After the formal aquifer protection area mapping was developed for wells located in Bethlehem, the Bethlehem Inland Wetlands Commission was designated as the official Aquifer Protection Agency. These regulations provide the manner in which boundaries of aquifer protection areas are established and amended or changed. Procedures for the regulations of activity within the area. The form for an application to conduct regulated activities within the area. Notice and publication requirements. Criteria and procedures for the review of applications.

The intent of these regulations is to promote the public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas of the Town of Bethlehem 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;
- Ensure that purchasers of property are notified of special flood hazards;
- Ensure that all land approved for subdivision shall have proper provisions for water, drainage, and septic systems; and in areas contiguous to brooks, rivers, or other bodies of water subject to flooding, that proper provisions be made for protective flood control measures;

- ❑ Ensure that property owners are responsible for their actions;
- ❑ Ensure the continued eligibility of owners of property in Bethlehem for participation in the National Flood Insurance Program.

NFIP Coordination

The Town of Bethlehem First Selectman serves as the NFIP administrator and oversees the enforcement of NFIP regulations. The Town has not completed an update of its flood hazard regulations, and currently has no plans to enroll in the Community Rating System program. The Town of Bethlehem Planning Commission uses the 100-year flood lines from the FIRM and FIS delineated by FEMA to determine floodplain areas. Site plan standards require that all proposals be consistent with the need to minimize flood damage, that public facilities and utilities be located and constructed to minimize flood damage, and that adequate drainage is provided. The Bethlehem Inland Wetlands Agency also reviews new developments and existing land uses on and near wetlands and watercourses.

Roads and Drainage

The Bethlehem Highway Department/Department of Public Works (DPW) is in charge of the maintenance of the Town's drainage systems, and performs clearing of bridges and culverts and other maintenance as needed. Drainage complaints are routed to the DPW and recorded. There have not been any changes in the last five years regarding how drainage complaints are handled. The Town uses these records to identify potential problems and plan for maintenance and upgrades. However, the town has not replaced or constructed any culverts in the last few years. The town maintains a capital improvement plan, and is in the midst of evaluating needs as of early 2015.

Emergency Communications

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. As noted in Chapter 2, Bethlehem subscribes to the CT Alert system for direct notifications from local emergency personnel in the event of emergency situations or critical community alerts.

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

In summary, the Town of Bethlehem primarily attempts to mitigate flood damage and flood hazards by restricting building activities inside flood-prone areas. This process is carried out through both the Planning Commission and the Inland Wetlands Agency. All watercourses are to be encroached minimally or not at all to maintain the existing flood carrying capacity. These regulations rely primarily on the FEMA-defined 100-year flood elevations to determine flood areas. Freeboard is required. The town’s capabilities to mitigate for flooding and prevent loss of life and property have remained consistent since the initial hazard mitigation plan was adopted.

3.5 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk to flooding within the Town. Major land use classes and critical facilities within these areas are identified. According to the FEMA FIRMs, 483 acres of land in Bethlehem are located within the 100-year flood boundary. In addition, indirect and nuisance flooding occurs near streams and rivers throughout Bethlehem due to inadequate drainage and other factors. Based on correspondence with the State of Connecticut NFIP Coordinator, repetitive loss properties are not located in the Town of Bethlehem.

The primary waterway in the Town is the Weekeepeemee River, a non-navigable watercourse running north to south through the western part of Town. The secondary waterway in Bethlehem is East Spring Brook which runs north to south in the eastern part of Town. The remaining waterways in Bethlehem are mostly small streams and brooks significant for water supply and conservation purposes, but are not recreational resources. Recall from Figure 3-1 that floodplains with elevations are delineated for the Weekeepeemee River, the Nonnewaug River, and portions of East Spring Brook, while several smaller brooks and streams, including the major water bodies, have floodplains delineated by approximate methods. All of these delineated floodplains are generally limited to the areas adjacent to the streams.

Due to the steep topography surrounding the major watercourses, there is little wide-scale flooding in Bethlehem. Specific areas susceptible to flooding were identified by Town personnel and observed by Milone & MacBroom, Inc. staff during field inspections as described in Section 1.5 and documented in Appendix B. Most flooding occurs due to large amounts of rainfall falling in conjunction with snowmelt and occurs due to undersized road culverts, as noted below.

- Arrowhead Lane – Homes here are near the Weekeepeemee River and have experienced flooding damage in the past. The two homes at the end of the street reportedly have flooding problems due to a nearby small pond.

- Crane Hollow Road – The initial HMP explained that water from the Weekeepeemee River overtopped the road at least once every two years, whereas the FIS showed the 100-year flood elevation as not overtopping the road. The town has not noted any flood incidents in the past five years, and this area is no longer believed to have high flood risk.

- Double Hill Road – A resident has beavers on property that includes the Weekeepeemee River, and the beavers build the dam high enough such that water overtops the road crossing for the river. The owner does not want the beavers to be bothered, so the Town does not try to remove the dams.

- Falls Road – This area is the only access from Bethlehem into the Land Trust property on the Woodbury/Watertown border. Bethlehem is often the first responder for emergencies in this forest, but access is limited because of poor road conditions and a poor crossing over the Nonnewaug River. The tract is designed to be used for passive recreation but is primarily used by all-terrain vehicles (ATVs) and horses. Emergency personnel noted that this forest often has problems related to alcohol use, namely ATV and snowmobile accidents, parties, and underage drinking. While the Town of Bethlehem has pursued a multi-town resolution regarding emergency access to this parcel, including rebuilding the bridge on Falls Road, at least one of the other municipalities does not support such a resolution.

- Hickory Lane – The initial HMP explained that the culvert near the south end of this road is undersized, causing the road to flood at least once every two years. The Town cannot fix the problem without elevating the road, but the area is in the 100-year floodplain of a tributary of the Nonnewaug River. The town has not noted any flood incidents in the past five years, and this area is no longer believed to have high flood risk due to the culvert although the town understands that it is located in the SFHA.

- Hard Hill Road North – There are drainage issues along this road that occur primarily on private property. Each farm directs its drainage south to the next downstream farm, causing flooding problems on the downstream farms.

- Route 132 (Kasson Road) – Water overtops the road near the fire pond. This area is between Lakes Road and Sky Meadow Road. This flooding impedes emergency response to the Sky Meadow Lane, Woodland Road, Cabbage Lane, and Hard Hill Road neighborhoods.

- Route 132 (Lakes Road) – Town personnel have reported general flooding problems occur near Long Horizon Road.

As noted above, flooding was substantial during Tropical Storm Irene in 2011. Downstream of Long Meadow Pond dam, a section of Lake Drive washed out at the twin culverts and Munger Lane overtopped. The Arrowhead Lane area along the Weekeepeemee River was evacuated as a precaution. The Falls Road culvert was lost at the Nonnewaug River, and culverts overtopped at Nonewaug Road (East Spring Brook).

Critical Facilities and Emergency Services

Critical facilities are not regularly impacted by flooding in the Town of Bethlehem. Route 132, a major east-west thoroughfare, has occasional flooding issues in two areas as described above. This flooding slows emergency response times due to detours around these areas.

***HAZUS-MH* Vulnerability Analysis**

HAZUS-MH is FEMA's loss estimation methodology software for flood, wind, and earthquake hazards. The software utilizes year 2000 U.S. Census data and a variety of engineering information to calculate potential damages (specified in year 2006 United States dollars [USD]) to a user-defined region. The software was used to perform a basic analysis and generate potential damages to Bethlehem from a 1% annual chance riverine flood event simultaneously occurring along both the East Spring Brook Watershed and Weekeepeemee Watershed. Hydrology and hydraulics for the streams and rivers were generated utilizing the Connecticut LiDAR 10-foot Digital Elevation Model based on LiDAR collected in the year 2000. The following paragraphs discuss the results of the HAZUS-MH analysis.

The FEMA default values were used for each of the town's census blocks in the HAZUS simulation. Approximately $358 million of total building replacement value were estimated to exist within the town of Bethlehem. Of that total, the HAZUS 1% annual chance riverine flood event estimates a total building-related loss of $8.82 million. A summary of the default building values is shown in Table 3-2.

Table 3-2
***HAZUS-MH* Flood Scenario – Basic Information**

Occupancy	Dollar Exposure (2006 USD)
Residential	$ 282,113,000
Commercial	$ 45,274,000
Other	$ 30,281,000
Total	**$ 357,668,000**

The *HAZUS-MH* simulation estimates that during a 1% annual chance flood event, one building will be at least moderately damaged in the town from flooding. Table 3-3 presents the expected damages based on building type.

Table 3-3
***HAZUS-MH* Flood Scenario – Building Stock Damages**
Number of Structures Damaged

Occupancy	1-10% Damaged	11-20% Damaged	21-30% Damaged	31-40% Damaged	41-50% Damaged	Substantially Damaged
Residential	0	1	0	9	0	1
Commercial	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	**0**	**1**	**0**	**0**	**0**	**1**

HAZUS-MH utilizes a subset of critical facilities known as "essential facilities" that are important following natural hazard events. These include one fire station, one hospital[3], one police station, and three schools. The software noted that under the 1% annual chance flood both the police station and fire station will be at least moderately damaged.

The *HAZUS-MH* simulation estimated that a total of 1,014 tons of debris would be generated by flood damage for the 1% annual chance flood scenario. It is estimated that 41 truckloads (at approximately 25 tons per truck) will be required to remove the debris. The breakdown of debris is as follows:

- ❑ Finishes (drywall, insulation, etc.) comprise 347tons.
- ❑ Structural material (wood, brick, etc.) comprise 426 tons.
- ❑ Foundation material (concrete slab, concrete block, rebar, etc.) comprise 241 tons.

HAZUS-MH calculated the potential sheltering requirement for the 1% annual chance flood event. The model estimates that 153 households will be displaced due to flooding. Displacement includes households evacuated from within or very near to the inundated areas. Of these households, 171 people are projected to seek temporary shelter in public shelters.

HAZUS-MH also calculated the predicted economic losses due to the 1% annual chance flood event. Economic losses are categorized as either building-related losses or business interruption losses. Building-related losses (damages to building, content, and inventory) are the estimated

[3] It is understood that a hospital is not located in Bethlehem

costs to repair or replace the damage caused to the building and its contents. 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.

- ❑ A total of $8.77 million of building-related losses is expected. Building losses account for the building structure, contents, and inventory. As such, residential losses accounted for a total of $3.83 million, commercial losses totaled $2.62 million, and other (municipal and industrial) losses totaled $2.32 million.

- ❑ Building-related economic losses of $8.82 million are predicted if $0.05 million in business interruption losses are included.

In summary, flooding is likely the most significant hazard to pose risk to the town of Bethlehem. Based on the historic record and *HAZUS-MH* simulations of the 1% annual chance flood events, the SFHAs and other areas are vulnerable to flooding damages, which can include direct structural damages, interruptions to business and commerce, emotional impacts, and injury or death.

3.6 Potential Mitigation Strategies and Actions

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

3.6.1 Prevention

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.

<u>Planning and Zoning</u>: Zoning[4] and Subdivision ordinances regulate development in flood hazard areas. Flood hazard areas should reflect a balance of development and natural areas, although

[4] The Town of Bethlehem is distinct from other communities as it does not regulate through zoning.

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.
- 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 can only be accomplished through revised FEMA-sponsored engineering studies or Letters of Map Change (LOMC).

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.

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

<u>Drainage System Maintenance</u>: An effective drainage system must be continually maintained to ensure efficiency and functionality. Maintenance should include programs to clean out blockages caused by overgrowth and debris. Culverts should be monitored, and repaired and improved when necessary. The use of Geographic Information System (GIS) technology would greatly aid the identification and location of problem areas.

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

The Town of Bethlehem Inland Wetlands Agency administers the wetland regulations and the Bethlehem Planning Commission administers the Subdivision regulations. The regulations simultaneously restrict development in floodplains, wetlands, and other flood prone areas. The Land Use Coordinator and Building Official are charged with ensuring that development follows the subdivision regulations and inland wetlands regulations. The Town of Bethlehem has a checklist that cross-references the bylaws, regulations, and codes related to flood damage prevention that may be applicable to a proposed project, and the Town makes this list available to potential applicants.

3.6.2 ***<u>Property Protection</u>***

A variety of steps can be taken to protect existing public and private properties from flood damage. 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.

- ***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.

> **Dry floodproofing refers to the act of making areas below the flood level watertight.**
>
> **Wet floodproofing refers to intentionally letting floodwater into a building to equalize interior and exterior water pressures.**

  - ***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.

All of the above *property protection* mitigation measures may be useful for Town of Bethlehem residents to prevent damage from inland and nuisance flooding.

3.6.3 ***Emergency Services***

A 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 Emergency Operations Plan outlining procedures for the mobilization and position of staff, equipment, and resources to facilitate evacuations and emergency floodwater control.
- Implementing an emergency notification system that combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas; or specific groups of people, such as emergency responder teams.

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

3.6.4 ***Public Education and Awareness***

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

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

3.6.5 ***Natural Resource Protection***

Floodplains can provide a number of natural resources and benefits, including storage of floodwaters, open space and recreation, water quality protection, erosion control, and preservation of natural habitats. Retaining the natural resources and functions of floodplains can not only reduce the frequency and consequences of flooding but also minimize stormwater management and nonpoint pollution problems. Through natural resource planning, these objectives can be achieved at substantially reduced overall costs.

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 flooding include:

- ❑ Pursue additional open space properties in floodplains by purchasing repetitive loss properties and other floodprone structures and converting the parcels to open space;
- ❑ Pursue the acquisition of additional municipal open space properties as discussed in the Plan of Conservation and Development;
- ❑ Selectively pursue conservation objectives listed in the Plan of Conservation and Development and/or more recent planning studies and documents; 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.

3.6.6 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 often recommended.

3.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies and actions for addressing riverine, drainage-related, and nuisance flooding are listed below in Table 3-4 with commentary regarding the status of each.

Table 3-4
Status of Previous Strategies and Actions

Strategy or Action	Status
Consider joining FEMA's Community Rating System.	Very few flood insurance policies are active and this strategy is not needed.
Continue to regulate activities within SFHAs.	The action is ongoing and is therefore a capability.
Consider requiring buildings constructed in floodprone areas to be protected to the highest recorded flood level, regardless of being within a defined SFHA.	Very few buildings have been constructed in SFHAs and this strategy is not needed. The town also maintains freeboard of 1.0 foot in the flood damage prevention code.
Ensure new buildings be designed and graded to shunt drainage away from the building.	The action is part of the building code and is therefore a capability.
Assist with the Map Mod program to ensure an appropriate update to the Flood Insurance Study, Flood Insurance Rate Maps, and Flood Boundary and Floodway Maps.	Litchfield County is not scheduled for map modernization, and this action is deleted.
After Map Mod has been completed, consider restudying local flood prone areas and produce new local-level regulatory floodplain maps using more exacting study techniques, including using more accurate contour information to map flood elevations provided with the FIRM.	Litchfield County is not scheduled for map modernization, and this action is deleted.
Adopt an aquifer protection area overlay zone to regulate development after Watertown Fire District has completed their final mapping of the Aquifer Protection Area for their wellfield in northeastern Woodbury.	Complete.
Pursue the acquisition of additional municipal open space properties inside SFHAs and set it aside as greenways, parks, or other non-residential, non-commercial, or non-industrial use.	This strategy has not been pursued and is carried forward.
Selectively pursue conservation recommendations listed in the Plan of Conservation and Development and other studies and documents.	This strategy has been pursued mainly for agricultural land, and is deleted in favor of the above strategy which is more specific to flood risk areas.

Strategy or Action	Status
Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.	The action is ongoing and is therefore a capability. By ordinance, the IWC excludes steep slopes and wetlands from the area that is counted toward development and septic systems.
Pursue funding to elevate Crane Hollow Road to prevent future instances of overtopping.	This area has not been floodprone and the strategy is not needed.
Pursue funding to elevate the road near the south end of Hickory Lane, or to widen the stream and install a box culvert.	This area has not been floodprone and the strategy is not needed.
Encourage the State Department of Transportation to elevate the level of Route 132 between Lakes Road and Sky Meadow Lane, or to widen the stream and install a box culvert.	This action has not been completed and is carried forward.

Portions of the above strategies and actions have been carried forward and are listed in the table of strategies in Appendix A. Two new strategies have been identified through the process of updating this plan:

- Consider limited acquisitions of homes along Arrowhead Lane depending on their elevations and flood risk.
- Replace culverts throughout town and increase capacities where appropriate.

4.0 HURRICANES

4.1 Setting

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

4.2 Hazard Assessment

Hurricanes are a class of tropical cyclones which are defined by the National Weather Service as 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 (1-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 geographical 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 less susceptible to hurricane wind damages than coastal areas in Connecticut; however, the heaviest rainfall often occurs inland. Therefore, inland areas are most vulnerable to flooding along roadways, lakes, and streams 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 2014 *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). Minimal Damage: Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs in building structures. Some damage is done to poorly constructed signs.

- ❑ **Category Two Hurricane:** Sustained winds 96-110 mph (83-95 kt). Moderate Damage: Considerable damage is done to shrubbery and tree foliage, some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing materials, windows, and doors; no major damage occurs to the building integrity of structures.

- ❑ **Category Three Hurricane:** Sustained winds 111-130 mph (96-113 kt). Extensive damage: Foliage torn from trees and shrubbery; large trees blown down. Practically all poorly constructed signs are blown down. Some damage to roofing materials of buildings occurs, with some window and door damage. Some structural damage occurs to small buildings, residences and utility buildings. Mobile homes are destroyed. There is a minor amount of failure of curtain walls (in framed buildings).

- ❑ **Category Four Hurricane:** Sustained winds 131-155 mph (114-135 kt). Extreme Damage: Shrubs and trees are blown down; all signs are down. Extensive roofing material and window and door damage occurs. Complete failure of roofs on many small residences occurs, and there is complete destruction of mobile homes. Some curtain walls experience failure.

- ❑ **Category Five Hurricane:** Sustained winds greater than 155 mph (135 kt). Catastrophic Damage: Shrubs and trees are blown down; all signs are down. Considerable damage to roofs of buildings. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings, and extensive shattering of glass in windows and doors occurs. Some complete buildings fail. Small buildings are overturned or blown away. Complete destruction of mobile homes occurs.

4.3 <u>Historic Record</u>

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 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 Bethlehem follows.

The most devastating hurricane to strike Connecticut, and believed to be the strongest hurricane to hit New England in recorded history, was believed to be a Category 3 hurricane. 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. The hurricane made landfall at Long Island, New York and moved quickly northward over Connecticut into northern New England.

The majority of damage was caused from storm surge and wind damage. Surges of 10 to 12 feet were recorded along portions of the Long Island and Connecticut Coast, and heavy winds flattened forests, destroyed nearly 5,000 cottages, farms, and homes, and damaged an estimated 15,000 more throughout New York and southern New England. Overall, the storm left an estimated 700 dead and caused physical damages in excess of $300 million (1938 United States dollars (USD)).

The "Great Atlantic Hurricane" hit the Connecticut coast in September 1944. This Category 3 hurricane brought rainfall in excess of six inches to most of the state and rainfall in excess of eight to ten inches in Fairfield County. Most of the wind damage from this storm occurred in southeastern Connecticut.

Another Category 3 hurricane, Hurricane Carol, struck in August of 1954 shortly after high tide and produced storm surges of 10 to 15 feet in southeastern Connecticut. Rainfall amounts of six inches were recorded in New London, and wind gusts peaked at over 100 mph. Near the coast, the combination of strong winds and storm surge damaged or destroyed thousands of buildings, and the winds toppled trees that left most of the eastern part of the state without power. Overall damages were estimated at $461 million (1954 USD), and 60 people died as a direct result of the hurricane. Western Connecticut was largely unaffected by Hurricane Carol due to the compact nature of the hurricane.

The following year, back-to-back hurricanes Connie and Diane caused torrential rains and record-breaking floods in Connecticut. Hurricane Connie was a declining tropical storm when it 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 Diane five days later, a Category 1 hurricane and the wettest tropical cyclone on record for the Northeast. Diane produced 14 inches of rain in a 30-hour period, causing destructive flooding conditions along nearly every major river system in the state. The Mad and Still Rivers in Winsted, the Naugatuck River, the Farmington River, and the Quinebaug River in northeastern Connecticut caused the most damage. The flood waters caused over 100 deaths, left 86,000 unemployed, and caused an estimated $200 million in damages (1955 USD). For comparison, the total property taxes levied by all Connecticut municipalities in 1954 amounted to $194.1 million.

In September of 1985, hurricane Gloria passed over the coastline as a Category 2 hurricane. 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 and heavy winds which damaged structures and uprooted trees. Over 500,000 people suffered 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 Bethlehem shelters were opened during Irene, and power outages averaged 48 hours. Approximately 40,000 yards of debris were generated.

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. However, damages were moderate to minor, and townwide brush collection was not necessary.

4.4 Existing Programs, Policies, and Mitigation Measures

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

Wind loading requirements are addressed through the state building code. The 2005 Connecticut State Building Code was amended in 2011 and adopted with an effective date of October 6, 2011; and subsequently amended to adopt the 2009 International Residential Code (IRC), effective February 28, 2014. 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 Bethlehem is 100 miles per hour. Bethlehem 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.

Trees and branches may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. The Town of Bethlehem approaches residents on a case-by-case basis if branches appear to be hazardous. Otherwise, it performs roadside tree maintenance, and Connecticut Light & Power performs trimming near power lines as well. The town's tree warden in the Public Works Department has a budget of $2,000 per year to remove trees. The Town policy is for utilities in new subdivisions to be located underground whenever possible in order to mitigate wind-related damages.

Connecticut Light & Power was under intense scrutiny after storms Irene and Alfred in 2011. The utility has reportedly done an adequate job trimming trees since 2011. Loss of power is a concern for the town. Trimming has reportedly helped avoid significant outages in a few recent high wind events.

During emergencies, the Town of Bethlehem currently has a designated emergency shelter (Memorial Hall) which is served by a generator. In addition, the Town has additional facilities available that could be converted to additional shelter space if the need arose. As hurricanes generally pass an area within a day's time, additional shelters can be set up after the storm as needed for long-term evacuees.

The Town relies on radio and television to spread information on the location and availability of shelters. Prior to severe storm events, the Town ensures that warning/notification systems and communication equipment is working properly, and prepares for the possible evacuation of impacted areas.

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

4.5 Vulnerabilities and Risk Assessment

The previous HMP noted that "it is generally believed that New England is long overdue for another major hurricane strike." Subsequent to the adoption of the plan, Tropical Storm Irene and Superstorm Sandy struck Connecticut and neighboring states in 2011 and 2012, respectively.

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 <u>on average</u> 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. 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 (representative of western Connecticut)	Block Island, RI (representative of eastern Connecticut)
One	17	17
Two	39	39
Three	68	70
Four	150	160
Five	370	430

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."

According to the 2014 *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. As shown in Table 4-2, NOAA estimates that the return period for a Category Two or Category Three storm to be 39 years and 68 years, respectively.

The 2014 *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 future that may be of greater frequency and intensity than in the past.

Description of 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.

The Town of Bethlehem is vulnerable to hurricane damage from wind and flooding, and from any tornadoes accompanying the storm. Areas of known and potential flooding problems are discussed in Section 3, and tornadoes will be discussed in Section 5. Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. There are currently no mobile home parks in the Town. 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), 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, so adequate fire protection is important.

Factors that influence vulnerability to tropical cyclones in the town include building codes currently in place, and local development patterns and the age and number of structures located in highly vulnerable areas of the community.

Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes. There are currently no mobile home parks in Bethlehem. Bethlehem's housing stock consists of a handful 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 much of the existing housing stock in the town predates the recent code changes, many structures are highly susceptible to roof and window damage from high winds.

Bethlehem is expected to experience low-to-moderate population growth in the coming years. 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.

Town-owned critical facilities do not 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 town are as likely to be damaged by hurricane-force winds as any other. However, 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. For example, the town hall roof was replaced in 2013 and meets the building code in place at the time of construction, with the most up-to-date wind load requirements. Older facilities are considered to be more susceptible to wind damage.

Wind risks appear to be higher at the Carmel Hill Road North due to the single-wire power distribution to this area. Tree trimming and maintenance in this area has helped considerably.

As the Town of Bethlehem is not affected by storm surge, hurricane sheltering needs have not been calculated by the Army Corps of Engineers for the Town. The Town of Bethlehem determines sheltering need based upon areas damaged within the Town. Under limited emergency conditions, a high percentage of evacuees will seek shelter with friends or relatives rather than go to established shelters. During extended power outages, it is believed that only 10% to 20% of the affected population of Bethlehem will relocate.

Loss Estimates

In order to quantify potential hurricane damage, HAZUS-MH simulations were run for historical and probabilistic storms that could theoretically affect Bethlehem. 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 C 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 Bethlehem. These two storm tracks produced the highest winds to affect Bethlehem out of all the hurricanes in the HAZUS-MH software.

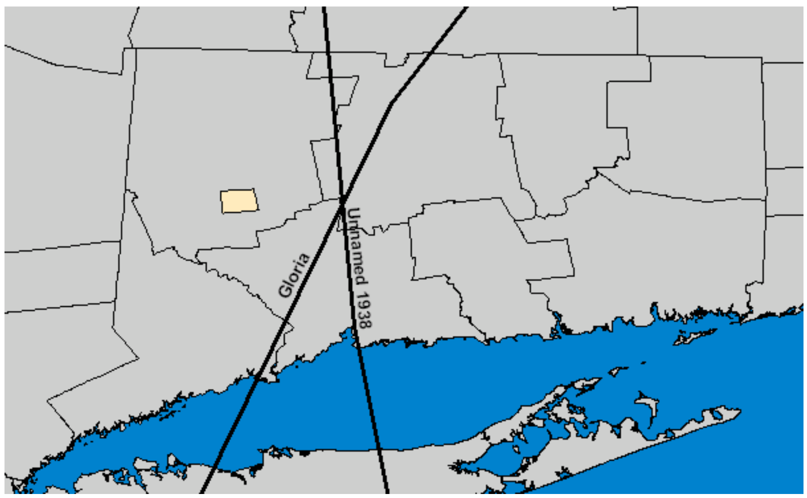


Figure 4-1: Historical Hurricane Storm Tracks

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

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 Bethlehem. 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 72 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	39	None	None	None	None	None
20-Years	54	None	None	None	None	None
Gloria (1985)	63	None	None	None	None	None
50-Years	72	4	None	None	None	4
100-Years	84	38	1	None	None	39
200-Years	95	147	11	None	None	158
Unnamed (1938)	100	234	25	1	1	261
500-Years	107	365	64	4	4	437
1000-Years	115	513	141	17	16	687

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	None	None	None	None	None
20-Years	1	None	None	None	None
Gloria (1985)	1	None	None	None	1
50-Years	5	None	None	None	5
100-Years	42	1	None	None	43
200-Years	159	12	None	None	171
Unnamed (1938)	254	29	1	1	285
500-Years	398	74	6	4	482
1000-Years	563	166	23	16	768

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 84 mph. Minor damage to schools occurs at wind speeds of approximately 95 mph and greater with loss of use to all schools.

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

Return Period or Storm	Hospitals (1)	Fire Stations (1)	Police Stations (1)	Schools (2)
10-Years	None or Minor	None or Minor	None or Minor	None or Minor
20-Years	None or Minor	None or Minor	None or Minor	None or Minor
Gloria (1985)	None or Minor	None or Minor	None or Minor	None or Minor
50-Years	None or Minor	None or Minor	None or Minor	None or Minor
100-Years	None or Minor	None or Minor	None or Minor	None or Minor
200-Years	None or Minor	None or Minor	None or Minor	Minor damage with loss of use to all schools
Unnamed (1938)	None or Minor	None or Minor	None or Minor	Minor damage with loss of use to 2 schools
500-Years	None or Minor	None or Minor	None or Minor	Minor damage with loss of use to all schools
1000-Years	None or Minor	None or Minor	None or Minor	Minor damage with loss of use to all schools

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 50-year event, and reinforced concrete and steel buildings are not expected to generate debris. Much of the debris that is generated is not structure-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	None	None	None
Gloria (1985)	None	None	2	15	17
50-Years	7	None	6	49	62
100-Years	83	None	423	3,420	3,926
200-Years	278	None	829	6,705	7,812
Unnamed (1938)	465	None	928	7,504	8,897
500-Years	920	None	1,601	12,950	15,471
1000-Years	1,952	None	3,151	25,492	30,595

No sheltering requirements are predicted in the HAZUS model for Bethlehem; however, it is likely that hurricanes will also produce heavy rain and flooding that will increase the overall sheltering need in Bethlehem.

Table 4-7 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 4-7
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	$250	$250	$10	$260
Gloria (1985)	$73,960	$81,090	$20	$81,110
50-Years	$265,040	$272,280	$180	$272,460
100-Years	$945,390	$974,950	$45,160	$1,020,110
200-Years	$2,305,990	$2,452,170	$123,000	$2,575,170
Unnamed (1938)	$3,673,180	$3,975,120	$294,550	$4,269,660
500-Years	$7,572,370	$8,364,410	$856,970	$9,221,380
1000-Years	$17,498,820	$19,625,160	$2,306,440	$21,931,610

Losses are minimal for storms with return periods of less than 20-years (54 mph) but increase rapidly as larger storms are considered. For example, a reenactment of the 1938 hurricane would cause approximately $4.2 million in wind damages to Bethlehem. 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 Bethlehem. 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.

4.6 Potential Mitigation Strategies and Actions

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

4.6.1 Prevention

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

- ❑ Continue Town-wide tree limb inspection and maintenance programs to ensure that the potential for downed power lines in diminished.

- ❑ Continue location of utilities underground in new developments or as related to redevelopment.
- ❑ Continue to review the currently enacted Emergency Operations Plan for the Town and update when necessary.

4.6.2 ***Property Protection***

Many 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. Tree wardens may 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.

4.6.3 ***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 and evacuation routes prior to a hurricane event, as well as potential measures to mitigate personal property damage.

4.6.4 ***Emergency Services***

The Emergency Operation Plan of the Town of Bethlehem includes guidelines and specifications for communication of hurricane warnings and watches, as well as for a call for evacuation. The public needs to be made aware in advance of a hurricane event of evacuation routes and the locations of public shelters, which could be accomplished by placing this information on the Town website and by creating informational displays in local municipal buildings. In addition, Bethlehem should identify and prepare additional facilities for evacuation and sheltering needs. The Town should also review its mutual aid agreements and update as necessary to ensure help is available as needed.

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. Bethlehem is not currently interested in participating in such a program but may be in the future, especially for power supply redundancy in the Main Street South area.

4.6.5 ***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.

4.7 *Status of Mitigation Strategies and Actions*

Strategies and actions described in Section 3.7 for the mitigation of flooding are also pertinent to mitigating tropical storm or hurricane related flooding, and are not repeated here. The prior mitigation strategies and actions for mitigation of hurricane and tropical storm winds are listed below with commentary regarding the status of each.

Table 4-8
Status of Previous Strategies and Actions

Strategy or Action	Status
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	The action is ongoing (for new developments) and is therefore a capability. The town does not wish to place existing utilities underground. Instead, hardening is desired.
Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards.	The action is ongoing and is therefore a capability.
Increase tree limb maintenance and inspections, especially along Route 61, Route 132, and other evacuation routes.	Eversource has been doing this and it is a capability.
Increase inspections of trees on private property near power lines and Town right-of-ways.	The town cannot do this, and the strategy is deleted.

Strategy or Action	Status
Review and disseminate potential evacuation plans to ensure timely migration of people seeking shelter in all areas of Bethlehem.	The town does not have a written evacuation plan. However, procedures are in place for certain areas such as Arrowhead Lane (due to flood risks).

One new strategy has been identified through the process of updating this plan:

- Harden utility lines that feed the Main Street area, as the services along Main Street South are critical for the town after weather emergencies

Future editions of this plan will revisit the potential for replacing overhead utilities with underground utilities. Strategies addressing shelters and critical facilities that are wind-related are addressed in Section 10.1 of this HMP.

5.0 SUMMER STORMS & TORNADOES

5.1 Setting

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

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

5.2 Hazard Assessment

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

Tornadoes

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.

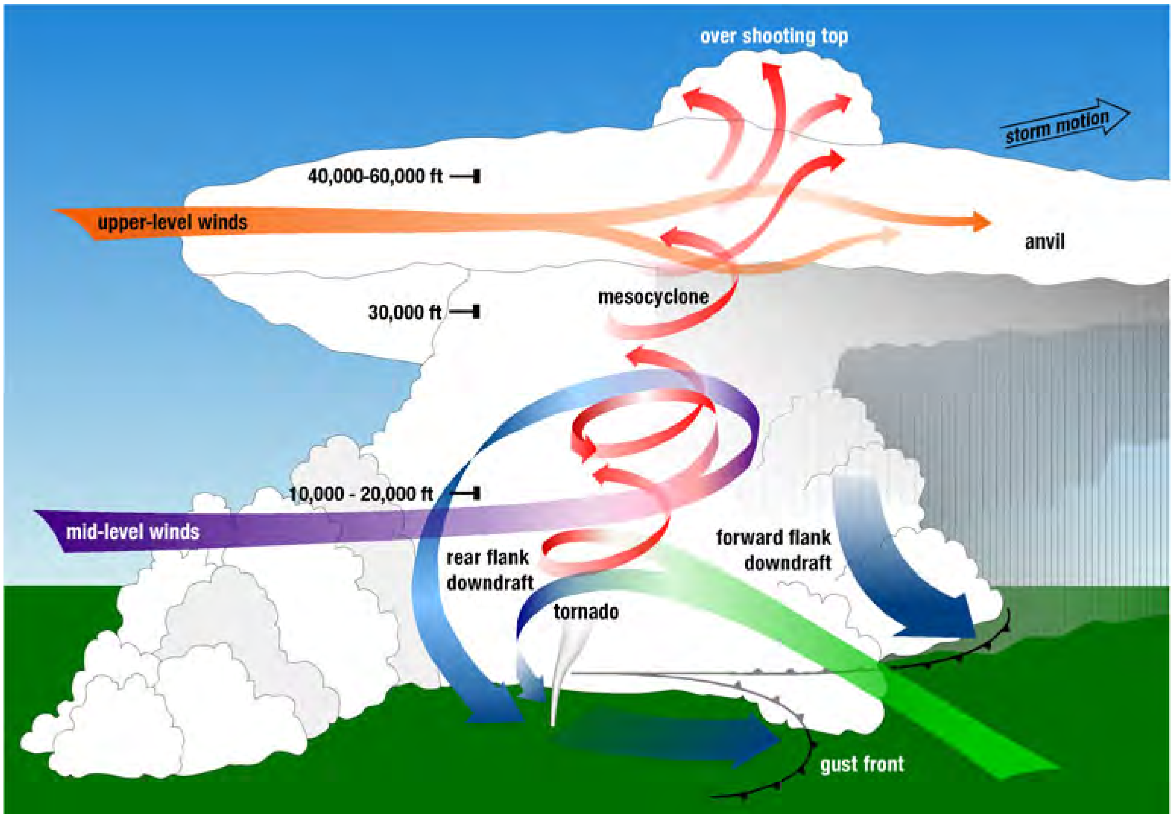
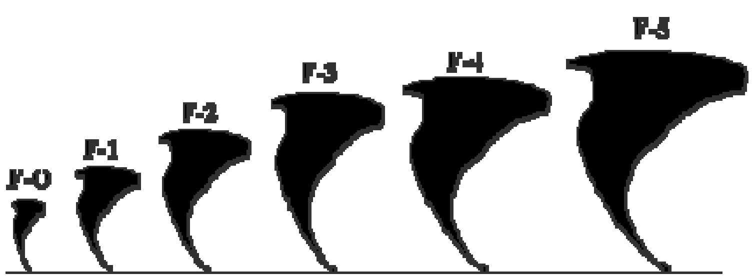


Figure 5-1: Anatomy of a Tornado. Image from NOAA National Severe Storms Laboratory.

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 Bethlehem is discussed in Section 5.4. Tornadoes are most likely to occur in Connecticut in June, July, and August of each year

<u>Lightning</u>

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.

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.

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 Historic Record

According to NOAA, the highest number of occurrences of tornadoes in Connecticut is Litchfield and Hartford counties, followed by New Haven and Fairfield counties, and then Tolland, Middlesex, Windham, and finally New London County. Bethlehem is located in southern Litchfield County. 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 Bethlehem through July 2013 based on the Wikipedia list.

Table 5-3
Tornado Events Near Bethlehem From 1648 to July 2013

Date	Location	Fujita Tornado Scale	Property Damage	Injuries / Deaths
July 22, 1817	Woodbury to Watertown	-	Tree damage	NR
July 26, 1937	Terryville to Bristol	F2	NR	NR
August 21, 1951	Southwestern Litchfield County through northern Watertown and into Hartford County (40 miles)	F2	NR	9 injured
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
June 18, 1962	Eastern Litchfield County	F2	NR	NR
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
July 21, 2010	Litchfield, Thomaston, Bristol	EF1	Tree damage	NR

NR = Not Reported

Thunderstorms occur on 18 to 35 days each year in Connecticut. Only 17 lightning-related fatalities occurred in Connecticut between 1959 and 2009. Hail is often a part of such thunderstorms. A limited selection of summer storm damage in and around Bethlehem, taken from the NCDC Storm Events database, is listed below:

- July 10, 1989 – A particularly powerful thunderstorm produced 80 mile per hour winds and spawned two tornadoes that cut a path from Salisbury to New Haven. Two people were killed and 67 homes were destroyed. One of the fatalities occurred in Black Rock State Park in nearby Watertown. Damages from the storm totaled $125 million (1989 dollars), and a Presidential Disaster Declaration was issued. One of the tornadoes passed above Bethlehem before landing again in Watertown and the Town received residual damage from flying debris.
- June 27, 1994 – Thunderstorm winds brought down trees and power lines in Litchfield, with a few hundred customers losing electric service.
- May 21, 1996 – Severe thunderstorms produced damage across parts of Litchfield County and caused approximately $5,000 in property damage.
- July 9, 1997 – Severe thunderstorms produced flooding and damaging winds that downed trees throughout Litchfield County, causing approximately $5,000 in damage. The wind downed trees and a power pole in Thomaston.
- October 1, 1998 – Gusty winds knocked down large limbs, trees, and power lines during the middle of the day throughout Litchfield County, resulting in as many as 7,800 electric

customers being without power and bringing commerce to a halt. Approximately $100,000 in property damage was reported.

- July 6, 1999 – Powerful thunderstorms brought down trees in New Milford, Litchfield and Bethlehem, causing $2,000 in damage.
- September 16, 1999 – In addition to the flooding damages described in Section 3.3, the remnants of Tropical Storm Floyd also produced wind gusts up to 60 miles per hour in Litchfield County, causing widespread downing of trees and power lines. Up to 5,000 were left without power, and approximately $100,000 in wind damage was reported.
- November 2, 1999 – A storm produced high wind across the higher elevations of Litchfield County, bringing down some trees and a few power lines. Scattered power outages and approximately $11,000 in damages were reported.
- May 31, 2002 – Severe weather in Litchfield County produced hail up to two inches in diameter in Thomaston, blew down trees, and caused 37,000 power outages and $10,000 in damages across the county.
- July 15, 2007 – Strong thunderstorm winds blew a large tree onto a house in Thomaston, causing structural damage.
- July 19, 2007 – Trees were reported down in Thomaston due to strong thunderstorm winds that gusted up to 50 miles per hour.
- August 21, 2009 – A tropical and very unstable air mass was in place across the area. An upper level disturbance moved over the region ahead of a slow moving cold front Friday afternoon on August 21st, triggering widespread severe thunderstorms across Litchfield County. A house was struck by lightning on Munger Lane in Bethlehem, near the Morris line.
- June 17, 2011 – A disturbance rotating around a low in the upper levels of the atmosphere moved across the region on Friday, June 17th, triggering showers and scattered thunderstorms. Isolated strong thunderstorms produced penny to nickel size hail in Litchfield County. Nickel size hail was reported in Bethlehem during a thunderstorm.
- July 1, 2012 - A very warm and humid air mass was in place across the region. At the surface, a frontal boundary was draped just south of the area across the northern Mid-Atlantic States. As a shortwave trough moved across upstate New York, severe thunderstorms broke out across Connecticut during the early to mid-afternoon hours. Some of these thunderstorms contained hail as large as golf-ball size. Thunderstorms ended by the late afternoon, as a secondary cold front moved across the area, bringing drier and less humid air into the region. Golf-ball size (measured) hail was reported during a thunderstorm in Bethlehem.

5.4 Existing Capabilities

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

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

Table 5-4
NOAA Weather Watches

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

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

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

Municipal responsibilities relative to tornado mitigation and preparedness include:

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

- ❑ Designate appropriate shelter space in the community that could potentially withstand tornado impact.
- ❑ Periodically test and exercise tornado response plans.
- ❑ Put emergency personnel on standby at tornado 'watch' stage.
- ❑ Utilize CT Alert as needed to warn residents of watches and warnings.

In summary, many of the town's capabilities to mitigate for wind damage and prevent loss of life and property have improved since the initial hazard mitigation plan was adopted, such as the use of CT Alert. Furthermore, Eversource has increased its capabilities relative to tree and tree limb maintenance near utility lines.

5.5 Vulnerabilities and Risk Assessment

Description – According to the 2014 *Natural Hazard Mitigation Plan Update,* Litchfield County has a moderate to high risk of tornado activity based on historical occurrences. By virtue of its location in Litchfield County, Bethlehem has greater potential to experience tornado damage than other parts of Connecticut. In addition, 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, more deaths from lightning occur on the East Coast than elsewhere, according to FEMA. Lightning-related fatalities have declined in recent years due to increased education and awareness.

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

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

Loss Estimates – The 2014 *Connecticut Natural Hazard Mitigation Plan Update* provides annual estimated losses on a countywide basis for several hazards. Based on the population of Bethlehem relative to Litchfield County, the annual estimated loss is $1,104 for thunderstorms and $29,404 for tornadoes. The figure for tornadoes is based on their infrequent occurrence coupled with high costs.

Summary – The entire community is at relatively equal risk for experiencing damage from summer storms and tornadoes. Based on the historic record, a few severe thunderstorms have resulted in costly damages in Bethlehem. 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 adjusted from time to time to address storms. Given the limited historic record for damaging tornado events, an estimate of several million dollars in damage may be reasonable for an EF2 tornado striking Bethlehem, and with a greater damage amount to be expected should an EF3 or stronger tornado strike. The town notes that tornadoes have struck the adjacent community of Watertown and nearby towns such as Thomaston and Waterbury.

5.6 Potential Mitigation Measures, Strategies, and Alternatives

Strategies and actions described in Section 4.6 for wind are applicable to thunderstorms and tornadoes as well.

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 community shelters.
- Recommendations to better protect from tornado damage for your business, community, and home. This includes construction and design guidelines for business and homes, as well as guidelines for creating and identifying shelters.
- 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/

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

Specific mitigation steps that can be taken to prevent property damage and protect property are given below.

5.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies and actions for mitigation related to winds, hail, tornadoes, and downbursts are listed below with commentary regarding the status of each.

Table 5-6
Status of Previous Strategies and Actions

Strategy or Action	Status
Continue outreach regarding dangerous trees on private property.	The town does not wish to pursue outreach relative to private properties and the strategy is not needed.
Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.	The action is ongoing (for new developments) and is therefore a capability. The town does not wish to place existing utilities underground. Instead, hardening is desired.
Continue to require compliance with the amended Connecticut Building Code for wind speeds.	The action is part of the building code and is therefore a capability.
Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards.	The action is ongoing and is therefore a capability.
Increase tree limb maintenance and inspections, especially in the center of town	Eversource has been doing this and it is a capability.

The one new strategy listed in Section 4.7 is also applicable to the hazards associated with summer storms and tornadoes:

- ❑ Harden utility lines that feed the Main Street area, as the services along Main Street South are critical for the town after weather emergencies

Future editions of this plan will revisit the potential for replacing overhead utilities with underground utilities. Strategies addressing shelters and critical facilities that are wind-related are addressed in Section 10.1 of this HMP.

6.0 WINTER STORMS

6.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any area of the Town of Bethlehem. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. The entire Town of Bethlehem is susceptible to winter storms. In general, winter storms are considered highly likely to occur each year (major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of the Town.

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.

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.

> 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.

Until recently, the Northeast Snowfall Impact Scale (NESIS) was used by NOAA to characterize and rank high-impact northeast snowstorms. This ranking system has evolved into the currently used Regional Snowfall Index (RSI). The RSI ranks snowstorms that impact the eastern two thirds of the United States, placing them in one of five categories: Extreme, Crippling, Major, Significant, and Notable. The RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population. RSI differs from NESIS in that it uses a more refined geographic area to define the population impact. NESIS had used the population of the entire two-thirds of the United States in evaluating impacts for all storms whereas RSI has refined population data into six regions. The result is a more region-specific analysis of a storm's impact. The use of population in evaluating impacts provides a measure of societal impact from the event. Table 6-1 presents the RSI categories, their corresponding RSI values, and a descriptive adjective.

Table 6-1
RSI Categories

Category	RSI Value	Description
1	1-3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18.0+	Extreme

RSI values are calculated within a GIS. The aerial distribution of snowfall and population information are combined in an equation that calculates the RSI score, which varies from around one for smaller storms to over 18 for extreme storms. The raw score is then converted into one of the five RSI categories. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. Approximately 196 of the most notable historic winter storms to impact the Northeast have been analyzed and categorized by RSI through March 2013.

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

6.3 ***Historic Record***

A total of 16 extreme, crippling, and major winter storms have occurred in Connecticut during the past 30 years. One is listed for each of the years 1983, 1987, 1993, 1994, 1996, 2003, 2005, 2006, and 2007. More alarmingly, four are listed in the calendar year 2010 and two in 2011.

Considering nor'easters only, 11 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).

According to the NCDC, there have been 134 snow and ice events in the state of Connecticut between 1993 and April 2010, causing over $18 million in damages. Notably, heavy snow in December 1996 caused $6 million in property damage. Snow removal and power restoration for a winter storm event spanning March 31 and April 1, 1997 cost $1 million. On March 5, 2001, heavy snow caused $5 million in damages, followed by another heavy snow event four days later that caused an additional $2 million in damages.

Catastrophic ice storms are less frequent in Connecticut than the rest of New England due to the close proximity of the warmer waters of the Atlantic Ocean and Long Island Sound. However, winter storm Alfred from October 29-30, 2011 had an ice precipitation component to it. Although wet snow was the major problem, ice mixed in along and just to the north of the shoreline which slickened roadways and led to additional weight build-up on trees and utility lines and other infrastructure.

The most severe ice storm in Connecticut on record was Ice Storm Felix on December 18, 1973. This storm resulted in two deaths and widespread power outages throughout the state. An ice storm in November 2002 that hit Litchfield and western Hartford Counties resulted in $2.5 million in public sector damages.

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

- January 13, 1993 – Six inches of snowfall beginning during the morning rush hour that created slippery roads and resulted in numerous accidents.
- February 12, 1993 – Five to seven inches of snow was reported in Litchfield County, followed by freezing rain and drizzle. This storm caused up to 10,000 power outages throughout the state.
- March 13 to 14, 1993 – A powerful storm caused blizzard conditions and up to 21 inches of snow in Litchfield County, with 40,000 power outages and $550,000 in property damage reported throughout Connecticut.
- December 26, 1993 – Heavy arctic winds brought 40 to 60 mph gusts to the State.
- February 11, 1994 – A major storm produced eight to 13 inches of snow across Connecticut.
- December 23, 1994 – An unusual snow-less 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 five million dollars in damages. Peak wind gusts of up to 64 miles per hour were reported.

- December 19, 1995 – A winter storm produced six to eight inches of snow in Litchfield County.
- January 2, 1996 – A winter storm originating near the Gulf of Mexico produced ten to 12 inches of snow across Litchfield County.
- January 7, 1996 – An intense winter storm caused heavy snow throughout Litchfield County, causing many power outages, several roofs to collapse, and approximately $80,000 in damages. Reported snowfall totals included 24 inches in New Hartford and 22 inches in Harwinton.
- January 19, 1996 – An intense area of low pressure created damaging winds throughout Litchfield County, causing $10,000 in property damage. Many downed trees, limbs, and power lines were reported.
- March 7, 1996 – A large winter storm caused heavy snow throughout Litchfield County, including eight inches in Thomaston.
- February 22, 1997 – High winds downed trees and wires across Litchfield County, resulting in approximately $6,000 in property damage.
- March 14, 1997 – A storm brought heavy snow, sleet, and freezing rain to Litchfield County, producing two to four inches of snow, treacherous driving conditions, and downed trees and power lines.
- March 31, 1997 – A late season storm produced rain and wet snow across Litchfield County, with 12 inches of snow reported in Litchfield. This storm caused over one million dollars in property damage and over 30,000 homes lost power across the County.
- January 25, 2000 – A winter storm produced snow, sleet, and freezing rain in Litchfield County with accumulations of six to ten inches. $25,000 in property damage was reported.
- April 9, 2000 – A late-season snowstorm produced snowfall rates of more than an inch per hour, with blizzard conditions reported at times. Four to eight inches accumulated throughout Litchfield County, with $35,000 in property damage reported.
- December 25, 2002 – Six to 12 inches of snow fell throughout Litchfield County, with six inches reported at the Thomaston Dam.
- March 6, 2003 – A winter storm produced nine inches of snow as measured at the Thomaston Dam.
- March 16, 2007 – A winter storm beginning during the Friday afternoon rush hour produced eight to 12 inches of snow throughout Litchfield County, including 7.5 inches in Thomaston. The storm caused treacherous travel conditions that resulted in many accidents.
- December 19, 2008 – A winter storm produced 4.8 inches of snow in Cornwall.
- The winter storms of December 24-28, 2010 and January 9-13, 2011 were rated preliminarily as "Category 2 – Significant" storms on RSI. 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 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 FEMA-1958-DR being declared for the state.
- January 18, 2011 – A winter storm brought two to three inches of snow and sleet across northern Connecticut, with a quarter to one-half inch of ice accumulation on top of that. Several barns collapsed or had minor damage associated with them. The Bethlehem Building

Official inspected municipal and school roofs. The town has taken the perspective that if a collapse did not happen in this storm than it is unlikely to ever collapse because these types of snow loads are rare.

- February 1, 2011 – "The Groundhog Day Blizzard of 2011" An ice storm brought a mixture of snow, sleet, and freezing rain with a second heavier round of freezing rain and sleet. The later episode caused numerous road closures and roof collapses across Connecticut.
- February 7, 2011 – Excessive weight from snow and ice caused numerous roof collapses across southern Connecticut during the second week in February.
- October 29, 2011 –Winter Storm Alfred (October 29-30, 2011) dumped up to 32" of snow and caused over 600,000 electrical customers in Connecticut to lose power for a significant amount of time. The entire state dealt with wet snow and ice and statewide power outages affecting Connecticut for a week or longer. The storm was unique in that much of the foliage had yet to fall from trees, which provided more surface area for snow to land and stick, therefore making the trees significantly heavier than if the storm was to occur when trees had lost their foliage. The storm resulted in the death of eight people in Connecticut, four from carbon monoxide poisoning. In all, approximately 90 shelters and 110 warming centers were opened state-wide. The overall storm impacts and damages resulted in another Presidential Disaster Declaration for Connecticut. In Bethlehem, Winter Storm Alfred caused power outages that lasted approximately seven days, and many roads were blocked.
- 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. All roads in Connecticut were closed for two days. This storm was ranked as a "Major" storm by NESIS. The overall storm impacts and damages resulted in yet one more Presidential Disaster Declaration for Connecticut. The Bethlehem public works department was very aggressive before and after the storm. Utility crews were able to use the roads quickly. The town sought PA reimbursement for overtime.

The winter storms of January and February 2011 are listed as the 18th and 19th storms in the NESIS ranking. These storms produced snow, sleet, freezing rain, strong gusty winds, severely low temperatures, and coastal flooding. Snowfall totals for winter 2010-2011 in Connecticut averaged around 70 inches. The snowfall, sleet, freezing rain, and rain that affected Connecticut during the 2010-2011 winter season proved to be catastrophic for a number of buildings. With severely low temperatures coupled with the absence of the removal of snow and ice buildup from roofs of buildings in Connecticut, numerous roofs collapsed during the winter season.

Using media reports, a list of roof/building collapses and damage due to buildup of frozen precipitation was compiled. The list (Table 6-2) includes 76 locations that span over a month of time from January 12, 2011 to February 17, 2011.

TABLE 6-2
Reported Roof Collapse Damage, 2011

Address	Municipality	Date	Description
205 Wakelee Avenue	Ansonia	2/2/2011	Catholic Charities
Route 44	Barkhamsted	2/4/2011	Barkhamsted Highway Department Salt Shed
8 Railroad Avenue	Beacon Falls	2/2/2011	Manufacturing Corporation
20 Sargent Drive	Bethany	2/2/2011	Fairfield County Millworks
50 Hunters Trail	Bethany	2/2/2011	Sun Gold Stables
74 Griffin Road South	Bloomfield	2/14/2011	Home Depot Distribution Center
25 Blue Hill Road	Bozrah	1/27/2011	Kofkoff Egg Farm
135 Albany Turnpike	Canton	2/3/2011	Ethan Allen Design Center
520 South Main Street	Cheshire	1/12/2011	Cheshire Community Pool (Prior to recent ice storm)
1701 Highland Avenue	Cheshire	1/23/2011	Cox Communications
174 East Johnson Avenue	Cheshire	2/2/2011	First Calvary Life Family Worship Center
166 South Main Street	Cheshire	2/3/2011	George Keeler Stove Shop (Historic Building)
1755 Highland Avenue	Cheshire	2/7/2011	Nutmeg Utility Products
45 Shunpike Road (Route 372)	Cromwell	2/2/2011	K Mart (cracks inside and outside - no official collapse)
Cromwell Hills Drive	Cromwell	2/4/2011	Cromwell Gardens
98 West Street	Danbury	1/28/2011	Garage
142 N. Road (Route 140)	East Windsor	2/3/2011	Dawn Marie's Restaurant - Bassdale Plaza Shopping Center
3 Craftsman Road	East Windsor	2/4/2011	Info Shred
140 Mountain Road	Ellington	1/27/2011	Garage Collapse
100 Phoenix Avenue	Enfield	2/1/2011	Brooks Brothers
South Road	Enfield	2/2/2011	Bosco's Auto Garage
175 Warde Terrace	Fairfield	2/3/2011	Parish Court Senior Housing (Ceiling damage - 10 apartments)
19 Elm Tree Road	Glastonbury	2/6/2011	Residence
Unknown	Hampton	1/28/2011	Wood Hill Farm barn collapse - animals died
Gillette Street	Hartford	1/19/2011	Garage
West Street	Hebron	2/2/2011	Residential
Connecticut Route 101	Killingly	2/8/2011	Historic church converted to an office building
759 Boston Post Road	Madison	2/3/2011	Silver Moon, The Brandon Gallery, Madison Coffee Shop and Madison Cinemas (awning began to collapse)
478 Center Street	Manchester	1/28/2011	Lou's Auto Sales and Upholstery
1388 East Main Street	Meriden	1/28/2011	Jacoby's
260 Sherman Avenue	Meriden	2/6/2011	Engine 4 Fire Station

Address	Municipality	Date	Description
275 Research Parkway	Meriden	2/17/2011	Four Points by Sheraton Carport
1310 South Main Street	Middletown	1/30/2011	Passport Inn Building & Suites
505 Main Street	Middletown	2/2/2011	Accounting firm, converted, mixed use (3 story)
70 Robin Court	Middletown	2/3/2011	Madison at Northwoods Apartment
80 North Main Street	Middletown	2/7/2011	Abandoned warehouse
Pepe's Farm Road	Milford	1/30/2011	Vacant manufacturing building
282 Woodmont Road	Milford	2/2/2011	Kip's Tractor Barn
150 Main St # 1	Monroe	2/2/2011	Monroe Paint & Hardware (Slumping roof, weld broke loose from structural beam)
Route 63	Naugatuck	1/21/2011	Former Plumbing Supply House
410 Rubber Avenue	Naugatuck	2/2/2011	Thurston Oil Company
1210 New Haven Road	Naugatuck	2/4/2011	Rainbowland Nursery School (structural damage)
1100 New Haven Road	Naugatuck	2/17/2011	Walmart (structural damage)
290 Goffe Street	New Haven	2/7/2011	New Haven Armory
201 South Main Street	Newtown	2/9/2011	Bluelinx Corp.
80 Comstock Hill Avenue	Norwalk	1/27/2011	Silvermine Stable
5 Town Line Road	Plainville	1/27/2011	Classic Auto Body
130 West Main Street	Plainville	2/2/2011	Congregational Church of Plainville
Terryville Section	Plymouth	1/12/2011	Public Works Garage (Terryville section) - taking plow trucks out
286 Airline Avenue	Portland	1/27/2011	Midstate Recovery Systems, LLC (waste transfer station)
680 Portland-Cobalt Road (Route 66)	Portland	1/27/2011	Vacant commercial property (next to Prehistoric Mini Golf - former True Value Hardware building)
Tryon Street	Portland	1/27/2011	Residential home (sunroof)
Main Street	Portland	1/28/2011	Middlesex Marina
93 Elm Street	Rocky Hill	2/6/2011	Residential garage
99 Bridgeport Avenue	Shelton	2/3/2011	Shell Gas Station
100 Maple Street	Somers	1/27/2011	Lindy Farms (barn)
68 Green Tree Lane	Somers	2/2/2011	Residential
95 John Fitch Boulevard	South Windsor	2/3/2011	South Windsor 10 Pin Bowling Alley
595 Nutmeg Road North	South Windsor	2/8/2011	Waldo Brothers Company
45 Newell Street	Southington	2/2/2011	Yarde Metals
Furnace Avenue	Stafford Springs	2/2/2011	Abandoned mill building
370 South Main Street	Terryville	2/8/2011	Former American Modular
46 Hartford Turnpike	Tolland	2/3/2011	Colonial Gardens

Address	Municipality	Date	Description
364 High Street	Tolland	2/9/2011	Horse barn
61 Monroe Turnpike	Trumbull	2/1/2011	Trumbull Tennis Center
5065 Main St # L1207	Trumbull	Unknown	Taco Bell
Route 83	Vernon	1/31/2011	Former Clyde Chevrolet
136 Dudley Avenue	Wallingford	1/27/2011	Tri State Tires
1074 South Colony Road	Wallingford	1/29/2011	Zandri's Stillwood Inn
121 N. Main Street	Waterbury	2/2/2011	Former bowling alley (Sena's Lanes)
456 New Park Avenue	West Hartford	2/8/2011	Shell gas station
Island Lane	West Haven	1/27/2011	Commercial building
Unknown	Wethersfield	2/2/2011	Automotive center roof collapse; 10 cars damaged
50 Sage Park Road	Windsor	2/2/2011	Windsor High School (auditorium roof collapse)
1001 Day Hill Road	Windsor	2/7/2011	Mototown USA
27 Lawnacre Road	Windsor Locks	2/7/2011	Long View RV

The overall storm impacts and damages of the winter 2010-2011 storms resulted in Presidential Disaster Declaration 1958-DR for Connecticut. During this snow load disaster, several barns in Bethlehem collapsed or had damage, but nothing major was damaged. The Bethlehem building official inspected municipal and school roofs. The town's view is that anything that did not collapse is unlikely to collapse, as these types of snow loads are rare. For example, the heavy snow of January and February 2015 did not result in any significant damage in Bethlehem.

6.4 Existing Capabilities

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

As it is almost guaranteed that winter storms will occur annually in Connecticut, it important for municipalities to budget fiscal resources towards snow management. The Town ensures that all warning/notification and communications systems are ready before a storm, and ensures that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order. The Town also prepares for the possible evacuation and sheltering of some populations which could be impacted by the upcoming storm (especially the elderly and special needs persons).

The Town of Bethlehem primarily uses Town staff for plowing operations. The Public Works Department utilizes plow trucks to clear and treat all Town-owned roadways, properties, and sidewalks. The department maintains five plow trucks. The Connecticut DOT plows Routes 61 and 132. Town roads are not prioritized for plowing because school buses traverse every road in Town. During emergencies, a plow vehicle can be dispatched ahead of an emergency vehicle. The CT DOT shed is located in Bethlehem, and the Public Works Department reportedly works well with CT DOT. Treated salt is used for deicing.

The town found it necessary to remove snow from municipal facilities and school roofs in January 2011 when buildings collapsed throughout Bethlehem. As a result of this experience, the town has been careful to watch for conditions that may lead to damage from snow loads.

In summary, the town's capabilities to mitigate for winter storm damage and prevent loss of life and property have improved significantly since the initial hazard mitigation plan was adopted, such as the increasing attention to removing snow from buildings and protecting power lines. As proof of this increased capability, the Public Works department was very aggressive before and after the storms of February 2013 (Nemo) and January-February 2015, and utility crews were able to access roads quickly.

6.5 *Vulnerabilities and Risk Assessment*

Description – 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 2014 *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 2014 *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.

As mentioned for summer storms, the heavily treed landscape in close proximity to densely populated residential areas in the Town of Bethlehem poses problems in relation to blizzard condition damage. Tree limbs and some building structures may not be suited to withstand high wind and snow loads. Ice can damage or collapse power lines, render steep gradients impassable for motorists, undermine foundations, and cause "flood" damage from freezing water pipes in basements.

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

A few areas in the Town of Bethlehem have been identified by Town personnel and residents as having problems with ice during the winter months. Icing causes difficult driving conditions throughout the hillier sections of Bethlehem, especially at the intersection of Cabbage Lane and Route 132, and at the intersection of Wood Creek Road and Route 132. Both of these instances of icing are due to poor drainage. The intersection of Cabbage Lane and Route 132 is especially dangerous because cars traveling towards Route 132 on Cabbage Lane are coming downhill, the ice collects near the intersection, and drivers tend to speed through this section of Route 132.

Icing is particularly a concern along the access road to the Horace Mann Nature Center in Washington off the end of Arch Bridge Road. There is no public access to this property in Washington due to private roads and limited egress over Sprain Brook. Approximately 30-40 children attend the facility each week 40 weeks per year. The Town of Washington has asked the Town of Bethlehem to be the first responder to this facility in case of emergency, as it is a 22 minute response time from Washington. However, the road leading in from Bethlehem is unpaved, narrow, and steep. Emergency personnel are worried that the facility could become isolated during a winter emergency.

Drifting snow is not as large a problem in Bethlehem as other areas, but it still occurs. Todd Hill Road and Hard Hill Road are at elevated risk for snow drifts. This problem is mitigated through municipal plowing efforts. Ice jams are not a problem along the rivers in Bethlehem.

Recall from Figure 2-7, Figure 2-8, and Figure 2-9 that elderly, linguistically isolated, and disabled populations reside in the Town of Bethlehem. It is possible that several hundred of the population impacted by a severe winter storm could consist of the elderly, a small number could consist of linguistically isolated households, and several hundred could be disabled. Thus, it is important for Bethlehem's emergency personnel to be prepared to assist these special populations during emergencies such as winter storms.

<u>Loss Estimates</u> – The 2014 *Connecticut Natural Hazard Mitigation Plan Update* provides annual estimated losses on a countywide basis for several hazards. Based on the population of Bethlehem relative to Litchfield County, the annual estimated loss is $1,845 for severe winter storms. The low figure is influenced by the difficulty in separating typical winter storm costs from those associated with extreme events.

<u>Summary</u> – The entire community is at relatively equal risk for experiencing damage from winter storms, although some areas may be more susceptible. Many damages are relatively site-specific and occur to private property (and therefore are paid for by private insurance), while repairs for power outages is 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, as did the snow associated with Winter Storm Alfred in October 2011, storm Nemo in February 2013, and the January and February storms of 2015.

6.6 *Potential Mitigation Strategies and Actions*

Winter storm mitigation measures must address blizzard, snow, and ice hazards. These are emphasized below. Note that structural projects are generally not applicable to hazard mitigation for wind, blizzard, snow, and ice hazards.

6.6.1 *Prevention*

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

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

6.6.2 *Property Protection*

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

FEMA has produced a Snow Load Safety Guidance fact sheet. A copy is included in Appendix D.

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. The town 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.

6.6.3 *Public Education and Awareness*

The public is typically more aware of the hazardous effects of snow, ice, and cold weather than they are with regard to other hazards discussed in this plan. Nevertheless, people are still stranded in automobiles, get caught outside their homes in adverse weather conditions, and suffer heart failure while shoveling during each winter in Connecticut. Public education should therefore focus on safety tips and reminders to individuals about how to prepare 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.

6.6.4 Emergency Services

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

The Town of Bethlehem by default has plowing routes that prioritize access to and from most critical facilities, as these facilities are almost all located in the municipal complex. However, the Town should make the effort to design standard plowing routes that prioritize the remaining critical facilities. Residents should be made aware of the plow routes in order to plan how to best access critical facilities, perhaps via posting of the general routes on the Town website. Such routes should also be posted in other municipal buildings, such as the library and the post office.

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

6.6.5 Structural Projects

Structural projects for many aspects of Winter Storms are not possible. However, projects can be designed to mitigate icing due to poor drainage and other factors. In regards to the intersection of Cabbage Lane and Route 132, the Town wants to install 200 feet of catch basins down the end of Cabbage Lane and along Route 132 to facilitate street drainage. The Town plans to try to acquire grant funding at some point for this project. In addition, the Town should investigate complaints of icing at the intersection of Wood Creek Road and Route 132 and perform corrective actions if applicable.

6.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies associated with winds were addressed in earlier sections of this plan. Previous strategies and actions for snow and ice are listed below with commentary regarding the status of each.

Table 6-3
Status of Previous Strategies and Actions

Strategy or Action	Status
Consider modifying the Plan of Conservation and Development to encourage two modes of egress into every neighborhood by the creation of through streets.	This strategy was not completed when the Plan of Conservation and Development was updated in 2010, due to a lack of consensus, and is carried forward for consideration in 2020 when the Plan of Conservation and Development is updated.
Increase tree limb maintenance and inspections, especially in the center of town	Eversource has been doing this and it is a capability.
Review and disseminate potential evacuation plans to ensure timely migration of people seeking shelter in all areas of Bethlehem.	The town does not have a written evacuation plan. However, procedures are in place for certain areas such as Arrowhead Lane (due to flood risks).
Post a list of Town sheltering facilities in the Town Hall and on the Town's website so residents can best plan how to access to critical facilities during a winter storm event.	This strategy will be carried forward for consideration when the town has a shelter that can accommodate overnight usage.
Prioritize plowing routes and post the snow plowing prioritization in Town buildings each winter to increase public awareness.	The town has only four plowing routes and they are not changed. This action can be deleted.
Pursue grant funding to install drainage along Cabbage Lane and Route 132 to eliminate icing at this dangerous intersection. Consider removing some trees to improve sight lines if possible.	Complete.
Investigate complaints of icing at the intersection of Wood Creek Road and Route 132, and perform corrective actions if applicable.	Complete.
Encourage the Horace Mann Nature Center to widen and improve the access road from Bethlehem to facilitate emergency and standard vehicular access.	This action has been attempted but has not yet been successful due to lack of consensus at the Center. It is carried forward.

Portions of the above strategies and actions have become capabilities and they are not listed in the table in Appendix A, as they are ongoing. In addition, important strategies that apply to all hazards are listed in Section 10.1.

7.0 EARTHQUAKES

7.1 Setting

The entire Town of Bethlehem is susceptible to earthquakes. However, even though earthquakes have the potential to occur anywhere both in the Town and in the northeastern United States, the effects may be felt differently in some areas based on the type of geology. In general, damaging earthquakes are considered a hazard that is possible to occur, but that may cause significant effects to a large area of the Town if one occurred.

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 which have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value recorded by a seismograph, which record the varying amplitude of ground oscillations.

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

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

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

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

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

The built environment in Connecticut includes old, 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 <u>Historic Record</u>

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 2014 *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 2.1 quake occurred near Stamford on September 8, 2012. Dozens of residents reported feeling the ground move, but no injuries were reported.

An earthquake of special consideration was the magnitude 5.8 earthquake which 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.

- An earthquake with a magnitude 2.1 was recorded near southeastern Connecticut on November 29, 2013. The earthquake did not cause damage but was felt by residents from Montville to Mystic.
- A magnitude 2.7 quake occurred beneath the Town of Deep River on August 14, 2014.
- A series of quakes hit Plainfield, Connecticut on January 8, 9, and 12, 2015. These events registered magnitudes of 2.0, 0.4, and 3.1, respectively. Residents in the Moosup section of Plainfield reported minor damage such as the tipping of shelves and fallen light fixtures.

7.4 *Existing Capabilities*

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

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

The town'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 the town has incorporated those changes.

7.5 *Vulnerabilities and Risk Assessment*

Description – According to the USGS, Connecticut is at a low risk for experiencing a damaging earthquake. The USGS has determined that the State of Connecticut has a 10% chance that at some point in a 50-year period an earthquake would cause peak acceleration (ground shaking) values of 4% to 8% of the force of gravity. To appreciate why these values of ground shaking are expressed as a percentage of the force of gravity, note that it requires more than 100% of the force of gravity to throw objects up in the air.

In terms of felt effects and damage, ground motion at the level of several percent of gravity corresponds to the threshold of damage to buildings and houses (an earthquake intensity of approximately V). For comparison, reports of "dishes, windows and doors disturbed" corresponds to an intensity of about IV, or about 2% of gravity. Reports of "some chimneys broken" correspond to an intensity of about VII, or about 10% to 20% of gravity. According to the USGS National Seismic Hazard Mapping Project (2008), an earthquake impacting the Town of Bethlehem has a 2% chance of exceeding a peak acceleration of 10-12% of the force of gravity in a 50-year period.

> ***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, especially the finer textured soils.

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 the Town of Bethlehem are underlain by sand and gravel. Figure 2-5 depicts surficial materials in the Town. Structures in these areas are at increased risk from earthquakes due to amplification of seismic energy and/or collapse. The best mitigation for future development in areas of sandy material may be application of the most stringent building codes, or possibly the prohibition of new construction. However, many of these areas occur in floodplains associated with the Weekeepeemee River, East Spring Brook, and the Nonnewaug River, 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.

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.

> 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 2014 *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.

Nevertheless, 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 Bethlehem 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 Bethlehem.

Because a damaging earthquake would likely affect a large area beyond Bethlehem, 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.

<u>Loss Estimates</u> – The 2014 *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 Bethlehem 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 C and presented below. These results are believed conservative and considered appropriate for planning purposes in Bethlehem. Note that potentially greater impacts could also occur.

Table 7-2 presents the number of residential buildings (homes) damaged by the various earthquake scenarios, while Table 7-3 presents the total number of buildings damaged by each earthquake scenario. A significant percentage of building damage is to residential buildings, while other building types include agriculture, commercial, education, government, industrial, 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 7-2
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	66	12	1	None	79
Portland – 5.7	90	18	2	None	110
Stamford – 5.7	55	10	1	None	66
East Haddam – 6.4	146	35	3	None	184

Table 7-3
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	78	17	2	None	97
Portland – 5.7	105	24	3	None	132
Stamford – 5.7	64	13	1	None	78
East Haddam – 6.4	172	48	6	1	227

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

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

Epicenter Location and Magnitude	Hospital (1)	Fire Stations (1)	Police Stations (7)	Schools (46)
Haddam – 5.7	Minor damage (81% functionality)	Minor damage (81% functionality)	Minor damage (80% functionality)	Minor damage (81% functionality)
Portland – 5.7	Minor damage (77% functionality)	Minor damage (76% functionality)	Minor damage (76% functionality)	Minor damage (77% functionality)
Stamford – 5.7	Minor damage (82% functionality)	Minor damage (83% functionality)	Minor damage (84% functionality)	Minor damage (83% functionality)
East Haddam – 6.4	Minor damage (69% functionality)	Minor damage (68% functionality)	Minor damage (68% functionality)	Minor damage (68% functionality)

Table 7-5 presents potential damage to utilities and infrastructure based on the various earthquake scenarios. The HAZUS-MH software assumes that the Bethlehem transportation network and utility network includes the following:

- Highway: 7 major bridges;
- A potable water system consisting of 110 total kilometers of pipelines;
- A waste water system consisting of 66 total kilometers of pipelines and;
- A total of 44 kilometers of natural gas lines

The HAZUS-MH software is based on a national database that assumes each town has infrastructure such as water and wastewater facilities and gas pipelines. It is understood that Bethlehem does not have this level of infrastructure.

As shown in Table 7-6, highway bridge damage occurs under only the East Haddam scenario. Water, sewer, and gas lines are expected to have leaks and breaks, but no loss of potable water or electrical service is expected. No displacement of people due to fire is expected.

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

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Haddam – 5.7	No Damage	1 leak in potable water system ($0.01 million) and 1 leak in waste water system (<$0.01 million). No loss of service expected. Total damage: Approximately $0.01 million.	Fire damage will displace no people.

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Portland – 5.7	No Damage	2 leaks in potable water system ($0.01 million) and 1 leak in waste water system (<$0.01 million). No loss of service expected. Total damage: Approximately $0.01 million.	Fire damage will displace no people.
Stamford – 5.7	No Damage	1 leak in potable water system (<$0.01 million). No loss of service expected. Total damage: Approximately $0.01 million.	Fire damage will displace no people.
East Haddam – 6.4	Minor damage to transportation infrastructure ($0.01 million to bridges)	5 leaks and 1 major break in potable water system ($0.02 million),2 leaks and 1 major break in waste water system ($0.01 million) and 1 leak in natural gas system (<$0.01 million). No loss of service expected. Total damage: Approximately $0.04 million.	Fire damage will displace no people.

Generation of debris is not expected for any earthquake scenarios according to HAZUS. Likewise, no predicted sheltering requirements are predicted due to displaced households for earthquake damage. 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.

Table 7-6 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 7-6
HAZUS-MH Earthquake Scenarios – Casualty Estimates

Epicenter Location - Magnitude	2 AM Earthquake	2 PM Earthquake	5 PM Earthquake
Haddam – 5.7	None	None	None
Portland – 5.7	None	None	None
Stamford – 5.7	None	None	None
East Haddam – 6.4	1 (Level 1)	None	None

All earthquake scenarios cause only minor injuries or no injury at all.

Table 7-7 presents the total estimated losses and direct economic impact that may result from the four earthquake scenarios created for Bethlehem 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 7-5.

Table 7-7
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	$1,170,000	$230,000	$1,400,000
Portland – 5.7	$1,780,000	$34,000	$2,120,000
Stamford – 5.7	$880,000	$18,000	$1,060,000
East Haddam – 6.4	$3,390,000	$73,000	$4,110,000

The maximum simulated damage considering direct losses and infrastructure losses is approximately $4.1 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 of damaging earthquakes, this analysis demonstrates that earthquake damage presents a potential hazard to Bethlehem.

7.6 Potential Mitigation Strategies and Actions

As earthquakes are difficult to predict and can affect the entire town of Bethlehem, potential mitigation can only include adherence to building codes, education of residents, and adequate planning.

Requiring adherence to current State building codes for new development and redevelopment is necessary to minimize the potential risk of earthquake damage. Communities may consider preventing new residential development in areas that are most at risk 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. 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.

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, particularly public water and the waste water treatment 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.

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.

Critical facilities may 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.

7.7 *Status of Mitigation Strategies and Actions*

The prior mitigation strategies associated with earthquakes are listed below with commentary regarding the status of each.

Table 7-8
Status of Previous Strategies and Actions

Strategy or Action	Status
Consider preventing new residential development in areas prone to collapse.	The town does not have a specific regulation for this. By ordinance, the IWC excludes steep slopes from the area that is counted toward development; this results in steep slopes not being used for development. This is a capability.
Continue to require adherence to the state building codes.	The action is part of the building code and is therefore a capability.
Ensure that municipal departments have adequate backup facilities in case earthquake damage occurs.	The town has some backup facilities in place but this will continue to be evaluated because there may be opportunities to increase capabilities.

Some of the above strategies have been carried forward and are listed in the table of strategies in Appendix A. One new strategy has been identified through the process of updating this plan.

- ❑ The town may consider bracing systems and assets inside critical facilities. This could help protect IT systems, important records and files, libraries, and department-specific assets such as mechanical equipment in the wastewater treatment plant.

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

8.0 DAM FAILURE

8.1 <u>Setting</u>

Dam failures can be triggered suddenly, with little or no warning, 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 19 registered dams and potentially several other minor dams in the Town, dam failure can occur almost anywhere in Bethlehem. While flooding from a dam failure generally has a medium geographic extent, the effects are potentially catastrophic. Fortunately, a major dam failure is considered only a possible natural hazard event in any given year.

8.2 <u>Hazard Assessment</u>

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

- *Class AA* dams are negligible hazard potential dams that upon failure would result in no measurable damage to roadways and structures, and negligible economic loss.
- *Class A* dams are low hazard potential dams that upon failure would result in damage to agricultural land and unimproved roadways, with minimal economic loss.
- *Class BB* dams are moderate hazard potential dams that upon failure would result in damage to normally unoccupied storage structures, damage to low volume roadways, and moderate economic loss.
- *Class B* dams are significant hazard potential dams that upon failure would result in possible loss of life, minor damage to habitable structures, residences, hospitals, convalescent homes, schools, and the like, damage or interruption of service of utilities, damage to primary roadways, and significant economic loss.
- *Class C* dams are high potential hazard dams that upon failure would result in loss of life and major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways with great economic loss.

As of 1996, there were 19 DEEP-registered dams within the Town of Bethlehem, of which one is Class AA, nine are Class A, six are Class BB, one is Class B, one is Class C, and one is undefined. The list of Class B and C dams was updated by the DEEP in 2007, with five dams being reduced from Class B status. This section primarily discusses the possible effects of failure of significant and high hazard (Class B & C) dams. In addition, this section discusses the failure of Long Meadow Pond Dam as it is owned by the Town of Bethlehem.

Dams in Bethlehem are listed in Table 8-1. Note that the registered names of some dams do not match the current road names.

Table 8-1
Dams Registered with the DEEP in the Town of Bethlehem

Number	Name	Location	Class
1001	Bronson Lockwood Dam	Off Kasson Road	C
1002	Addie Road Pond Dam	Molzon Lane	BB*
1003	Benjamin Pond Dam	Munger Lane	BB
1004	Watertown Reservoir Dam	Off Kasson Road	BB*
1005	Bird Pond Dam	Wood Creek Road	B
1006	Long Meadow Pond Dam	Lake Drive	BB*
1007	Zieglers Pond Dam	Carmel Hill Road North	BB*
1008	Kassar Road Pond Dam	Kasson Road	BB*
1009	Asmus Dam	Guilds Hollow Road	A
1010	Leever Dam	Guilds Hollow Road	A
1011	Spring Brook Pond Dam	Off Woodland Road	A
1012	Messenger Lane Pond Dam	Off Munger Lane	A
1013	Unnamed Dam	Off Hickory Lane	A
1014	Park Pond Dam	Woods Edge Road	A
1015	Barnes Pond Dam	Wood Creek Road	A
1016	Assard Pond Dam	Off Woodcreek Road	A
1017	Newman Pond Dam	Arch Bridge Road	-
1020	Thurber Pond Dam	Off Harrison Lane	A
1022	Angelus Pond Dam	Off Flanders Road	AA

*Rated a Class B dam in 1996, but was no longer rated Class B in 2007.

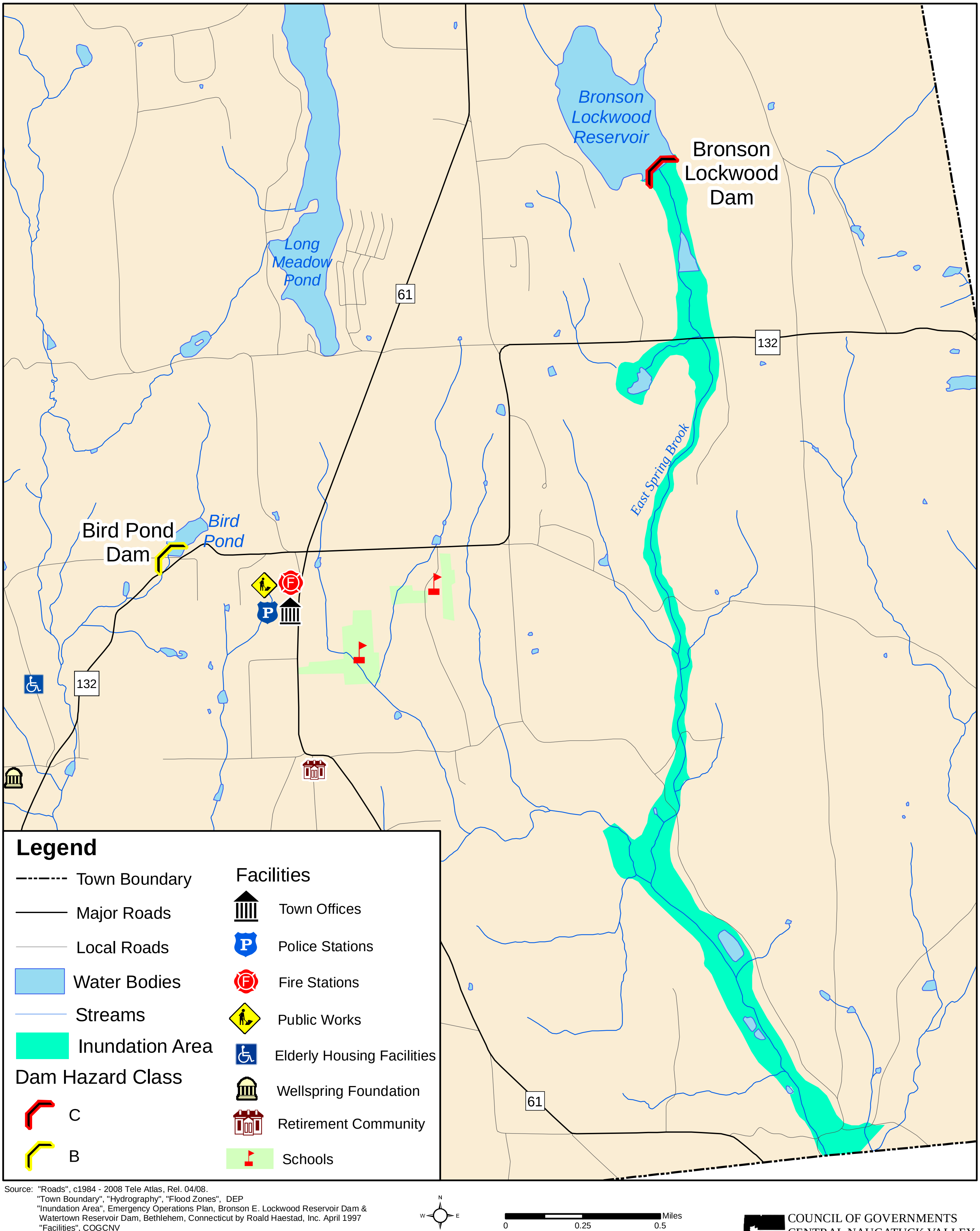
Failure of a Class C dam has the potential for loss of life and property damage totaling millions of dollars. Failure of a Class B dam has the potential for loss of life and minor damage to property and critical facilities. Bronson Lockwood Dam is the only Class C dam in Bethlehem, and Bird Pond Dam is currently the only Class B dam in Bethlehem. The Class B and C dams, along with the dam failure inundation area for Bronson Lockwood Dam, are shown in Figure 8-1. A close-up of the area downstream of Long Meadow Pond is shown on Figure 8-2.

8.3 Historic Record

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

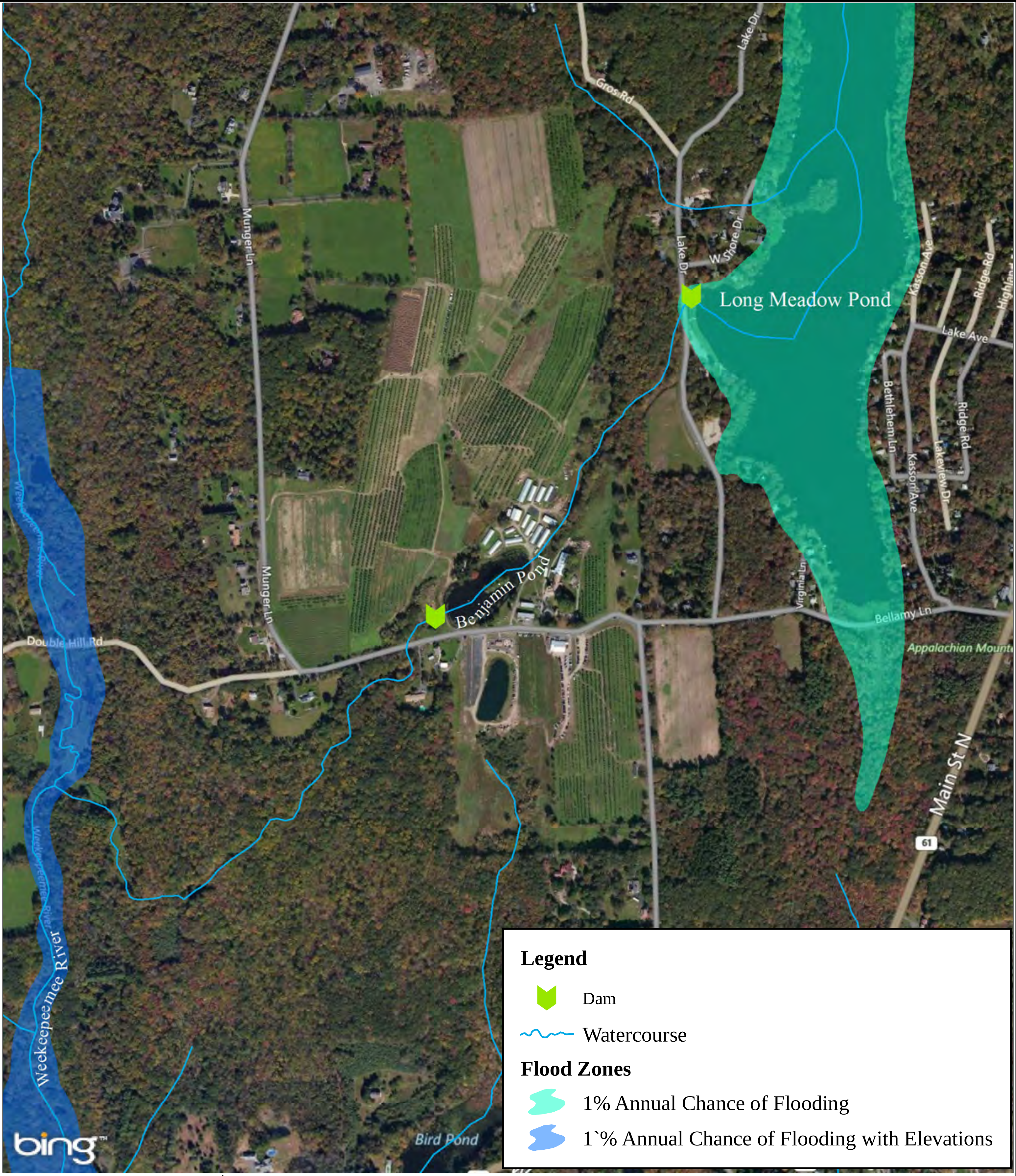
- 1938 and 1955: Exact numbers of dam failures caused by these floods are unavailable, but Connecticut DEEP believes that more dams were damaged in these events than in the 1982 or 2005 flooding events.
- 1961: Crystal Lake dam in Middletown failed, injuring three and severely damaging 11 homes.
- 1963: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

Figure 8-1: High Hazard Dams in Bethlehem



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", "Hydrography", "Flood Zones", DEP
"Inundation Area", Emergency Operations Plan, Bronson E. Lockwood Reservoir Dam & Watertown Reservoir Dam, Bethlehem, Connecticut by Roald Haestad, Inc. April 1997
"Facilities", COGCNV
For general planning purposes only. Delineations may not be exact.
August 2008

COUNCIL OF GOVERNMENTS
CENTRAL NAUGATUCK VALLEY



SOURCE(S):	Figure 8-2: Long Meadow Pond Subset Area		LOCATION: Bethlehem, CT
FEMA Flood Zones, CT Ortho 2012	N Town of Bethlehem Natural Hazard Mitigation Plan Update MXD: P:\2097-11\Design\GIS\Maps\Bethlehem\2013_Figure8-2_Long.mxd	Map By: JDW MMI#: 2097-11 Original: 12/2008 Revision: 07/05/2013 Scale: 1 inch = 750 feet	MILONE & MACBROOM 99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

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.

No major dam failures have occurred in the Town of Bethlehem. According to Town personnel, the dams throughout Town are in varying stages of condition, with the higher hazard dams being in good to excellent condition. The following paragraphs provide a description and highlight the general condition these dams based on information available at the Connecticut DEEP:

- Bronson E. Lockwood Dam – This reservoir dam is owned by the Watertown Fire District and located in the headwaters of East Spring Brook in northeastern Bethlehem. It consists of an earth and rockfill dam approximately 600 feet long. The dam is 142 feet high and 2,000 feet long. Outlet works are controlled by a gate house in the center of the structure. The dam is maintained by the Watertown Fire District and is believed to be in good to excellent condition. An Emergency Operations Plan (EOP) for this dam from 1997 is on file with the DEEP.

- Bird Pond Dam – This private dam is located at 10 Woodcreek Road in central Bethlehem. The dam impounds an unnamed tributary on the way to its confluence with the Weekeepeemee River. Outlet works are believed to include an earthen and concrete overflow into the outlet stream channel. The dam is maintained by the owner and is believed to be in good condition.

- Long Meadow Pond Dam – This dam is owned by the Town of Bethlehem and is currently rated below a Class B dam. This dam overtopped during the April 2007 storms, and though the dam sustained some damage, it did not fail. The Connecticut DEEP sent the Town of Bethlehem an engineering request letter in October 2007 requiring the Town to retain an engineer to perform a hydraulic and hydrologic analysis of the dam, and to design improvements to allow the dam to safely pass the 100-year storm event.

8.4 Existing Capabilities

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 DEEP, according to Connecticut Public Act 83-38.

> Dams permitted by the DEEP must be designed to pass the 100-year rainfall event with one foot of freeboard, a factor of safety against overtopping.
>
> Significant and high hazard dams are required to meet a design standard greater than the 100-year rainfall event.

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.

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.

Owners of Class C dams have traditionally been required to maintain Emergency Operation Plans (EOPs). 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. Public Act 13-197, *An Act Concerning the Dam safety Program and Mosquito Control*, 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 Act requires owners of certain unregistered dams or similar structures to register them by October 1, 2015. The Act generally shifts regularly scheduled inspection and reporting requirements from the DEEP to the owners of dams. The Act 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 (Class B and C) 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.

Bethlehem's capabilities 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. In the next few years, dam safety programs will continue to strengthen.

8.5 ***Vulnerabilities and Risk Assessment***

By definition, failure of Class C dams may cause catastrophic loss of life and property. Therefore, the failure of Bronson E. Lockwood Dam would likely have the highest impact on the residents and infrastructure of the Town of Bethlehem. However, the failure of any of the 18 other dams in Town could also have impacts within the Town of Bethlehem. The impacts related to the larger and higher-hazard dams in Town, namely the Bronson E. Lockwood Dam, Bird Pond Dam, and Long Meadow Pond Dam, are described in general detail below.

Bronson E. Lockwood Dam

The dam failure inundation area shown in Figure 8-1 and described below for the Bronson E. Lockwood dam was scanned in and redrawn from its EOP. Thus, the dam failure inundation area shown in Figures 8-1 is for planning purposes only and does not replace the official EOP map.

Bronson E. Lockwood Dam is owned by the Watertown Fire District and is used for public water supply. Based on dam failure inundation maps from the EOP, a dam failure at full pool height (worst-case scenario) would cause flooding along the East Spring Brook corridor all the way to the Nonnewaug River at the Watertown town boundary. The Watertown Reservoir Dam immediately downstream would likely fail, and water would likely wash out Route 132. Floodwaters would backwater up an unnamed stream to flood the area around Kassar Road Pond Dam, and Spring Brook Pond Dam would likely fail. Magnolia Hill Road and Maddox Road would likely be overtopped, and several houses along Nonnewaug Road / Paradise Valley Road would likely be inundated. Flood waters would spread in the area of Nonnewaug Road, Hickory Lane, and Porter Hill Road, ending the inundation area at the confluence of East Spring Brook with the Nonnewaug River.

Bird Pond Dam

Bird Pond Dam is privately owned and impounds an unnamed tributary to the Weekeepeemee River. A failure of this dam would likely overtop Wood Creek Road, potentially flooding several homes nearby. Flood waters could also over top Route 132 twice downstream, and would likely washout the Asmus Dam as well. Downstream of the Asmus Dam, floodwaters would enter the Weekeepeemee River and would likely not cause further flooding damage, although damage could be exacerbated if the failure Bird Pond Dam was caused in part by the failure of Long Meadow Pond Dam (see below).

Long Meadow Pond Dam

Long Meadow Pond Dam is owned by the Town of Bethlehem. The dam was formerly rated Class B but has recently been downgraded to at highest a Class BB. Long Meadow Pond is shallow (ten to 12 feet maximum depth) but is very long so it contains a lot of volume. The Town has been consistently performing all the necessary and required maintenance for this dam. Roald Haestad, Inc. performed an inspection following the dam overtopping in April 2007 and made recommendations regarding the design of this dam. The overtopping of the dam occurred because the dam was not properly designed to pass the 100-year storm event.

The Town retained an engineering consultant to inspect Long Meadow Pond Dam in 2015. This work is pending.

Should this dam fail, it is likely that floodwaters would travel down the outlet stream and cause damage to Lake Drive and Benjamin Pond Dam. Some flood waters could potentially overtop Munger Lane and drain south through the wetlands to Bird Pond, while the majority would likely continue southwest through forest into the Weekeepeemee River. If the dam failure occurs during heavy rain, the Weekeepeemee could already be flooded, and the additional waters would exacerbate flooding conditions downstream, particularly at Wood Creek Road, Crane Hollow Road, and in the Town of Woodbury. Increased flooding conditions could also potentially occur along the Pomperaug River in Woodbury and Southbury.

The spillway of Long Meadow Pond Dam does not convey the 100-year flood, and therefore some have the opinion that the dam needs to be modified. However, overtopping discharges from the dam already exceed the culverts at Lake Road and Munger Road, immediately downstream. Therefore, a coordinated effort may be needed to ensure that attention to the spillway does not occur without attention to the downstream culverts.

Loss Estimates

The HAZUS analysis in Chapter 3 provided potential loss estimates for the rivers downstream of the above dams. Therefore the HAZUS results can be used as a *minimum* estimate of losses associated with failure of the dams upstream of Weekeepeemee River and East Spring Brook. For East Spring Brook, building-related losses for the 1% annual chance flood were estimated by HAZUS at \$3.34 million, with an additional \$0.01 million in business interruption losses. For the Weekeepeemee River, building-related losses were estimated by HAZUS at \$5.03 million, with an additional \$0.04 million in business interruption losses.

In reality, losses associated with failures upstream of the Weekeepeemee River and East Spring Brook could be much higher. A failure could occur during a flood that would be filling the pool behind the dam. But the same flood could also be causing riverine flooding downstream. Therefore, the failure combined with the riverine flooding could be catastrophic in Bethlehem. For this reason, the continued maintenance of these dams is critical.

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

Preventive measures associated with 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 licensed professional engineer. In addition, local communities should maintain a dialogue with Connecticut DEEP regarding the development of EAPs 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. Some of this will be forthcoming with the recent legislation.

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 registered and periodically inspected to assure that their continued operation does not constitute a hazard to life, health, or property.

The Connecticut DEEP also administers the Flood and Erosion Control Board program, which can provide non-competitive state funding for repair of municipality-owned dams. Funding is limited by the state bond commission. State statute Section 25-84 allows municipalities to form Flood and Erosion Control Boards, but municipalities must take action to create the board within the context of the local government, such as by revising the municipal charter. The Town of Bethlehem may wish to establish such a Flood and Erosion Control Board to oversee local flooding and erosion problems and municipal dams.

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 EOP/EAP 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.

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.

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.

The Town of Bethlehem should work with the Watertown Fire District, private property owners, and the Connecticut DEEP to stay up to date on the evolution of EOPs/EAPs and Dam Failure Analyses for the significant and high hazard dams in Bethlehem. When possible, copies of these documents should be made available at the Town Hall for reference and public viewing.

With regard to Long Meadow Pond Dam, the Town of Bethlehem may pursue modifications of the dam to pass the 100-year flood event, and should review and update the EOP or EAP when modifications are completed. The Town should also maximize Town emergency preparedness for a potential dam failure. The Town should continue its ongoing program of inspection and maintenance. In addition, all Class C and B dams in the Town should continue to be regularly inspected by their respective owners and DEEP, with maintenance performed as required to keep the dams in safe and functional order. The Town may also consider implementing occasional Town inspections of Class A, AA, BB, and unranked dams.

The Town of Bethlehem should consider including dam failure areas into a CT Alert-style emergency notification system. This system combines database and GIS mapping technologies to deliver outbound emergency notifications to geographic areas or specific groups of people such as emergency responder teams at a rate of up to 60,000 calls per hour. This technology should be used to warn downstream residents of an impending dam failure and facilitate evacuation.

8.7 Status of Mitigation Strategies and Actions

The prior mitigation strategies associated with dam failure are listed below with commentary regarding the status of each.

Table 8-3
Status of Previous Strategies and Actions

Strategy or Action	Status
Remain current on the evolution of EOPs and Dam Failure Analyses for Class C and Class B dams whose failure could impact areas of Bethlehem.	The town anticipates that DEEP will be addressing Class B and C dams per the recent legislation. This is no longer an action needed at the municipal level.
Consider implementing Town inspections of Class AA, A, and unranked dams.	The town does not have this expertise or sufficient funding, and the strategy is deleted.
If the Town acquires an emergency notification system, include dam failure areas in the contact database.	The town subscribes to CT Alert/Everbridge but it takes less time to evacuate the limited areas of concern by going door-to-door, such as the Arrowhead Lane area. A new action has been developed for the Arrowhead Lane area, specific below this table.
When possible, have copies of the Class C dam EOPs and Dam Failure Analyses on file in the Town hall for public viewing.	The town anticipates that DEEP will be addressing Class B and C dams per the recent legislation, resulting in the availability of EAPs. These should be filed with the EMD. A new action is listed below this table.

Strategy or Action	Status
Continue pursuing modifications to Long Meadow Pond Dam to pass the 100-year flood event, review and update the Emergency Operations Plan when modifications are completed, and maximize Town emergency preparedness for a potential dam failure.	Some repairs have occurred and the town routinely focuses on downstream vulnerable areas when floods are occurring. Additional work is desired and new actions are provided below this table.
Continue the ongoing program of inspection and maintenance of Long Meadow Pond Dam.	An inspection was completed several years ago and in 2015. This is ongoing and is considered a capability.
Consider forming a Flood and Erosion Control Board in Bethlehem to oversee municipal dam maintenance and problems with flooding and erosion.	This is not of interest and the strategy is deleted.

Portions of the above strategies and actions have been carried forward and are listed in the table of strategies in Appendix A. Four new strategies have been identified:

- Construct a properly sized spillway for Long Meadow Pond Dam.
- Increase capacities of culverts downstream of Long Meadow Pond Dam to convey the same discharges as the spillway after it is constructed.
- Develop a written evacuation plan for Arrowhead Lane and Crane Hollow Road residents.
- File EAPs in the office of emergency management and ensure that they are current.

With the legislature passed in 2013, dam assessment and management capabilities will continue to increase in the state. The next edition of this plan will revisit dams and discuss the outcomes of the legislation and any new regulations administered by the Connecticut DEEP.

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

9.0 WILDFIRES

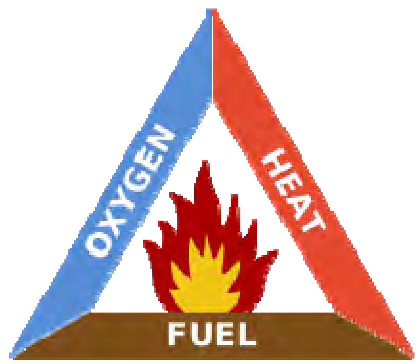
9.1 Setting

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

The Town of Bethlehem is considered a low-risk area for wildfires. Wildfires are of particular concern in the many wooded areas and other areas with poor access for fire-fighting equipment. Figure 9-1 presents the wildfire risk areas for the Town of Bethlehem. Hazards associated with wildfires include property damage and loss of habitat. Wildfires of any type 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

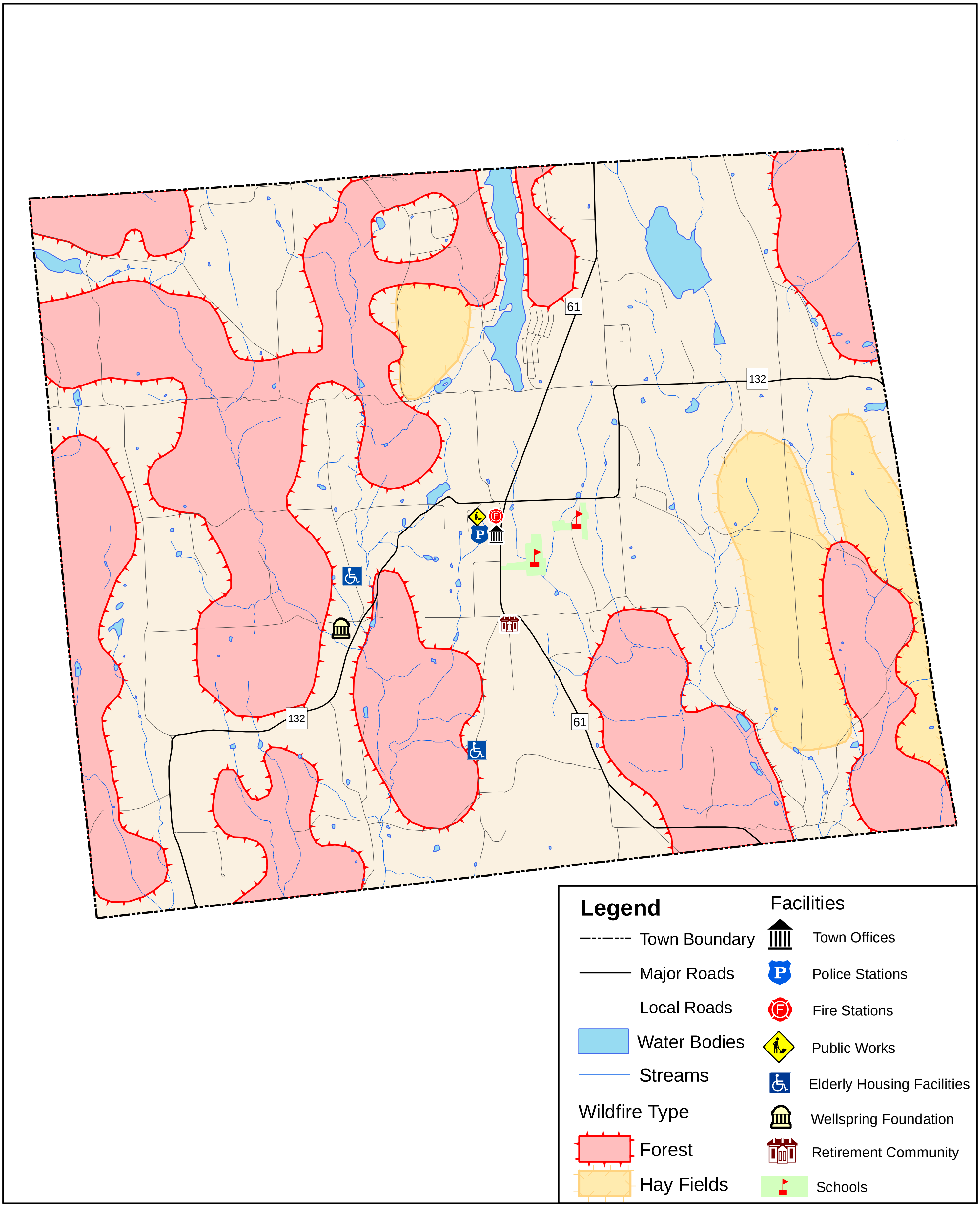
Wildfires are any non-structure fire, other than a prescribed burn, that occurs in undeveloped areas. They are considered to be highly destructive, uncontrollable fires. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially 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:
  - Ground Fuels, consisting of organic soils, forest floor duff, stumps, dead roots, and buried fuels;
  - Surface Fuels, consisting of the litter layer, downed woody materials, and dead and live plants to two meters in height;
  - Ladder Fuels, consisting of vine and draped foliage fuels; and
  - Canopy Fuels, consisting of tree crowns

Figure 9-1: Bethlehem Wildfire Risk Area



Source: "Roads", c1984 - 2008 Tele Atlas, Rel. 04/08.
"Town Boundary", DEP
"Facilities", "Wildfire Area", COGCNV
For general planning purposes only. Delineations may not be exact.
August 2008

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- 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.

- 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 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.

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 2014 *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.

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

The 2014 *Connecticut Natural Hazard Mitigation Plan Update* states that in seven of the eight counties in Connecticut, the primary cause of wildland fires is unknown. The secondary cause is identified as incendiary (arson) and debris burning.

Traditionally, the highest forest fire danger in Connecticut occurs in the spring from mid-March to mid-May. The worst wildfire year in Connecticut since 1994 occurred during the extremely hot and dry summer of 1999. Over 1,733 acres of Connecticut burned in 345 separate wildfires, an average of about five acres per fire. Only one wildfire occurred between 1994 and 2003 that burned over 300 acres, and a wildfire in 1986 in the Mattatuck State Forest in the nearby Town Watertown burned 300 acres. More recently, a 30-acre wildfire occurred in Oxford at the south end of the Central Naugatuck Valley region on April 19, 2008.

Much of Bethlehem is privately owned forest, and fires have occurred throughout the Town. The town does not report that any significant wildfires occurred since the initial HMP was adopted.

9.4 Existing Capabilities

Connecticut enacted its first state-wide 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 1940's prompted the state legislature to join the Northeastern Interstate Forest Fire Protection Compact with its neighbors in 1949. Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEP, forest has reclaimed over 500,000 acres of what was farmland in 1914.

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.

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.

Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. The Town of Bethlehem Subdivision Regulations require the creation of fire ponds for new subdivisions or re-subdivisions. In addition, new roads, subdivisions, and fire ponds are required to allow for fire truck access.

The Connecticut DEEP has recently changed its Open Burning Program. It now requires individuals to be nominated and designated by the Chief Executive Officer in each municipality that allows open burning to take an online training course and exam to become certified as an "Open Burning Official." Permit template forms were also revised that provides permit requirements so that the applicant/permittee is made aware of the requirements prior to, during and post burn activity. The regulated activity is then overseen by the town.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the Bethlehem Fire Department goes to the fires. This proactive approach is believed to be effective for controlling wildfires. The Fire Department has some water storage capability, but primarily relies on the use of 32 fire ponds with dry hydrants to fight fires throughout Town.

The Bethlehem Fire Department is often the first responder for fires that happen in the Land Trust on the Watertown/Woodbury/Bethlehem boundary, and coordinates with the Watertown and Woodbury Fire Departments to control these forest fires. The Fire Department is also the first responder to part of Camp Columbia's property off Munger Lane and the nearby state forest in Morris. The DEP has recently increased public access to this area, so the Town feels it is at a higher risk for fires. The Bethlehem Fire Department has a four-wheel drive brush truck capable of accessing remote locations. The Town also has mutual aid agreements with all of its neighbors.

Finally, the DEEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system (see Section 3.4) to compile forest fire probability forecasts. This allows the Division and the Town of Bethlehem to monitor the drier areas of the state in an effort to reduce forest fire risk.

Aside from moderate changes in State policy, the town's capabilities to mitigate for wildfires and prevent loss of life and property have not changed since the initial hazard mitigation plan was adopted. The town will continue to evaluate whether capabilities need to be strengthened in the future.

9.5 Vulnerabilities and Risk Assessment

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

According to the Connecticut DEP, the actual forest fire risk in Connecticut is low due to several factors. First, the overall incidence of forest fires is very low. Secondly, as the wildfire/forest fire prone areas become fragmented due to development, the local fire departments have increased access to those neighborhoods for fire fighting equipment. Third, the problematic interface areas are site specific, such as driveways too narrow to permit emergency vehicles. Finally, trained fire fighters at the local and state level are readily available to fight fires in the state, and inter-municipal cooperation on such instances is common. The 2014 *Connecticut Natural Hazard Mitigation Plan Update* characterizes the wildfire risk for Litchfield County as medium-low.

Based on the historic record presented in Section 9.3, most wildfires in Connecticut are relatively small. In the drought year of 1999, the average wildfire burned five acres in comparison to the two most extreme wildfires recorded since 1986 that burned 300 acres each. Given the availability of fire-fighting water in the Town, including the use of nearby water bodies, and long-standing mutual aid assurances the Town Fire Department has with neighboring communities, it is believed that these average and severe values are applicable to the Town as well. Indeed, Town personnel reported that the largest fires only burn a couple of acres before being contained despite the rural nature of the Town.

The wildfire risk areas presented in Figure 9-1 were defined as being contiguous wooded areas greater than 30 acres in size with limited access. These areas are generally associated with wooded water company lands, privately owned land trust property and forests, and Town-owned open space. The limited access conservation properties are considered to be at the highest risk for fires. As each area borders residential sections of the Town, residents on the outskirts of these risk areas are the most vulnerable to fire, heat, and smoke effects of wildfires.

Bethlehem has many rural areas with hayfields. Town personnel feel that these areas are also at risk for wildfires; as such fires could quickly encompass the entire field during a drought. These areas are delineated separately on Figure 9-1, and often occur near residential areas and roadways, presenting an increased risk of smoke, heat, and fire damage to residents.

Despite having a large amount of forest/urban interface, the overall risk of wildfires occurring in the Town of Bethlehem is considered to be low. Such fires fail to spread far due speed of detection and strong fire response. The Town has no state parks, so there are few fires caused by out of control campfires. Town personnel report that the larger private tracts of forest do not tend to attract kids. As most of the Town has fire-fighting water available nearby in the forms of fire ponds, a large amount of water can be made readily available for fire fighting equipment. The Town also has the support of the Watertown Fire District to provide access to their extensive watershed lands in case of a wildfire.

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

There are many areas of Town where roads are narrow and one-way. This hinders emergency access to fight fires. This is a particular problem around Long Meadow Pond, such as on West Shore Drive and in the private Kasson community. Fire trucks often need to drive into such areas in line with the last one in being the first one to back out as there is no place to turn around. In other places, fire trucks simply can't get to the houses that are up narrow dirt roads. The Fire Department should consider public education in these areas and encourage homeowners and private communities to widen the access for emergency vehicles if possible.

In summary, areas adjacent to hayfields are considered most at risk from wildfires. In addition, there is concern about fires in the wooded southeastern, northern, and western sections of Town. While fires are infrequent in these areas, they can often be difficult to access. The Town has the support of the owners of the tracts of open space to provide access to their lands in case of a wildfire.

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

<u>Loss Estimates</u> – The 2014 *Connecticut Natural Hazard Mitigation Plan* provides annual estimated losses on a countywide basis for several hazards. Based on the population of Bethlehem relative to Litchfield County, the annual estimated loss is $1,064 for wildfires. This is reasonable for Bethlehem.

9.6 *Potential Mitigation Strategies and Actions*

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

9.7 *Status of Mitigation Strategies and Actions*

The prior mitigation strategies associated with wildfires are listed below with commentary regarding the status of each.

Table 9-2
Status of Previous Strategies and Actions

Strategy or Action	Status
The Town of Bethlehem should continue to require the installation of fire ponds and dry hydrants in new subdivisions, and should look to install additional ponds where adequate water supplies do not currently exist.	The action is ongoing and is therefore a capability.
Encourage property owners to widen access roads such that fire trucks and other emergency vehicles can access remote locations.	This is done on a case-by-case basis and is a capability.
Continue to promote inter-municipal cooperation in fire-fighting efforts.	The action is ongoing and is therefore a capability.
Continue to support public outreach programs to increase awareness of forest fire danger and how to use common fire-fighting equipment.	The action is ongoing and is therefore a capability.
Provide outreach programs on how to properly manage burning and campfires on private property.	The action is ongoing and is therefore a capability.
Patrol Town-owned open space and parks to prevent unauthorized campfires.	The action is ongoing and is therefore a capability.
Enforce regulations and permits for open burning.	The action is ongoing and is therefore a capability.

Most of the above strategies and actions are already ongoing and are part of the town's capabilities. One new strategy for wildfire mitigation has resulted from the modification of the above fire pond strategy:

- ❑ Explore other fire protection solutions such as the use of cisterns.

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

10.0 MITIGATION STRATEGIES AND ACTIONS

10.1 Additional Strategies

Strategies that are applicable to a small number of hazards were discussed in the applicable subsections of Sections 3.0 through 10.0. For example, placing utilities underground is a strategy for hurricane, summer storm, winter storm, and wildfire mitigation. A remaining class of "all-hazard" strategies is applicable to all hazards, because it includes actions for improving public safety and planning for emergency response. Instead of repeating these strategies in each of this Plan, these are described below.

Bethlehem has made great progress with most of the all-hazard strategies described in the previous HMP. Preparedness and disaster-related information is continuously provided in municipal facilities, and the town subscribes to the CT Alert notification system. The town's EOP is reviewed annually and updated as needed. These previous strategies are now considered capabilities.

Three new categories of all-hazard mitigation is proposed in this plan: (1) acquisition and installation of additional standby power supplies (generators); (2) development or designation of shelters for people and animals; and (3) provision of power supply redundancy to the Main Street South area. Several critical facilities require standby power supplies or power supply redundancy. Consider, for example, that power outages caused by storms Irene, Sandy, and Alfred caused outages at some of the town's facilities. The town would prefer to avoid these situations, going forward. Strategies and actions include:

- ❑ Designate or construct an emergency shelter that can accommodate overnight evacuees; or
- ❑ Consider constructing a community center that can serve as a shelter that can accommodate overnight evacuees.
- ❑ Support regional efforts to make Nonnewaug High School available as a shelter for Bethlehem and Woodbury by installing a generator and making other needed improvements.
- ❑ Construct an animal shelter that serves Bethlehem.
- ❑ Consider developing a microgrid for the Main Street South corridor, as the services on this road are critical for the town after weather emergencies.

10.2 Summary of Specific Strategies and Actions

Strategies and actions have been presented throughout this document in individual sections as related to each natural hazard. 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 used in the previous HMP.

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 in Appendix A. The STAPLEE matrix presents a summary of scores. The highest scoring is determined to be of more importance economically, socially, environmentally, and politically and, hence, prioritized over those with lower scoring. In addition, structural projects were also evaluated qualitatively. Note that the scoring system inherently favors actions that have minimal incremental costs, such as modifying regulations (which is accomplished by existing municipal personnel and commissions).

Although a community may implement actions as prioritized by the STAPLEE method, an additional consideration is important for those actions 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 actions 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 action is therefore listed as "minimal", "low", "intermediate", or "high" on the STAPLEE matrix. These identifiers are defined as follows:

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

- "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.

10.3 Priority Strategies and Actions

The STAPLEE scores were used to prioritize the suggested mitigation strategies and actions. The highest ranking actions are listed below:

- Incorporate additional elements of this hazard mitigation plan into the Plan of Conservation and Development
- Acquire open space properties within SFHAs and set aside as greenways, parks, or other non-residential, non-commercial, or non-industrial use
- Encourage the State DOT to elevate Route 132 between Lakes Road and Sky Meadow Lane, or to widen the stream and install a box culvert
- Develop a written evacuation plan for Arrowhead Lane and Crane Hollow Road residents
- Explore other fire protection solutions such as the use of cisterns
- Construct a properly sized spillway for Long Meadow Pond Dam

10.4 Sources of Funding and Technical Assistance

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

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.

Continuing Training Grants (CTG)
http://www.grants.gov/web/grants/search-grants.html

> This program provides funds to develop and deliver innovative training programs that are national in scope and meet emerging training needs in local communities.

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 floodplain managers, 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.

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 DEMHS.

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 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.

Intercity Passenger Rail (IPR) Program
http://www.fema.gov/fy-2013-intercity-passenger-rail-ipr-amtrak-0

This program provides funding to the National Passenger Railroad Corporation (Amtrak) to protect critical surface transportation infrastructure and the traveling public from acts of terrorism, and to increase the resilience of the Amtrak rail system.

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.

Nonprofit Security Grant Program (NSGP)
http://www.fema.gov/fy-2014-urban-areas-security-initiative-uasi-nonprofit-security-grant-program-nsgp

This program provides funding support for hardening and other physical security enhancements to nonprofit organizations that are at high risk of terrorist attack and located within one of the specific Urban Areas Security Initiative (UASI)-eligible Urban Areas. The program seeks to integrate the preparedness activities of nonprofit organizations that are at high risk of terrorist attack with broader state and local preparedness efforts, and serve to promote coordination and collaboration in emergency preparedness activities among public and private community representatives and state and local government agencies.

Pre-Disaster Mitigation (PDM) 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 DEMHS.

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.

Small Town Economic Assistance Program
http://www.ct.gov/opm/cwp/view.asp?Q=382970&opmNav

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action bonds. This program is administered by the Connecticut Office of Policy and Management (OPM). Connecticut municipalities may receive up to $500,000 per year if (1) they are not designated as a distressed municipality or a public investment community, and (2) the State Plan of Conservation and Development does not show them as having a regional center. Public Act 05-194 allows an Urban Act Town that is not designated as a regional center under the State Plan of Conservation and Development to opt out of the Urban Action program and become a STEAP town for a period of four years.

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.

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.

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 Energy and Environmental Protection – *assistance to municipalities to solve flooding and dam repair problems through the Flood and Erosion Control Board Program.*

Erosion Control and Wetland Protection

- U.S. Department of Agriculture – *technical assistance for erosion control.*
- North American Wetlands Conservation Act Grants Program – *funding for projects that support long term wetlands acquisition, restoration, and/or enhancement. Requires a 1-to-1 funds match.*

11.0 PLAN IMPLEMENTATION

11.1 Implementation Strategy and Schedule

The Town of Bethlehem is authorized to update this hazard mitigation plan as described below and guide it through the FEMA approval process.

As individual recommendations of the hazard mitigation plan are implemented, they must be implemented by the municipal departments that oversee these activities. The First Selectman, the Department of Public Works, and the Emergency Management Director will primarily be responsible for developing and implementing selected projects. **A "local coordinator" will be selected as the individual in charge; this is the Emergency Management Director**. Appendix A incorporates an implementation strategy and schedule, detailing the responsible department and anticipated time frame for the specific recommendations listed throughout this document.

Upon adoption, the Plan will be made available to all Town departments and agencies as a planning tool to be used in conjunction with existing documents. It is expected that revisions to other Town plans and regulations, such as the Plan of Conservation and Development, department annual budgets, and the Subdivision Regulations will reference this plan and its updates. The local coordinator and First Selectman will be responsible for ensuring that the actions identified in this plan are incorporated into ongoing Town planning activities, and that the information and requirements of this plan are incorporated into existing planning documents within five years from the date of adoption or when other plans are updated, whichever is sooner. Should a general revision be too cumbersome or cost prohibitive, simple addendums to these documents will be added that include the provisions of this plan.

The 2010 Plan of Conservation and Development already includes several aspects of hazard mitigation. Land Use Policy #1 is "encourage the continued preservation of the natural features of Bethlehem" and Land Use Policy #3 is "ensure that new buildings be located on land suitable for supporting development." The Plan of Conservation and Development recommends that the town develop a capital improvement plan.

The Plan of Conservation and Development and the town's capital improvement plan are the two documents most likely to benefit from the inclusion of the Plan in the Town's library of planning documents. The Plan of Conservation and Development was updated in 2010, subsequent to adoption of the initial hazard mitigation plan, and already includes elements of hazard mitigation. However it is scheduled to be updated in 2020 at the end of the lifespan of this hazard mitigation plan update. **Therefore, continued incorporation of the hazard mitigation plan into the Plan of Conservation and Development is listed as a specific action of this hazard mitigation plan.**

Finally, information and projects in this planning document will be included in the annual budget and capital improvement plans as part of implementing the projects recommended in this Plan. This will primarily include the annual budget and capital improvement projects lists maintained and updated by the Public Works Department.

11.2 *Progress Monitoring and Public Participation*

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 associated with specific actions. Examples include structural projects. This will ensure that the suggested actions remain viable and appropriate. The worksheet in Appendix C will be filled out for specific project-related actions as appropriate. This worksheet is taken from the *Local Mitigation Planning Handbook.*

Site Reconnaissance to be completed between April 1 and November 1 each year.

The local coordinator will be responsible for obtaining a current list of repetitive loss properties (RLPs) in the community each year, understanding that the town does not include any at this time and may not include any in the future. Any 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 holding 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 March or April of each year, at least two months before the annual application cycle for grants under the HMA program[5]. This will enable a list of possible projects to be circulated to applicable local 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.

An annual meeting should be conducted by March or April each year. Appendix E contains worksheets that may be helpful for this annual meeting.

Post-Disaster Reporting and Meeting – Subsequent to federally-declared disasters in the State of Connecticut for Litchfield 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.

Post-disaster meeting to be conducted within two months of each Federal disaster declaration in Connecticut.

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

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 the town's web site and the Naugatuck Valley Council of Governments website.

11.3 Updating the Plan

The town will update the hazard mitigation plan if a consensus to do so is reached by the Board of Selectmen, or at least once every five years. Updates to this HMP will be coordinated by the local coordinator. The town 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; the assistance of the Naugatuck Valley Council of Governments may be solicited from time to time for this purpose.

Table 11-1 presents a schedule to guide the preparation for the plan update and then the update of the plan. The schedule is based on a plan adoption of October 2015 and expiration in October 2020. The record of adoption is included in Appendix F.

Table 11-1
Schedule for Hazard Mitigation Plan Update

Month and Year	Tasks
October 2016	Annual meeting to review plan content and progress
October 2017	Annual meeting to review plan content and progress
October 2018	Annual meeting to review plan content and progress
June 2019	Ensure that funding for the plan update is included in the fiscal year 2019-2020 budget
August 2019	Secure consultant to begin updating the plan, or begin updating in-house
October 2019	Annual meeting to review plan content and progress
March 2020	Forward draft updated plan to State for review
April-August 2020	Process edits from State and FEMA and obtain the Approval Pending Adoption (APA)
September 2020	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 non-profit interest groups, and the neighboring municipalities will be solicited for representation, including the following:

- Naugatuck Valley Council of Governments;
- Pomperaug River Watershed Association;
- Key organizations from the list presented on Page 1-10;

- Town of Washington Public Works Department and Planning Department;
- Town of Morris Public Works Department and Planning Department;
- Town of Watertown Public Works Department and Planning Department; and
- Town of Woodbury Public Works Department and Planning Department;

The project action worksheets prepared by the local coordinator and annual reports described above 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, several prior actions were removed from the HMP while preparing this update because they had become institutionalized capabilities, they were successfully completed, or they were subsumed by more specific local or State actions.

11.4 Technical and Financial Resources

This Section is comprised of a list of resources to be considered for technical assistance and potentially financial assistance for completion of the actions outlined in this Plan. This list is not all-inclusive and is intended to be updated as necessary.

Federal Resources

Federal Emergency Management Agency
Region I
99 High Street, 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 *Technical Assistance Contracts (TAC)* in place 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.

Response & Recovery Division

As part of the National Response Plan, this division provides information on dollar amounts of past disaster assistance including Public Assistance, Individual Assistance, and Temporary Housing, as well as information on retrofitting and acquisition/ relocation initiatives. The Response & Recovery Division also provides mobile emergency response support to disaster areas, supports the National Disaster Medical System, and provides urban search and rescue teams for disaster victims in confined spaces.

The division also coordinates federal disaster assistance programs. The Public Assistance Grant Program (PA) that provides 75% grants for mitigation projects to protect eligible damaged public and private non-profit facilities from future damage. "Minimization" grants at 100% are available through the Individuals and Family Grant Program. The Hazard Mitigation Grant Program and the Fire Management Assistance Grant Program are also administered by this division.

Computer Sciences Corporation
New England Regional Insurance Manager
Bureau and Statistical Office
(781) 848-1908

Corporate Headquarters
3170 Fairview Park Drive
Falls Church, VA 22042
(703) 876-1000
http://www.csc.com/

A private company contracted by the Federal Insurance Administration as the National Flood Insurance Program Bureau and Statistical Agent, CSC provides information and assistance on flood insurance, including handling policy and claims questions, and providing workshops to leaders, insurance agents, and communities.

Small Business Administration
Region I
10 Causeway Street, Suite 812
Boston, MA 02222-1093
(617) 565-8416
http://www.sba.gov/

SBA has the authority to "declare" disaster areas following disasters that affect a significant number of homes and businesses, but that would not need additional assistance through FEMA. (SBA is triggered by a FEMA declaration, however.) SBA can provide additional low-interest funds (up to 20% above what an eligible applicant would "normally" qualify for) to install mitigation measures. They can also loan the cost of bringing a damaged property up to state or local code requirements. These loans can be used in combination with the new "mitigation insurance" under the NFIP, or in lieu of that coverage.

Environmental Protection Agency
Region I
1 Congress Street, Suite 1100
Boston, MA 02114-2023
(888) 372-7341

Provides grants for restoration and repair, and educational activities, including:

- *Capitalization Grants for Clean Water 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 DEEP.

U.S. Department of Housing and Urban Development
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.S. Army Corps of Engineers
Institute for Water Resources
7701 Telegraph Road
Alexandria, VA 22315
(703) 428-8015
http://www.iwr.usace.army.mil/

The Corps provides 100% funding for floodplain management planning and technical assistance to states and local governments under 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 percent federally-funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65 percent with a 35 percent non-federal match. In certain cases, the non-Federal share for construction could be as high as 50 percent. 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 non-profit 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 (non-structural) 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 percent federally funded.

In addition, the Corps also provides emergency flood assistance (under Public Law 84-99) after local and state funding has 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
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 Administrative Services, Division of Construction Services
165 Capitol Avenue
Hartford, CT 06106
(860) 713-5850
http://www.ct.gov/dcs/site/default.asp

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.

<u>Connecticut Department of Economic and Community Development</u>
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.

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

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 agencies, 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.

Planning and Standards Division - Administers the Clean Water Fund and many other programs directly and indirectly related to hazard mitigation including the Section 319 nonpoint source pollution reduction grants and municipal facilities program which deals with mitigating pollution from wastewater treatment plants.

Office of Long Island Sound Programs (OLISP) - Administers the Coastal Area Management Act (CAM) program and Long Island Sound License Plate Program.

Connecticut Department of Emergency Services and Public Protection
1111 Country Club Road
Middletown, CT 06457
(860) 685-8190
http://www.ct.gov/dps/

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

DEMHS is the lead division responsible for emergency management. Specifically, responsibilities include emergency preparedness, response and recovery, mitigation, and an extensive training program. DEMHS is the state point of contact for most FEMA grant and assistance programs and oversees hazard mitigation planning and policy; administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program; and the responsibility for making certain that the State Natural Hazard Mitigation Plan is updated every five years. 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 five years.

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.

<u>Connecticut Office of Policy and Management</u>
450 Capitol Avenue
Hartford, CT 06106
(860) 418-6200
http://www.ct.gov.opm

Small Town Economic Assistance Program

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation and quality of life projects for localities that are ineligible to receive Urban Action bonds. This program is administered by the Connecticut Office of Policy and Management (OPM). Connecticut municipalities may receive up to $500,000 per year if (1) they are not designated as a distressed municipality or a public investment community, and (2) the State Plan of Conservation and Development does not show them as having a regional center. Public Act 05-194 allows an Urban Act Town that is not designated as a regional center under the State Plan of Conservation and Development to opt out of the Urban Action program and become a STEAP town for a period of four years. Projects eligible for STEAP funds include:

1) Economic development projects such as (a) constructing or rehabilitating commercial, industrial, or mixed-use structures and (b) constructing, reconstructing, or repairing roads, access ways, and other site improvements;
2) Recreation and solid waste disposal projects;
3) Social service-related projects, including day care centers, elderly centers, domestic violence and emergency homeless shelters, multi-purpose human resource centers, and food distribution facilities;
4) Housing projects;
5) Pilot historic preservation and redevelopment programs that leverage private funds; and
6) Other kinds of development projects involving economic and community development, transportation, environmental protection, public safety, children and families and social service programs.

In recent years, STEAP grants have been used to help fund many types of projects that are consistent with the goals of hazard mitigation. Projects funded in 2013 and 2014 include streambank stabilization, dam removal, construction of several emergency operations centers (EOCs) in the state, conversion of a building to a shelter, public works garage construction and renovations, design and construct a public safety communication system, culvert replacements, drainage improvements, bridge replacements, generators, and open space acquisition.

<u>Private and Other Resources</u>

<u>Association of State Dam Safety Officials (ASDSO)</u>
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. The 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.

Connecticut Association of Flood Managers (CAFM)
P.O. Box 960
Cheshire, CT 06410
ContactCAFM@gmail.com
http://www.ctfloods.org/

CAFM is a professional association of private consultants and local floodplain managers that provides training and outreach regarding flood management techniques. CAFM is the local state chapter of ASFPM.

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.

***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
STAPLEE MATRIX

	Strategies and Actions for Bethlehem	Status *New Actions Noted*	Category 1. Prevention 2. Property Protection 3. Natural Resource Prot. 4. Structural Projects 5. Public Information 6. Emergency Services	Responsible Department[1]	Timeframe	Cost Low = Minimal[2] Intermediate = <$100,000 High = >$100,000	Potential Funding Sources[3]	Weighted STAPLEE Criteria[4]																Total STAPLEE Score
								Benefits								*Costs*								
								Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
	ALL HAZARDS																							
1	Add pages to Town website dedicated to citizen education and preparation for natural hazard events		5	EMD	7/2015-6/2016	Low	Municipal/OB	1	1	1	1	1	0	0	**6.0**	0	0	-0.5	0	0	0	0	**-0.5**	**5.5**
2	Support regional efforts to make the High School available as a shelter for by installing a generator and making other needed improvements	New	6	EMD	1/2016-1/2017	High		1	0.5	1	1	1	0.5	0	**6.0**	0	0	0	0	0	-0.5	0	**-1.0**	**5.0**
3	Designate an emergency shelter that can accommodate overnight evacuees	New	6	EMD	1/2018-1/2019	High	Municipal/CI, STEAP	1	0.5	1	1	1	0.5	0	**6.0**	0	0	0	0	0	-1	0	**-2.0**	**4.0**
4	Consider constructing a community center that can serve as a shelter that can accommodate overnight evacuees	New	6	EMD	1/2018-1/2019	High	Municipal/CI, EOC, STEAP	1	0.5	1	1	1	1	0	**7.0**	0	0	0	0	0	-1	0	**-2.0**	**5.0**
5	Construct an animal shelter that serves Bethlehem	New	6	EMD	1/2016-12/2016	High	Municipal/CI, STEAP	1	0	0	1	1	0	0	**3.0**	0	0	0	0	0	-1	0	**-2.0**	**1.0**
6	Consider developing a microgrid for the Main Street South corridor, as the services on this road are critical for the town after weather emergencies	New	1, 6	First Selectman	1/2016-12/2017	High	PURA, Municipal/CI	1	0.5	1	1	1	0.5	0	**6.0**	0	0	-1	0	0	-1	0	**-3.0**	**3.0**
7	Consider modifying the Plan of Conservation and Development to encourage two modes of egress into every neighborhood via through streets		1, 6	First Selectman	1/2016-12/2016	Low	Municipal/OB	0.5	0.5	0.5	0.5	1	1	0	**5.5**	0	-0.5	0	0	0	0	-0.5	**-1.5**	**4.0**
8	Incorporate additional elements of this hazard mitigation plan into the Plan of Conservation and Development	New	1, 3, 5	First Selectman	7/2019-6/2020	Low	Municipal/OB	1	0.5	1	1	1	1	0.5	**7.5**	0	0	0	0	0	0	0	**0.0**	**7.5**
	FLOODING																							
9	Acquire open space properties within SFHAs and set aside as greenways, parks, or other non-residential, non-commercial, or non-industrial use		3	First Selectman	1/2016-12/2019	High	Land Trust	1	1	1	1	1	1	1	**9.0**	0	0	0	0	0	-1	0	**-2.0**	**7.0**
10	Consider limited acquisitions of homes along Arrowhead Lane depending on their elevations and flood risk	New	3	First Selectman	1/2018-12/2019	High	HMA*	0.5	1	1	0.5	1	1	1	**8.0**	-0.5	0	-0.5	0	0	-1	0	**-3.0**	**5.0**
11	Encourage the State DOT to elevate Route 132 between Lakes Road and Sky Meadow Lane, or to widen the stream and install a box culvert		4	First Selectman	1/2017-12/2018	Low	CT DOT	1	1	1	1	1	1	1	**9.0**	0	-0.5	0	0	0	0	0	**-1.0**	**8.0**
12	Replace culverts throughout town and increase capacities where appropriate (CIP updated every year; in the middle of a needs assessment in 2015)	New	4	Public Works	7/2015-6/2010	High	HMA, Municipal/CI	0.5	1	1	1	1	0.5	1	**7.5**	0	0	0	0	0	-1	0	**-2.0**	**5.5**
	WIND DAMAGE RELATED TO HURRICANES, SUMMER STORMS, AND WINTER STORMS																							
13	Harden utility lines that feed the Main Street area, as the services along Main Street South are critical for the town after weather emergencies	New	1, 6	First Selectman	1/2019-12/2020	High	Municipal/CI, Eversource	1	1	1	1	1	0.5	0	**7.0**	0	0	-1	0	0	-1	0	**-3.0**	**4.0**
	WINTER STORMS																							
14	Post a list of Town sheltering facilities in the Town Hall and on the Town's website		5, 6	EMD	7/2015-6/2016	Low	Municipal/OB	1	0.5	1	1	1	0.5	0	**6.0**	0	0	0	0	0	0	0	**0.0**	**6.0**
15	Encourage the Horace Mann Nature Center to widen and improve the access road from Bethlehem to facilitate emergency access		6	First Selectman	1/2016-12/2017	Low	Horace Mann Nature Center	0.5	0.5	1	0.5	1	1	0	**6.0**	0	-0.5	0	0	0	0	0	**-1.0**	**5.0**
	EARTHQUAKES																							
16	Ensure that municipal departments have adequate backup facilities (power generation, heat, water, etc.) in case earthquake damage occurs		2	First Selectman	1/2016-12/2017	High	Municipal/CI	0.5	0.5	1	0.5	1	0.5	0	**5.0**	0	0	-0.5	0	0	-1	0	**-2.5**	**2.5**
17	Consider bracing systems for assets and equipment inside critical facilities	New	2	Public Works	1/2019-12/2020	Medium	Municipal/CI	1	1	1	1	1	0.5	0	**7.0**	0	0	-0.5	0	0	-0.5	0	**-1.5**	**5.5**
	DAM FAILURE																							
18	Construct a properly sized spillway for Long Meadow Pond Dam (inspection will be in 2015, then this will be after the inspection)	New	4	Public Works	7/2016-6/2017	High	HMA, Municipal/CI	1	1	1	1	1	1	1	**9.0**	0	0	-0.5	0	0	-1	0	**-2.5**	**6.5**
19	Increase capacities of culverts downstream of Long Meadow Pond Dam to convey the same discharges as the spillway after it is constructed	New	4	Public Works	7/2017-6/2018	High	HMA, Municipal/CI	0.5	1	1	0.5	1	0.5	1	**7.0**	0	0	0	0	0	-1	0	**-2.0**	**5.0**
20	Develop a written evacuation plan for Arrowhead Lane and Crane Hollow Road residents	New	6	EMD	1/2016-12/2016	Low	Municipal/OB	1	0.5	1	1	1	0.5	0.5	**6.5**	0	0	0	0	0	0	0	**0.0**	**6.5**
21	File EAPs in the office of emergency management and ensure that they are current.	New	6	EMD	1/2016-12/2016	Low	Municipal/OB	1	1	1	1	0	0	0	**5.0**	0	0	-0.5	0	0	0	0	**-0.5**	**4.5**
	WILDFIRES																							
22	Explore other fire protection solutions such as the use of cisterns (two schools might put in tanks as they upgrade in the near future)	New	2	EMD	1/2016-12/2017	Medium	Municipal/CI	1	1	1	1	0.5	1	0.5	**8.0**	0	0	0	0	0	-0.5	0	**-1.0**	**7.0**

NOTES
1. Departments:
   EMD = Emergency Management Director
2. Low = To be completed by staff or volunteers where costs are primarily printing, copying, or meetings and costs are less than $10,000; Moderate = Costs are less than $100,000; High = Costs are > than $100,000.
3. Funding sources:
   Municipal/OB = Municipal operating budgets
   Municipal/CI = Capital Improvement Plan budgets
   HMA = Hazard Mitigation Assistance
      A * by "HMA" indicates that it has a potential for a benefit-cost ratio above 1.0
   EOC = Emergency Operations Center grant (not currently active)
   STEAP = Small Town Economic Assistance Program (State grant program)
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)

APPENDIX B
DOCUMENTATION OF PLAN DEVELOPMENT

APPENDIX B
PREFACE

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the Town of Bethlehem 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 BETHLEHEM

October 29, 2013

---

1. Purpose and Need for Hazard Mitigation Plan
   a. Disaster Mitigation Act of 2000
   b. Status of Bethlehem's hazard mitigation plan (approved 4/10/09; expires 4/10/14)

2. Update on Hazard Mitigation Grant Programs (PDM, HMGP)
   a. Connecticut has funds to distribute under HMGP
   b. Types of projects that get funded

3. What's New with Local Plan Updates and Approvals
   a. HAZUS analysis
   b. Improved public involvement and outreach to neighboring towns
   c. Make plan maintenance more specific
   d. Incorporate effects of recent disasters into plan
   e. Incorporation of hazard mitigation plan into other town plans
   f. FEMA reviews changed ("crosswalk" is out, *Local Plan Review Tool* is in)
   g. State review has shifted from DEEP to DESPP/DEMHS

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

5. Project Schedule

6. Review of Hazards and Events from 2007-2013 (Table attached)

7. Data Collection Needs and Discussion

8. Review of Table of Strategies from Last Plan

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

10. Next Steps

11. Matching Grant

Hazard Mitigation Plan Update
Bethlehem, Connecticut

<u>Presented by</u>:
David Murphy, P.E., CFM
Milone & MacBroom, Inc.

October 29, 2013

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Purpose and Need for Hazard Mitigation Plan

- <u>Authority</u>
  - Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)
- <u>Goal of Disaster Mitigation Act</u>
  - Encourage disaster preparedness
  - Encourage hazard mitigation measures to reduce losses of life and property
- <u>Status of Bethlehem's Plan</u>
  - Developed 2008-2009
  - Adopted 2009
  - Expires 2014

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What is a Natural Hazard?

- An extreme natural event that poses a risk to people, infrastructure, and resources

MILONE & MACBROOM®

What is Hazard Mitigation?

- Actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

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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

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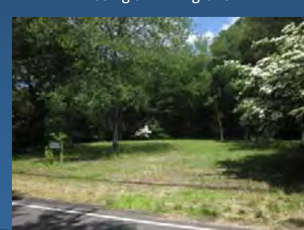
Update on Hazard Mitigation Grant Programs

- 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**
  - **NEW COST EFFECTIVENESS MEMO**

This home in Trumbull was acquired and demolished using a FEMA grant



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Update on Hazard Mitigation Grant Programs

Culvert Replacement to be funded by HMGP

Floyd 1999

Irene 2011

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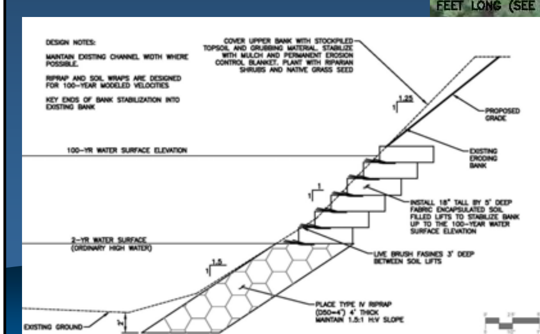
Update on Hazard Mitigation Grant Programs

Riverbank Stabilization to be funded by HMGP



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What's New with Local Plan Updates and Approvals

- HAZUS analysis
- Improve public involvement and outreach to neighboring towns
- Make plan maintenance more specific
- Incorporate effects of recent disasters
- Show how the plan will be incorporated into other town plans
- FEMA review process has changed from "crosswalk" to "Local Plan Review Tool"
- State administration moved from DEEP to DESPP/DEMHS as of July 2013

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Project Scope of Services

- Task 1 – Project Initiation and Data Collection
- Task 2 – Risk and Vulnerability Assessment
- Task 3 – Strategy Update and Plan Development
- Task 4 – DEMHS and FEMA Review and Plan Adoption

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Project Schedule

- Task 1 – Project Initiation and Data Collection: October-November 2013
- Task 2 – Risk and Vulnerability Assessment: November and December 2013
- Task 3 – Strategy Update and Plan Development: January 2014
- Task 4 – DEMHS and FEMA Review and Plan Adoption: February 2014, continuing as needed

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Review of Hazards and Events, 2007-2013

- Declared Disasters since last plan:
  - Flooding of March 2010
  - Snow, January 2011
  - Irene, August 2011
  - Winter Storm Alfred, October 2011
  - Superstorm Sandy, October 2012
  - Winter Storm Nemo, February 2013

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Data Collection and Discussion

- Have Bethlehem's critical facilities changed?
- Shelters and evacuation routes
- Standby power supplies
- Development and redevelopment trends
- Utilities above/below ground?
- Areas of flooding
- How are drainage and flooding complaints received and tracked?

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Data Collection and Discussion

- Areas prone to wind damage
- Tree maintenance and tree warden budget
- Snow and ice removal routes and capabilities
- Areas prone to icing in winter
- Dams and effects of dam failure
- Areas with fire protection
- Areas without fire protection and use of dry hydrants and cisterns
- Areas prone to wildfires, fire department capabilities, coordination with nearby municipalities

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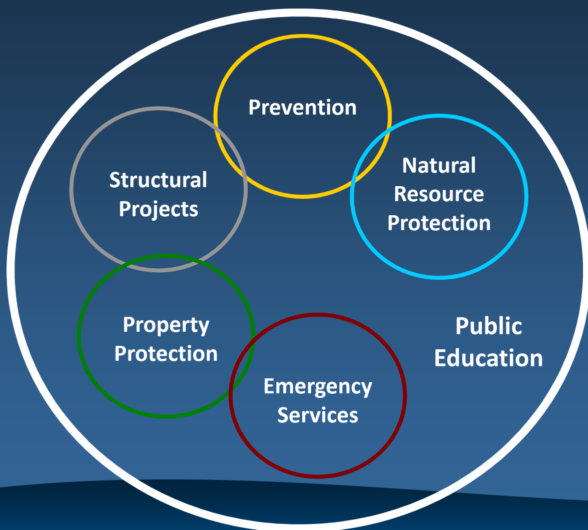
Review of Hazard Mitigation Strategies



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Examples of Hazard Mitigation Strategies

- Elevate or remove flood-prone buildings
- Wet and dry floodproofing
- Move critical facilities from flood zones
- Strengthen or reinforce the shelters
- Remove and replace undersized and/or failing bridges and culverts
- Replace overhead utilities with underground utilities
- Organize tree maintenance priorities and scheduling
- Enhance fire suppression capabilities
- Public education programs – dissemination of public safety information

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Review the Previous Hazard Mitigation Strategies

- Completed?
- Carried forward?
- Ongoing? – then it becomes a capability
- Modify?
- Cancel?
- What one or two things would be done in Bethlehem if money was not a concern?

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Outreach and Public Involvement

- Letters to surrounding municipalities
- Public meeting vs. using surveymonkey.com

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Next Steps

- Dates for survey or public information meeting
- Date for receipt of any materials resulting from this meeting

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Matching Grant

- Track your time
- Report to Carol Hubert in Southbury Office of the First Selectman

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TOWN OF BETHLEHEM HAZARD MITIGATION PLAN UPDATE
ADVISORY COMMITTEE MEETING
OCTOBER 29, 2013

A meeting was held on October 29, 2013 to review the previous hazard mitigation plan and discuss issues and potential mitigation strategies for inclusion in the update. A brief power point presentation was used to provide structure for the meeting. A copy is attached.

The meeting attendees included:

- Michael Devine, EMD
- Mark Piccirillo, Director of Public Works
- Jean Donegan, Land Use Administrator
- Joel Skitton, Building Official
- David Hardt, Fire Marshal
- David Murphy, P.E., CFM, Milone & MacBroom, Inc.

The following were discussion points:

- Critical facilities are mostly the same as they were in the first plan. A page from the plan was marked up to show which have standby power. Additional and changes include:

    - The ambulance association on Main Street South is a critical facility.
    - There is a need to keep the Main Street South services open as long as possible after a disaster. The town would like to list these are critical facilities, and believes that they <u>must</u> remain powered by electricity. The supply comes from the Carmel Hill substation near Woodbury. The entire length of utility lines from there to the downtown area cannot be placed underground.
    - The fire house is the EOC. The town hall is the backup EOC.
    - The "Abbey" on Flanders Road is a home for nuns. They need to be sheltered in place, and therefore the facility is a critical facility.
    - The Double Hill Group Home on Route 64 is a critical facility. It consists of three buildings and has standby power.
    - Bethlehem still lacks a true shelter. However, Memorial Hall should be added as a critical facility. It can be used for warming and charging, but people cannot sleep there. The first hazard mitigation plan might say that it's approved by the American Red Cross, but that should be deleted.
    - Nonnewaug High School would eventually be a shelter for Bethlehem and Woodbury, but the facility lacks a generator. A renovation was approved but has been delayed by court action.
    - Two day care centers should be added: Kids First LLC (151 Main Street North) and Bethlehem Daycare.
    - One more group home should be added: 52 Arrowhead Lane.
    - The Church of the Nativity at 92 East Street should be listed because children are moved to this facility when they are evacuated from the school.

- During the snow load disaster in January 2011, several barns collapsed or had damage, but nothing major was damaged. The building official inspected municipal and school roofs. The town's view is that anything that did not collapse is unlikely to collapse, as these types of snow loads are rare.

- The February-March 2011 floods of the Pomperaug River were not too bad in Bethlehem, as they are the headwaters of the river.

- Irene caused an average power outage in town of two days. Approximately 40,000 yards of debris were generated. Flooding was substantial. Downstream of Long Meadow Pond dam, a section of Lake Drive washed out (twin culverts) and Munger Lane overtopped. The private dam at March Farms held up. The Arrowhead Lane area along the Weekeepeemee River was evacuated as a precaution. The Falls Road culvert was lost at the Nonewaug River, and culverts overtopped at Nonewaug Road (East Spring Brook). The Kasson Road section of Route 132 downstream of the Bronson Lockwood Reservoir fared well because the reservoir was intentionally drawn down prior to Irene.

- During Winter Storm Alfred later that year, the maximum power outage was about one week, and many roads were blocked. The town has noticed significant tree trimming and removals in the last two years, and CL&P has been present in the town in the last few weeks. This is appreciated. However, the town has not observed any hardening. Many old wires are still in place.

- The town fared pretty well during Sandy.

- During February 2013 (Nemo), the public works department was very aggressive before and after the storm. Utility crews were able to use the roads quickly. The town sought PA reimbursement for overtime. Jean from the Selectman's Office has the PA figures for the last few disasters.

- The public works department acts as the tree warden. They budget about $2,000 per year for a bucket truck contract. The department maintains five plow trucks. The CT DOT shed is located in Bethlehem, and the public works department reportedly works well with CT DOT. Treated salt is used for deicing.

- The town has not replaced or constructed any culverts in the last few years. There have not been any changes in how drainage complaints are handled.

- The potential flooding at Crane Hollow Road (page 3-13 of initial plan) is not believed to be a frequent problem, although this area was of concern during Irene and Arrowhead Lane was evacuated. The potential flooding of Hickory Lane (page 3-13 of initial plan) is also not believed to be a frequent problem.

- The Horace Mann "John Dorr Nature Laboratory" (owned by a private school) remains a concern for Bethlehem[1]. Access is through Bethlehem. The driveway is 1.3 miles long, and the town is

[1] *In 1965, Horace Mann established the John Dorr Nature Laboratory in Washington, Connecticut with a gift of 83 acres. The Laboratory now encompasses 275 acres of fields, streams, and ponds in which students can explore nature and engage in outdoor pursuits.*

responsible for emergency response along this driveway. Calling 911 will ring through Bethlehem's dispatch. The school is very active, with many buses from the New York City area.

- Development trends were discussed:

  - One lot was approved in the last year.
  - Jennifer at the town hall has a list of permits.
  - Two new buildings were constructed at one of the group homes.
  - Utilities are below ground in new developments.

- Wind risks appear to be higher at the Carmel Hill Road North area due to the single-wire power distribution to this area. Trimming has helped.

- Todd Hill Road and Hard Hill Road are at elevated risk for snow drift.

- The previous mitigation strategies were reviewed. Comments and changes were noted.

- Mitigation strategies were brainstormed:

  - A new shelter could be built, or a community center that could serve as a shelter.
  - Power to the Main Street South must be uninterrupted.
  - People still think the Long Meadow Pond Dam needs work. The spillway does not convey the 100-year flood. However, the overtopping discharges already exceed the culverts at Lake and Munger. So a coordinated effort may be needed: attention to the spillway <u>and</u> the downstream culverts.
  - Properties along Arrowhead may need to be acquired if flood risk high.
  - All culverts in Bethlehem were replaced in the 1950s. It is time to replace many of them.
  - An animal shelter is needed for Bethlehem residents.

- A public meeting is preferred for the public outreach. The timeframe will be late November 2013 or early January 2014. A date will be determined after the elections.

with the cleanup early Christmas morning. Those interested can contact event Chairman Cliff Ritter at WoodburyCTLions@gmail.com.

Residents can also buy luminaria kits. They include 12 bags and candles, and instructions on how to put the luminarias together and light them. They can be purchased at several locations locally, including Ace Hardware of Woodbury, C.L. Adams, Plant Country, and LaBonne's at both the Woodbury and Southbury stores.

SOUTHBURY

Bates Rock Road project to continue during winter

Town officials remind residents that work on the Bates Rock Road realignment project will continue through winter, weather permitting.

The town states on its website that the right-of-way agreement with Connecticut Light & Power has been completed and preliminary construction is underway.

"The intent is to complete the tree removal, excavation, widening and realignment of the road and some drainage installation during the winter months and be ready to complete paving in the early spring," the town's news release states.

Drivers can expect some delays and periodic road closures.

They are advised to use North Poverty Road rather than Route 67 to exit or enter Bates Rock Road. Anyone with questions or concerns can contact Public Works at 203-262-0622.

WOODBURY

Officials seek volunteers for charter revision board

X

Anyone looking to join the Charter Revision Commission announced earlier this month has until Jan. 7 to get on board.

Any elector in the Town of Woodbury who is interested in serving can complete the Board/Commission/Committee form on the town's website at www.woodburyct.org.

Applicants should print it out and return it to the Selectman's Office in the Shove Building, 281 Main St. South, by Jan. 7.

Contact the Selectmen's Office at 203-263-2141 for information.

BETHLEHEM

Town to review hazard plan during special meeting Monday

X

The town will hold a special meeting at 7 p.m. Monday in the downstairs area of Town Hall to hear and receive comments on the five-year update of the predisaster hazard mitigation plan. All residents are welcome to attend.

>>> OBITUARIES ON PAGE 4-7B

Southbury selectmen approve fun

BY CHRIS GARDNER
REPUBLICAN-AMERICAN

SOUTHBURY — One of the most heavily used park playgrounds in town will get new equipment in the new year.

The Board of Selectmen has approved spending $123,207 to pay Kompan Inc. to install a new playground at Ballantine Park on Old Field Road.

Kompan was the third-lowest bidder for the project, and the lowest of three finalists considered by the Parks and Recreation Commission. In all, eight companies bid.

Two lower bids were received, but the study committee felt the companies did not provide enough equipment, such as structures, swings, climbing apparatus and spinners, wrote Ronald Kalban, director of the Parks and Recreation Department, in a letter to First Selectman Ed Edelson.

"This is not just looking for the lowest price," Edelson said. "They (committee members) wanted to look at quality and safety."

The concept is to have two play areas, including one for 2- to 5-year-olds, and another for 6- to 12-year-olds. There will be swings and climbing apparatus for all ages.

Another company did not have a large enough play component for younger children, so that bid was not consididered, Ka

Kompan $119,705, price to $ the amou wood fiber protect ch play.

The recr recommen project to K

Money t ground wil frastructur and will b Local Cap Program f by the state

The new replace e decades o meets code

GOOD NEWS >>> 2013 STORY

Baby James had a bliz

BY LARAINE WESCHLER
REPUBLICAN-AMERICAN

Editor's note: Republican-American reporters took some time to revisit the subjects of some good news reported in 2013. Reporter Laraine Weschler checked back in with James Wood Jr., who was born during the February blizzard.

NAUGATUCK

Ten months after taking a bumpy ride through a blizzard in his mother's womb, baby James Wood Jr. is busy exploring his new world.

"He's rugged. He never stops moving," said his mother, Lauri Wood.

The healthy boy with a huge smile has an appetite like a bear, his mother said. He likes eating steak, chicken, cat food, and anything he can put in his mouth.

With four older sisters to

watch over him, Jim Jr. is well-loved and cuddled, but his father is intent on having another man in the house. Jim Jr.'s green-painted room is decked out in a camouflage and deer theme.

Lauri went into labor in February as three-foot drifts piled up against her Naugatuck home. Friends and neighbors dragged her in an

Lauri Wood Jr., in their

improvised s luggage carr feet uphill fr on Tudor La

Hazard Mitigation Plan Update
Bethlehem, Connecticut

PDM
PRE-DISASTER MITIGATION

HMGP
HAZARD MITIGATION GRANT PROGRAM

Presented by:
David Murphy, P.E., CFM
Milone & MacBroom, Inc.
December 30, 2013

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 Bethlehem's Plan**
  - Developed 2008-2009
  - Adopted and Approved 2009
  - Expires 2014

FEDERAL EMERGENCY MANAGEMENT AGENCY

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What is a Natural Hazard?

- An extreme natural event that poses a risk to people, infrastructure, and resources

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What is Hazard Mitigation?

- Actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

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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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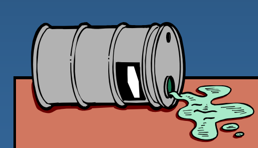
What a Hazard Mitigation Plan Does Not Address

- Terrorism and Sabotage

- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



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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

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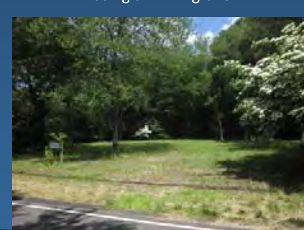
How Can the Plan be Used?

- 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



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How Can the Plan be Used?

Culvert Replacement to be funded by HMGP

Floyd 1999

Irene 2011

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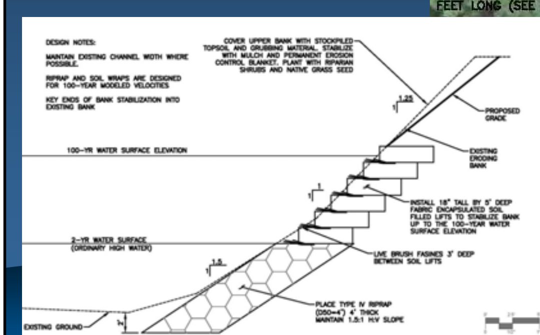
How Can the Plan be Used?

Riverbank Stabilization to be funded by HMGP



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Components of Hazard Mitigation Plan Update Process

- Review natural hazards that could occur in Bethlehem
- 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
  - ✓ Tropical Storm Irene in August 2011 (and T.S. Lee afterward)
  - ✓ Winter Storm Alfred in October 2011
  - ✓ Hurricane Sandy 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 town plans

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Hazards Included in the Previous Plan

- Floods
- Hurricanes and tropical storms
- Summer storms and tornadoes
- Winter storms and nor'easters
- Earthquakes
- Wildfires
- Dam failure

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Flooding

- From the first plan:
  - Dowd Brook and tributary at Crane Hollow Road
  - Homes along the Weekeepeemee on Arrowhead Lane
  - Route 132 overtops at the pond near Swanson's farm
  - Beaver dams back water over Double Hill Road
  - Hickory Lane culvert undersized
  - Cabbage Lane – poor drainage at Route 132
- Other areas identified recently:
  - Tropical Storm Irene washouts at Lake Drive, Mungertown Lane, Falls Road, and Nonewaug Road

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Hurricanes and Tropical Storms

- Winds
- Heavy rain / flooding

Typical Irene Damage in Connecticut

1955 Flooding in Waterbury

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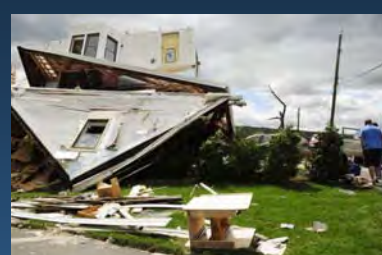
Summer Storms and Tornadoes

- Tornadoes
  - Wethersfield in 2009
  - Bridgeport in 2010
  - Springfield in 2011
  - Windsor in 2013
- 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

- Connecticut is prone to very low-energy earthquakes
- Did everyone feel the 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 Middlebury Fire Department

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Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life or millions of dollars in property damage
- Several registered dams in the town
- New dam safety legislation passed in 2013

Recent dam failure in Sherman, CT

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Review of Hazard Mitigation Strategies

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Hazard Mitigation Strategies in the Previous Plan

- Disseminate informational pamphlets regarding natural hazards to public locations.
- Add pages to the Town website (http://ci.bethlehem.ct.us/) dedicated to citizen education and preparation for natural hazard events.
- Consider implementation of an emergency notification system.
- Upgrade emergency communications to a high band system to better facilitate emergency response, particularly in coordination with neighboring municipalities.
- Pursue funding to elevate Crane Hollow Road to prevent future instances of overtopping.
- Pursue funding to elevate the road near the south end of Hickory Lane, or to widen the stream and install a box culvert.

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Hazard Mitigation Strategies in the Previous Plan

- Encourage the CTDOT to elevate the level of Route 132 between Lakes Road and Sky Meadow Lane, or to widen the stream and install a box culvert.
- Continue to require that utilities be placed underground in new developments and pursue funding to place them underground in existing developed areas.
- Continue to require compliance with the amended Connecticut Building Code for wind speeds.
- Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards.
- Increase tree limb maintenance and inspections, especially along Route 61, Route 132, and other evacuation routes. Increase inspections of trees on private property near power lines and Town right-of-ways.

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Hazard Mitigation Strategies in the Previous Plan

- Pursue grant funding to install drainage along Cabbage Lane and Route 132 to eliminate icing at this dangerous intersection. Consider removing some trees to improve sight lines if possible.
- Investigate complaints of icing at the intersection of Wood Creek Road and Route 132, and perform corrective actions if applicable.
- Encourage the Horace Mann Nature Center to widen and improve the access road from Bethlehem to facilitate emergency and standard vehicular access.
- If the Town acquires an emergency notification system, include dam failure areas in the contact database.
- Copies of the Class C dam EOPs and Dam Failure Analyses on file in the Town hall for public viewing.

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Hazard Mitigation Strategies in the Previous Plan

- Continue pursuing modifications to Long Meadow Pond Dam to pass the 100-year flood event; review and update the Emergency Operations Plan
- Continue to require the installation of fire ponds and dry hydrants in new subdivisions, and should look to install additional ponds where adequate water supplies do not currently exist.
- Encourage property owners to widen access roads such that fire trucks and other emergency vehicles can access remote locations.

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Next Steps

- Incorporate input from the public
- Refine hazard vulnerabilities and risks as needed
- Delete, remove, 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
- Apply for mitigation funds

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Town of Bethlehem Hazard Mitigation Plan Update
Public Meeting
December 30, 2013

A public information meeting was held on December 30, 2013 to describe the planning process, briefly review the previous hazard mitigation strategies, and receive public input to the update. A power point presentation was used and a copy is attached.

The meeting attendees included Lenny Assard, David Butkus, and David Deakin of the Board of Selectmen; Carol Ann Brown of the Finance Commission; Jean Donegan of the Land Use Office; and Emergency Management Director (EMD) Michael Devine. David Murphy of Milone & MacBroom, Inc. facilitated the presentation.

The following were discussion points:

- Spelling errors from the power point presentation (which came from the initial plan) were corrected. The local farm is "Swensen's" (not Swanson's), the road is" Munger" (not Mungertown), and the river is "Nonnewaug" (not Nonewaug, although USGS uses only one "n").

- The town hall roof was replaced in 2013. Attendees believe that it now meets current building codes for wind and snow load. A brief discussion about shelters and building codes proceeded. The town hopes to be able to use Nonnewaug High School (the regional school district's high school) as a shelter. Attendees inquired whether the regional school district could apply for HMGP funds for a generator for the high school, or would one of the towns need to apply?

- Attendees remarked that CT DOT would be unlikely to elevate the low-lying section of Route 132 as described in the first hazard mitigation plan. However, the strategy should remain, in case DOT someday has interest in this project. Mr. Murphy described the DOT's climate change pilot program and remarked that several culverts in the county would be evaluated for appropriateness of capacities in the face of increasing precipitation intensities.

- Attendees remarked that CL&P and CT DOT are making progress with tree trimming along utility lines.

- Mr. Murphy described the ongoing flood insurance reform. Attendees are uncertain how many NFIP policies are in place in Bethlehem.

- Mr. Murphy asked attendees what "one thing" would be done in the town to reduce hazard risks. The general consensus was that culverts and bridges would be inspected and then upgraded or replaced if needed.

- Mr. Devine asked whether upgrading of digital services would be eligible for mitigation funding. For example, does the town have the digital infrastructure in place to be able to react and respond to disasters accordingly? Mr. Murphy said that it's not eligible at this point, but any strategies should be included because (for example) standby power supplies were not eligible several years ago and are currently eligible.

Engineering, Planning,
Landscape Architecture
and Environmental Science

MILONE & MACBROOM®

November 25, 2013

To:

Rob Sibley, Deputy Director of Planning and Land Use, Town of Newtown	Scott Pelletier, EMD, Town of Oxford
Anne Marie Lindblom, assistant to the First Selectman, Town of Bridgewater	Tom Eighmie, EMD, Town of Seymour
Barbara Henry, First Selectman, Town of Roxbury	Clark Hurlburt, Deputy EMD/CERT Coordinator, Town of Bethany
Randy Ashmore, EMD, Town of Woodbury	Robert Chatfield, Mayor, Town of Prospect
Mark Lyon, First Selectman, Town of Washington	Sam Gold, Acting Executive Director, COGCNV
Tony Gedraitis, EMD, Town of Morris	Jocelyn Ayer, Executive Director, NWCCOG
Chuck Berger, Town Engineer, Town of Watertown	Rick Lynn, Planning Director, LHCEO
Tom O'Hare, EMD, Town of Litchfield	David Hannon, Deputy Director, HVCEO
Vincent Wheeler, EMD, Town of Harwinton	Carl Amento, Executive Director, SCRCOG
Tony Lorenzetti, Director of Public Works, Town of Plymouth	Carl Stephani, Executive Director, CCRPA
Mark Pronovost, City Engineer, Waterbury	Rick Dunne, Executive Director, VCOG

RE: Hazard Mitigation Plan Updates for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston
MMI #2097-11

Milone & MacBroom, Inc. (MMI) is working with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston to update the hazard mitigation plans that were approved by FEMA in 2009. In recent years, FEMA has emphasized the need for communities to work together to address hazards that span municipal boundaries. Thus, these municipalities are interested in coordinating with your jurisdictions relative to hazards that could cross municipal boundaries such as flooding, as well as strategies for hazard mitigation that could be addressed by two or more communities.

We understand that you are the representative that has been involved with hazard mitigation plans in your municipality, and therefore will have the most valuable input for the update of the Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston hazard mitigation plan. Please take a moment to share your thoughts for the following:

1. Does your municipality face any shared hazards with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston that could be addressed by both communities? Examples could be flooding along a stream that flows across a town boundary or wind storms 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. Does your municipality currently cooperate with Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, or Thomaston 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 (davem@miloneandmacbroom.com or scottb@miloneandmacbroom.com) or telephone (203-271-1773). A written response is not necessary. Thank you for your time.

David Murphy, P.E., CFM
Associate

Scott Bighinatti, CFM
Senior Environmental Scientist

2097-11-3-o1513-ltr.docx

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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

RA **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**

34 pages.

Established 1881,
Waterbury, Connecticut

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

WEDNESDAY TUESDAY MONDAY SUNDAY RTHWEST CONNECTICUT FIVE-DAY FORECAST

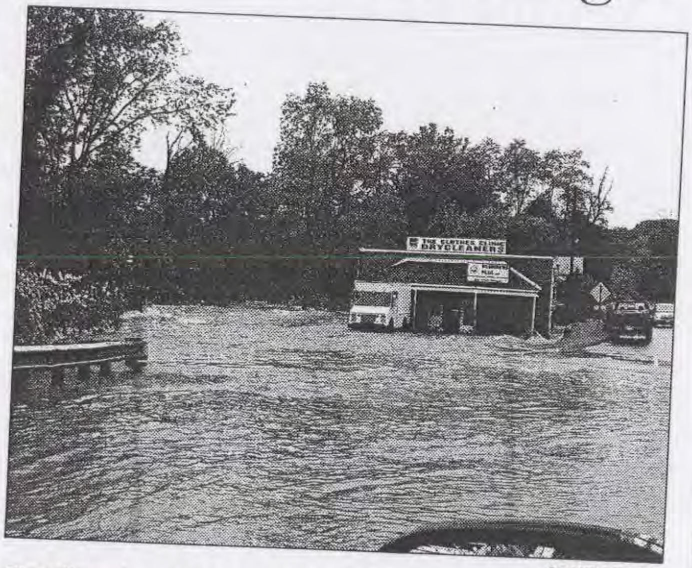
FLOOD: Plans in various stages

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, have ...

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 include the ...

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

COGCNV field notes
Field inspection on February 13, 2008.
Notes typed February 14, 2008
Scott Bighinatti

Connecticut experienced a period of heavy rains on frozen ground on February 13, 2008. Precipitation measured 1.35 inches over approximately 9 hours in nearby Litchfield and 1.62 inches in Waterbury. On February 13, 2008 David Murphy and Vince McDermott outlined areas of potential flooding in the Towns of Thomaston and Bethlehem. These sites were visited on February 13, 2008 and problematic areas were photographed. These problematic areas primarily included areas of potential poor drainage due to the snow cover. The sequence of photography is listed below:

Camera #1:

1. North end of Reynolds Bridge Road, Thomaston
2. Northern part of Munger Lane, Bethlehem (facing north)
3. Northern part of Munger Lane, Bethlehem (facing south)
4. North end of Westshore drive, Bethlehem (facing south)
5. North end of West shore drive, Bethlehem (facing west)

Many areas of both Towns were subject to minor sheet flow. Other areas had deeper puddles due to snow inhibiting inflow to the storm sewers. No major tree falls were noted, although there were areas with small branches that had fallen into or next to the streets.

Thomaston:

a) Waterbury Road (Route 262) (South) – Nibbling Brook appears to bend around a factory, but the channel appeared well developed. The stream was flowing hard, but the water did not contain much sediment. There is a low area on the south side of the road that is in the 100-year flood plain, but appeared to be used for storage. It was not flooded at the time of inspection.

b) Waterbury Road (Route 262) (South) – At the bend in Rt. 262 where Jericho Brook enters the Naugatuck River from the west, and there was a large puddle over the northbound lane about five inches deep. This curve is south of the Stevens business. No problems were noted near the Stevens business.

c) Waterbury Road (Route 262) (South) – A factory on the west side of the road had no problems with flooding, but the east side of the road was not draining. Two to three inches of water was present in the northbound lane.

d) Naugatuck River – The Naugatuck River was high, but not close to being over bank, during field inspections in Thomaston. All the bridges over the Naugatuck River are very high and in no danger of being overtopped by normal floods.

e) Reynolds Bridge Road – The north end of this road near the Route 8 northbound off-ramp had a deep puddle (approximately eight inches in the middle). This puddle is likely due to a clogged culvert in the low spot, but this was not verified. See Picture #1.

f) Unnamed Tributary near Route 6 – An unnamed tributary to the Naugatuck River is channelized starting from Watertown Road (Route 6) and running under Sumpf Avenue, Warner Lane, and Route 262. No flooding was noted upstream of the culvert.

g) Northfield Brook – No flooding was noted along Northfield Road (Route 254). Despite several crossings under Northfield Road, the culverts appear well sized to handle the discharge along Northfield Brook that outlets from Northfield Pond Dam, which is managed by the US Army Corps of Engineers.

h) Unnamed Stream along High Street Extension – A stream drains from a small pond along the west side of the street. While it is unlikely that the stream will be high enough to overtop the road, several driveway crossings exist over the stream, indicating the potential for residents to be trapped if the crossings back up.

i) Smith Road – No flooding problems were noted here on this unnamed stream that outlets from Southerly Pond Dam. The stream is a tributary to the Naugatuck River. The new development to the northeast has a large detention basin providing storage.

j) Unnamed stream under Atwood Road – This stream takes a sharp bend and may have been redirected around a nearby field. It was flowing under Atwood road with no problems.

k) Branch Brook – No problems were noted along Branch Brook, but access was limited due to the snow, the steep grade, and the closed recreation areas.

l) Wigwam Reservoir – The area around Wigwam Reservoir is undeveloped. The reservoir was low compared to Route 109.

Bethlehem:

m) Kasson Road (Route 132) (East) – While the wetlands along East Spring Brook appeared to be near the road level, no flooding was present at the time of inspection. However, this road would certainly be overtopped should either of the upstream dams fail.

n) Kasson Avenue (private road)– Long Meadow Pond is well downgradient of the houses along the lake, and the lake would overtop Route 132 at the south end of the pond before coming close to any of the houses. The wetlands nearby the south end of the lake on Bellamy Lane were high, but the road was not flooded.

o) Munger Lane (South and Middle) – No flooding was observed along these section of Munger Lane despite the nearby agricultural fields. The unnamed tributary to the Weekeepeemee River that drains from Long Meadow Pond and Benjamin Pond was not flooding Munger Lane, but some ponding was occurring at the crossing due to the snow pack.

p) Munger Lane (North) – The large plot of agricultural fields halfway to Gros Road were producing a significant amount of runoff, leading to ponding in the roadway up to four inches in places. The storm drains on this street may be too far apart, but the snow is definitely a factor contributing to the depths of ponding. See Photos #2 and #3.

q) Lake Road – The outlet channel was flowing regularly and the road was not flooded during the inspection.

r) Westshore Drive – An unnamed tributary to Long Meadow Pond flows under the northern section of Westshore Drive. The crossing was backed up and the street was flooded. A storm drain was noted above the crossing, but was completely filled with water. See Photos #4 and #5.

s) East Street – The unnamed tributaries along East Spring Brook appeared to be flowing normally. No flooding was present. Ponded water was present on Harrison Road near the Elementary School, but this appeared primarily due to snow pack.

t) East Spring Brook at Nonnewaug Road – East Spring Brook was flowing rapidly here, and contained a lot of sediment. There are several agricultural operations upstream on Maddox Road that could have contributed to the sediment levels.

u) Nonnewaug Road at Hickory Lane – East Spring Brook is still flowing hard, but is not overbank before its confluence with the Nonnewaug River.

v) Unnamed Pond off Hickory Lane – A small pond on the west side of Hickory Lane was overflowing, but erosion was not present along the south end.

w) Town Line Highway South – No erosion was noted along the dirt road sections of Hickory Lane and Town Line Highway South.

Name	Department	Phone Number	Email Address
Scott Bighinatti	MMI	203 271 1773	scottb@miloneandmacbroom.com
David Murphy	Milone & MacBroom	203 271-1773	davem@miloneandmacbroom.com
Sam Eisenbeiser	FHI	860-446-2102	seisenbeiser@fhiplan.com
Virginia Mason	COGCNV	203-757-0535	VMASON@COGCNV.org
Jim Kacerguis	Bethlehem Public WKS	203 266 7448	
Mike Devine	Emergency Mgmt	203 266-5817	michael.devine@sbcglobal.net
John L Rudzavice	Bethlehem Fire Marshal	203 266-6907	
Roger D. Netusch	Bethlehem Building Official	203-266-5703	
Jean Donegan	Land Use Coord.	203-266-7691	JFDWK@AOL.COM

Meeting Minutes

NATURAL HAZARD PRE-DISASTER MITIGATION PLAN FOR BETHLEHEM
Council of Governments Central Naugatuck Valley
Initial Data Collection Meeting
March 4, 2008
Minutes Revised August 6, 2008

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Samuel Eisenbeiser, Fitzgerald & Halliday, Inc. (FHI)
- Scott Bighinatti, Milone & MacBroom, Inc. (MMI)
- Virginia Mason, Council of Governments Central Naugatuck Valley (CGCNV)
- Jim Kacerguis, Bethlehem Public Works Director
- Mike Devine, Bethlehem Emergency Management
- John Rudzavice, Bethlehem Fire Marshall
- Roger Natusch, Bethlehem Building Official
- Jean Donegan, Bethlehem Land Use Coordinator

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

Virginia and David described the basis for the natural hazard planning process and possible outcomes. Bethlehem is responsible for a 1/8 cost share through in-kind services.

III. Project Scope and Schedule

The project scope was described, including project initiation and data collection, the vulnerability assessment, public meetings, development of recommendations, and the FEMA Review and Plan adoption. A 14-month schedule was presented.

Jean Donegan was selected to be the main point of contact for billing. The Board of Selectman will be the governing body to eventually approve the Plan.

IV. Hazards to Address

The Bethlehem plan will likely address flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failure, and wildfires.

V. Discussion of Hazard Mitigation Procedures in Effect & Problem Areas

- The Town has an almost entirely residential tax base, so funding of capital projects is difficult. The Town relies on outside grants, which can be difficult to obtain due to the small size of the Town.

- The FEMA FIS is in need of updating, but Litchfield is a low priority in the MapMod program.

- The Town has had no known history of earthquakes.

- The informational public meeting was scheduled for April 21st at 7:00 PM in the Town Hall.

Emergency Response Capabilities & Evacuation Routes

- The Fire House is the primary shelter used for small, short term events. Memorial Hall is used for larger events, but has limited bathrooms. Both have their own generators, as does each building in the municipal complex. The problem is that Memorial Hall and the Firehouse share the same long driveway, which could create a conflict during an emergency.

- Other sheltering spots that could be utilized include Bethlehem Elementary School and the private school (The Woodhall School) in Town during the summer. Neither have generators. In addition, the Wisdom House in Litchfield has been used as a shelter in the past for families that had extended power outages.

- The Abby of Regina Laudis Priory may also be used as a shelter in an emergency, but the Town is hesitant to do so because of the cloistered nature of the facility. The Town would only ask under the direst circumstances.

- Evacuation routes are regionally defined by the Regional Evacuation Plan. Evacuation Routes are Route 61 and Route 132. Flanders Road is also another good route south into Woodbury. Route 132 has some areas where flooding has been a problem where a watercourse crosses the road.

- There are three problem areas for the emergency personnel of Bethlehem related to surrounding Towns:

    1. A piece of Camp Columbia's property in Morris has public access off Munger Lane from Route 109 in Morris. Part of this property is state forest in Morris. They do some logging and the DEP has recently increased public access.

2. The Horace Mann Nature Center in Washington is located off the end of Arch Bridge Road. There is no public access to this property in Washington due to private roads and limited egress over Sprain Brook. Approximately 30-40 children are bussed in each week from New York, 40 weeks per year. This facility has dorms and outbuildings being built and renovated in a $10 million upgrade, and has COPE-style facilities and ziplines. The Town of Washington has asked the Town of Bethlehem to be the first responders to this facility in the case of an emergency, as it takes 22 minutes to reach the center from their fire house. Bethlehem has accepted this responsibility, but is wary as the road from Bethlehem is unpaved, narrow and steep. It is extremely difficult to get up the road when it snows in winter, despite the sand that is put down. The Town of Bethlehem plows most of the road with a pickup truck because of how narrow it is. Bethlehem worries about the students being isolated during an emergency, though the facility is well-funded and safety conscious.

3. Land Trust on the Woodbury / Watertown border. Physical access is via Bethlehem off the south end of Hickory Lane (Falls Road). The Town tries to keep the gate here locked, but people repeatedly cut the lock. Woodbury limits access but the tract is not well-managed. The tract is supposed to be used for "passive recreation" but is primarily used by ATVs and horses, especially along developed trails and the power lines. ATVs access the property via Watertown and other locations such as Route 6 and along the power lines. Bethlehem is the first responder here as well, but access is limited because of a bad crossing and poor road conditions. This forest often has problems related to alcohol – ATV and snowmobile accidents, parties, underage drinking, etc.

- ❑ The Town communications system is poor. All the adjoining Towns have upgraded to a high band radio system, so Bethlehem cannot communicate with any of its neighbors via its antiquated low band. The state trooper operates at 800 MHz. The Town does have the means to communicate to DEMS-5. Communications with their neighbors and police consists of walking up to them and talking while responding. A communications study is underway, which will likely recommend a new UHF/VHF communication system. The Town wants a system compatible with all personnel and surrounding Towns. However, the cost of the upgrade will be very high and difficult to fund through the Town budget. Instead, the Town plans to apply for grant funding in consecutive funding cycles in an effort to cobble together grant money from various sources.

- ❑ The Town has no emergency notification system, and no method to alert residents of floods or other problems.

- ❑ Homes around Long Meadow Pond are difficult to reach. This includes West Shore Drive and the private Kasson community. Some of the streets are essentially one-way. Fire trucks need to go in line with the last one in being the first one to back out because there is no place to turn around. In some places, the fire trucks simply can't get to the houses that are up narrow dirt roads.

Critical Facilities

- 40-unit "North Purchase Elderly Home" at 11 Jackson Lane is considered a critical facility.

- There are several group homes for troubled children in Town, including 84 Judge Lane (4 children), Wellspring Foundation at 21 Arch Bridge Road (more than 20 children, also has a day school called Arch Bridge School), and Angelus House at 158 Flanders Road (approximately 10 children)

- The Town maintains a salt shed in the municipal complex, but plans are in place to replace it. It is too small, and DEP wants it to be a covered structure. The Town would like to move the entire Public Works facility. The DEP has a consent order on the Town regarding this, but the Town has limited funding. This project won't be eligible under PDM due to the consent order, but still is useful to be in the plan.

- The Town Hall, Department of Public Works & Highways, Fire House, elderly housing, group homes, and schools are considered to be critical facilities. Many of the Town buildings are in the municipal complex.

Subdivision, Inland Wetlands and Other Regulations

- Regulations were collected from Jean.

Noted Flooding and/or Drainage Problem Areas

- Crane Hollow Road – water floods out at least once every two years. The road over the Weekeepeemee acts as a dike and eventually overtops.

- Arrowhead Lane – Homes here are near the Weekeepeemee River and can flood out. The two homes at the end of the street have flooding problems associated with the nearby pond.

- South end of Hickory Lane – The culvert here is undersized and floods the road every two years, but the Town can't fix this problem without elevating the road. This culvert is near Land Trust property.

- Hard Hill Road North – There are drainage issues along the road, but they occur primarily on private property. Farmers pass along drainage to their downstream neighbor. For example, one farmer built a 500' berm, which caused flooding problems on a field downstream.

- Route 132 near Swenson's Farm – water overtops the road near the fire pond.

- Double Hill Road – A resident has beavers on her property, and the beavers create a lake that eventually overtops the road. This might be along the Weekeepeemee River. The owner does not want the beavers to be bothered, so Town personnel don't try to remove the dams.

Problem Areas for Wind Damage

- The electric utility (CL&P) performs tree maintenance, and the Town has a tree warden who encourages the removal of trees that pose a danger to power lines. Outages due to tree fall have been less frequent recently.

- There are no mobile home parks in Bethlehem.

- A Tornado struck Morris in 1989 and passed over Bethlehem before landing again in Watertown. Bethlehem received some residual damage from that event from flying debris.

Problems Due to Snow and Ice

- There are many hills in Bethlehem which can sometimes make driving difficult during icy weather.

- The south end of Cabbage Lane has a drainage problem where it intersects Route 132. The end of the road is a low point and water collects and freezes in the winter, and cars slide out into Route 132 when trying to stop. There is also a poor sight line for cars on Route 132 to see cars coming out of Cabbage Lane, and people tend to speed on this relatively straight section of Route 132. This area is a serious problem, although reportedly there have been no fatalities. The Town wants to install 200 feet of catch basins down the side of Route 132 to help drain the area, but DOT won't pay for it because the problem is on the Town road.

- Plowing isn't prioritized because the school buses go down every road in Town, so DPW does all the side streets as fast as they can. CT DOT plows the state roads, which are the main routes in Town. Bethlehem uses "magic salt" which is supposed to cause less vehicle rust, while DOT uses regular salt.

Dams

- The Town owns Long Meadow Dam. The dam is not considered to be a significant hazard dam as of 2007, but was formerly a Class B dam. The dam needs to be elevated and spillway enlarged, or the whole dam needs to become a spillway.

Haested Engineering inspected this dam and made the recommendations. The Town would like to be able to find a way to get funding through PDM or another grant program for the necessary dam work (which is due to a design flaw, not a failure of the Town in performing regular maintenance). The Town needs to talk to DEP to weigh its options.

- Long Meadow Pond is shallow (10-12 feet deep maximum) but very long so it has a lot of volume. It would have a significant dam failure inundation area to the Weekeepeemee River.

- Bronson Lockwood Dam is Class C but is in good condition.

Wildfires and Fire Protection

- Fires only burn a couple of acres at their largest. The Town has no state parks, so there are no public camping related fires. The large private tracts of land don't tend to attract kids. The limited-access conservation properties are considered to be at the highest risk for fires.

- Bethlehem has a 4-wheel drive brush truck and utilizes a system of 32 fire ponds with dry hydrants to provide fire protection to the Town.

- In addition to the forest areas, the Town feels that its many hayfields are a significant fire risk, particularly just prior to harvest time.

- The Town has mutual aid agreements with all its neighbors.

Development Trends

- Bethlehem has almost no development ongoing because there is no public water, no public sewer, and poor soils for large on-site septic systems. Such systems would be expensive due to the poor soils. Applications are typically for very small (1-2 lot) subdivisions. Last real development push was in the late 80's.

- Underground utilities are required in new developments wherever possible.

- Bethlehem has a lot of undeveloped open space, but it is primarily private forest or land trust property.

VI. Acquisitions

- *Bethlehem Town Guide* – Voices, March 2007
- *2006 Annual Report – Bethlehem, Connecticut*
- *Bethlehem Inland Wetlands Regulations* – Undated, but most current copy

- *Earth Materials Ordinance – Bethlehem, Connecticut* effective May 5, 1977
- *Subdivision Regulations* effective October 10, 2003
- *Plan of Conservation & Development* effective November 1, 1999.

D Murphy

COUNCIL OF GOVERNMENTS CENTRAL NAUGATUCK VALLEY
60 NORTH MAIN STREET • 3RD FLOOR • WATERBURY, CT 06702-1403 (203) 757-0535
Web Site: www.cogcnv.org E-Mail: cogcnv@cogcnv.org

RECEIVED
MAR 19 2008
MILONE AND MACBROOM

March 17, 2008

Richard Stubbs
American Red Cross Waterbury Area
64 Holmes Avenue
Waterbury, CT 06710

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. ~~Stubbs~~ Rich,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

In order to successfully develop the local mitigation plans, a significant public outreach effort is required by FEMA. In addition, FEMA requests that stakeholders such as land trusts, neighborhood groups, chambers of commerce, health districts, watershed associations, and educational institutions be invited to provide input. Therefore, COGCNV invites your participation at one or more of the public informational meetings listed below:

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Bethlehem	April 21, 2008	7:30 PM	Library

Please contact the COGCNV at 203-757-0535 or vmason@cogcnv.org if you have any questions about the planning process or the meetings.

We hope that you will assist in this very important project, and we look forward to seeing you soon.

Sincerely,

Virginia Mason

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Web Site: www.cogcnv.org *E-Mail:* cogcnv@cogcnv.org

March 17, 2008

James Rokos
Director of Health
Torrington Area Health District
350 Main Street
Torrington, CT 06790

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Rokos,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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March 17, 2008

Kristen Bulkovitch
President
United Way of Greater Waterbury
P.O. Box 2688
Waterbury, CT 06723-2688

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Kristen
Dear ~~Ms. Bulkovitch~~,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Sincerely,

Virginia

Virginia Mason

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March 17, 2008

Mr. Paul E. Reid
Inland Wetlands Commission
36 Main Street South
Bethlehem, CT 06751

**Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston**

Dear Mr. Reid,

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Sincerely,

Virginia Mason

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March 17, 2008

Mr. John Nelson
Bethlehem Land Trust
PO Box 322
Bethlehem, CT 06751

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear ~~Mr. Nelson~~, Jack

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Sincerely,

Virginia

Virginia Mason

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March 17, 2008

Nancy McMillan
Bethlehem Conservation Commission
237 Wood Creek Road
Bethlehem, CT 06751

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Ms. McMillan, Nancy

The Council of Governments Central Naugatuck Valley (COGCNV) is coordinating the development of pre-disaster natural hazard mitigation plans for Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston. Plan development and adoption is required in order to be eligible for certain pre-disaster mitigation funds from FEMA, as well as a greater portion of post-disaster funding.

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Virginia

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March 17, 2008

Robert Gallo
Planning Commission
36 Main Street South
Bethlehem, CT 06751

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Mr. Gallo,

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March 17, 2008

Long Meadow Lake Management Committee
36 Main Street South
Bethlehem, CT 06751

Re: Pre-Disaster Natural Hazard Mitigation Planning
Beacon Falls, Bethlehem, Middlebury, Naugatuck, Southbury, and Thomaston

Dear Director,

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Sincerely,

Virginia Mason

Virginia Mason

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Republican-American
4-18-08

Natural disaster meeting planned

BETHLEHEM — The Council of Governments of the Central Naugatuck Valley will host a meeting Monday at 7:30 p.m. at the Town Library to identify natural hazards in town and discuss ways to reduce their impact.

The public is invited to discuss the possible damage caused by hurricanes, nor'easters, floods, severe thunderstorms, icing, and earthquakes.

Consultants hired by COGCNV will then develop a plan identifying projects that can be undertaken prior to a disaster to reduce loss and damages. The plan will be submitted to FEMA in accordance with the Disaster Mitigation Act of 2000, which requires communities to have approved mitigation plans in order to receive pre-disaster project grants.

Council of Governments of the Central Naugatuck Valley
Bethlehem Pre-Disaster Mitigation Meeting
April 21, 2008

Name	Affiliation	Phone No.	FAX No.	e-mail
Jean Donegan	P.O. Box 402 Bethlehem Land Use	203-266-5000 (home)	203-266 5615	JFDwk @AOL.com
Jim Kacerguis	Bethlehem Public Works	203 2667664	203 405 1074	
Ted Crawford		203-266-7869	—	—
Theresa O'Neill	municipal Agent for Elderly	203 2667089		
John L. Vail III	Resident	203-266-5862		YSVSLV@Aol.com
Mike Devine	Emergency Mgmt	203-266-5817		michaeljdevine@sbcglobal.net
Vince McDermott	—	203-266-7549		vcmmd@netscape.net
Mike Schuyler	Long Meadow Lake Management	203-263-2207	203-263-0112	LMLMC@earthlink.net
Nancy McMillan	Conservation Commission	203-266-5229	266-6688	nlmcm@yahoo.com

T:\General\Meetings\Sign-in Sheet with fax email.Form EPC.wpd

Natural Hazard Pre-Disaster Mitigation Plan
Bethlehem, Connecticut

Presented by:

David Murphy, P.E. – Associate
Milone & MacBroom, Inc.

Sam Eisenbeiser, AICP
Fitzgerald & Halliday, Inc.

April 21, 2008

History of Hazard Mitigation Plans

- **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

Municipalities Currently Involved in the Regional Mitigation Planning Process

- **Beacon Falls**
- **Bethlehem**
- **Middlebury**
- **Naugatuck**
- **Southbury**
- **Thomaston**

Local municipalities must have a FEMA approved Hazard Mitigation Plan in place to receive federal grant funds for hazard mitigation projects

Selection of FEMA Pre-Disaster Mitigation Grants: 2003-2006

List does not include seismic, wind retrofit, home acquisition, and planning projects

State	Description	Grant
Colorado	Detention pond	$3,000,000
Oregon	Water conduit replacement	$3,000,000
Washington	Road elevation	$3,000,000
Oregon	Floodplain restoration	$2,984,236
Colorado	Watershed mitigation	$2,497,216
Georgia	Drainage improvements	$1,764,356
Massachusetts	Pond flood hazard project	$1,745,700
Oregon	Ice storm retrofit	$1,570,836
North Dakota	Power transmission replacement	$1,511,250
Texas	Home elevations	$1,507,005
Florida	Storm sewer pump station	$1,500,000
Massachusetts	Flood hazard mitigation project	$1,079,925
Kansas	Effluent pump station	$765,000
South Dakota	Flood channel restoration	$580,657
Massachusetts	Culvert project	$525,000
Texas	Storm shelter	$475,712
Massachusetts	Housing elevation and retrofit	$473,640
Utah	Fire station retrofit	$374,254
Washington	Downtown flood prevention project	$255,000
New York	WWTP Floodwall construction	$223,200
Massachusetts	Road mitigation project	$186,348
Massachusetts	Flood mitigation project	$145,503
Vermont	Road mitigation project	$140,441
New Hampshire	Water planning for firefighting	$134,810
Oregon	Bridge scour relocation project	$116,709
New Hampshire	Box culvert project	$102,000
Missouri	Bank stabilization	$48,750
Tennessee	Utility protection	$40,564
Wisconsin	Waterway stabilization	$12,909

What is a Natural Hazard ?

- An extreme natural event that poses a risk to people, infrastructure, and resources

What is Hazard Mitigation?

- ***Pre-disaster*** actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

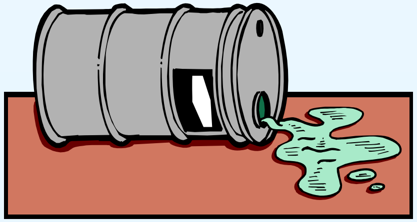
A Road Closure During / After a Large Scale Rainfall Event is a Type of Hazard Mitigation

Long-Term Goals of Hazard Mitigation

- Reduce loss / damage to life, property, and infrastructure
- Reduce the cost to residents and businesses
- Educate residents and policy-makers about natural hazard risk and vulnerability
- Connect hazard mitigation planning to other community planning efforts
- Enhance and preserve natural resource systems in the community

What a Hazard Mitigation Plan Does Not Address

- Terrorism and Sabotage
- Disaster Response and Recovery
- Human Induced Emergencies (some fires, hazardous spills and contamination, disease, etc.)



Components of Hazard Mitigation Planning Process

- Identify natural hazards that could occur in Bethlehem
- Evaluate the vulnerability of structures and populations and identify critical facilities and areas of concern
- Assess adequacy of mitigation measures currently in place
- Evaluate potential mitigation measures that could be undertaken to reduce the risk and vulnerability
- Develop recommendations for future mitigation actions

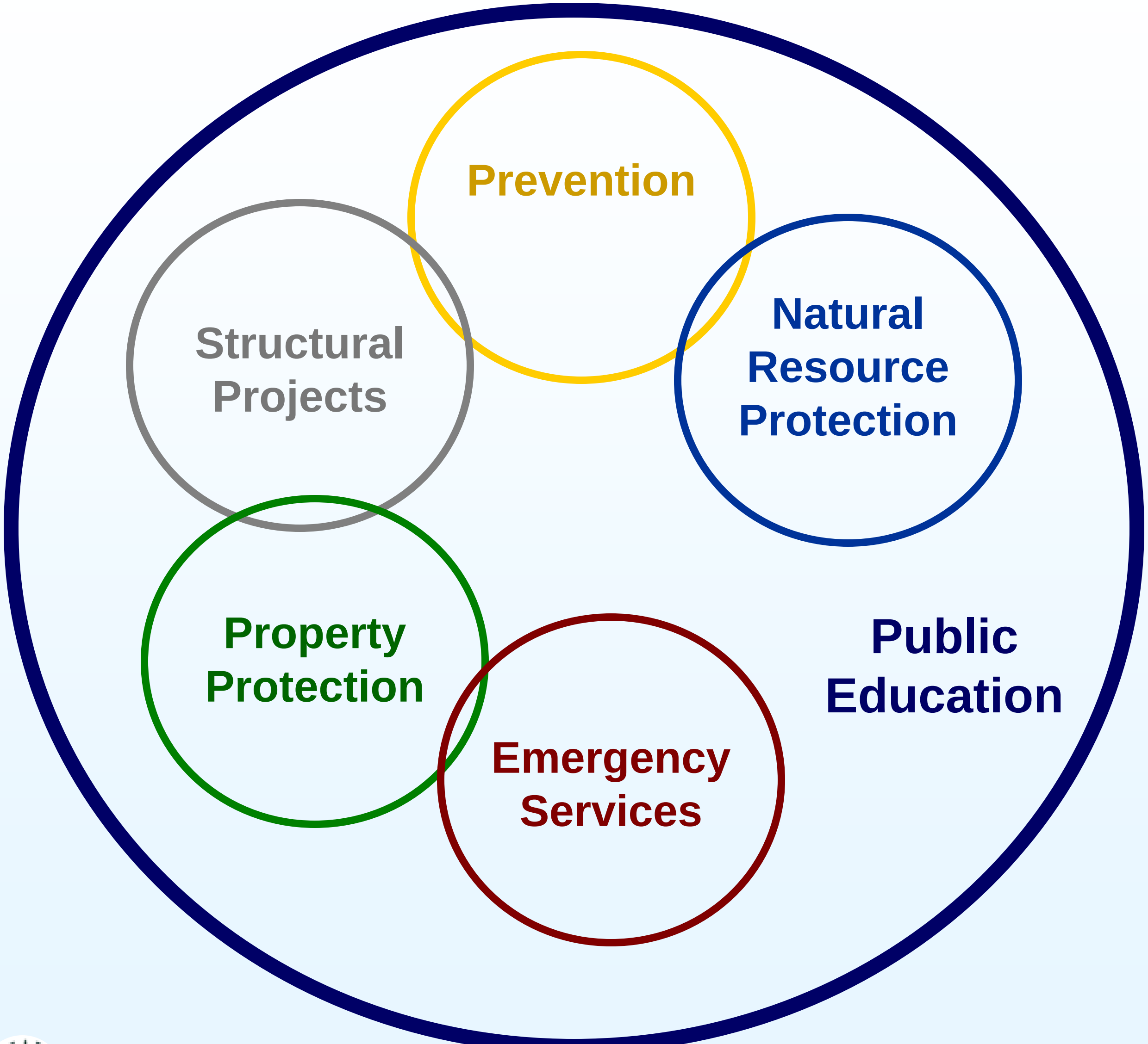
Bethlehem's Critical Facilities

- Emergency Services – Police, Fire, Ambulance
- Municipal Facilities – Town Hall
- Public Works Center

Bethlehem's Critical Facilities

- Health Care and Assisted Living – North Bridget Home
- Group Homes
- Shelters – Fire House, Memorial Hall, Bethlehem Elementary School

Potential Mitigation Categories



Potential Mitigation Measures

- Updating Communications Systems
- Adopt local legislation that limits or regulates development in vulnerable areas
- Public education programs – dissemination of public safety information
- Construction of structural measures
- Allocate technical and financial resources for mitigation programs
- Preserve critical land areas and natural systems

Primary Natural Hazards Facing Bethlehem

- Inland flooding
- Winter storms, nor'easters, heavy snow, blizzards, ice storms
- Hurricanes
- Summer storms, tornadoes, thunderstorms, lightning, hail
- Dam failure
- Wildfires
- Earthquakes

Hurricanes

- Winds
- Heavy rain / flooding

Summer Storms and Tornadoes

Lightning over Boston

Tornado in KS

- Heavy wind / tornadoes / downbursts
- Lightning
- Heavy rain
- Hail

Flooding in MN

Winter Storms

- Blizzards and nor'easters
- Heavy snow and drifts
- Freezing rain / ice

Connecticut

CT River - April 2007

Southbury - April 2007

Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life and millions of dollars in property damage

Long Meadow Pond Dam

Bronson Lockwood Pond Dam

Wildfires

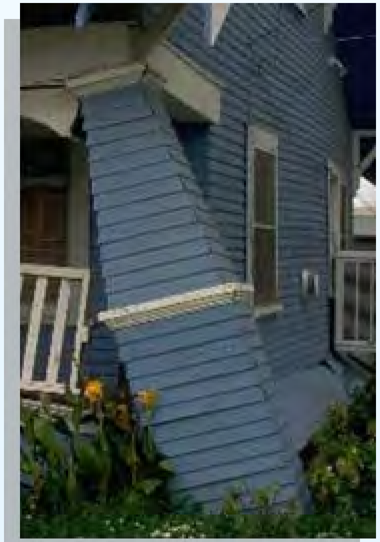
- Bethlehem has low to moderate risk of wildfires
- Land subject to wildfires is mostly private or land trust forests or farms during drought
- Fire
- Heat
- Smoke

Photo courtesy of FEMA

Earthquakes

- Bethlehem is in an area of minor seismic activity
- Chester, CT experienced a small, 2.0 magnitude earthquake on March 11, 2008
- Can cause dam failure
  - Shaking
  - Liquefaction
  - Secondary (Slides/Slumps)

Photos courtesy of FEMA



Area-Specific Problems

- Roadway and property flooding at rivers and streams
  - Crane Hollow Road
  - Arrowhead Lane
  - Route 132
  - Double Hill Road
- Localized problems
  - Hard Hill Road North
- Flooding caused by poor drainage
  - Hickory Lane
  - Cabbage Lane at Route 32 – ice

Other potential hazards

- Long Meadow Pond Dam
- Drought conditions – wildfires in hay fields

Flooding at Rivers and Streams

- Dowd Brook and tributary at Crane Hollow Road
- Homes along the Weekeepeemee on Arrowhead Lane
- Route 132 overtops at the pond near Swanson's farm.
- Beaver dams back water over Double Hill Road

Localized Problems

- Hard Hill Road North – farmers pass drainage from one field to the next

Flooding and Ice Caused by Poor Drainage

- Hickory Lane – culvert undersized, but can't fix without elevating road
- Cabbage Lane – poor drainage at Route 132 causes dangerous icing conditions

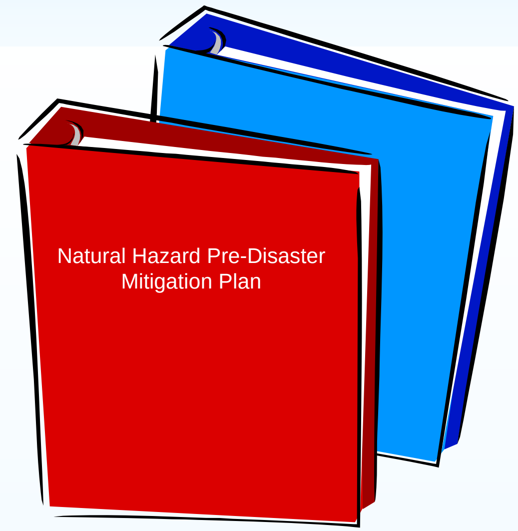
Route 132 at Cabbage Lane

Other Potential Hazards

- Long Meadow Pond dam
- Hay fields could spread wildfires during drought

Fields off Munger Lane

Next Steps



- Incorporate input from residents
- Rank hazard vulnerability
- Develop a response strategy
- Prepare the draft plan with recommendations for review by the Town and the public
- Adopt and implement the plan

Questions and Additions

Meeting Minutes

NATURAL HAZARD PRE-DISASTER MITIGATION PLAN FOR BETHLEHEM
Council of Governments Central Naugatuck Valley
Public Information Meeting
April 21, 2008

I. Welcome & Introductions

The following individuals attended the public meeting:

- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Samuel Eisenbeiser, Fitzgerald & Halliday, Inc. (FHI)
- Virginia Mason, Council of Governments Central Naugatuck Valley (CGCNV)
- Jean Donegan, Bethlehem Land Use Coordinator
- Jim Kacerguis, Bethlehem Public Works Director
- Mike Devine, Bethlehem Emergency Management
- Nancy McMillan, Conservation Commission
- Meike Schuyler, Long Meadow Pond Management
- Theresa O'Neill, municipal agent for the elderly
- Ted Crawford, resident
- Vince McDermott, resident
- John Vail, Jr., resident

Ms. Mason introduced the project team and the project, explaining the COG's role in the project, the goals of the Disaster Mitigation Act, and the relationship to the FEMA pre-disaster and post-disaster funding processes.

II. Power Point: "Natural Hazard Pre-Disaster Mitigation Plan, Bethlehem, Connecticut"

Mr. Murphy and Mr. Eisenbeiser presented the power point slideshow.

III. Questions, Comments, and Discussion

Corrections and Comments:

- "Swanson's" farm is "Swenson's" farm
- North "Bridget" Home is North "Purchase" Home
- Dowd Brook may not be the problem at Crane Hill Road. It may be a different stream. This needs to be checked.

Discussion:

- Ms. McMillan reported that an icy spot occurs at Route 132 and Wood Creek Road near the Weekeepeemee River due to poor drainage.

- A long discussion took place regarding the condition of Long Meadow Pond Dam and the potential impacts in Bethlehem, Woodbury, and Southbury if the dam should fail. Ms. Schuyler of the Long Meadow Pond Management Association would like to work with Milone & MacBroom, Inc. after the public meeting to ensure that proper documentation is available for the planning project. A potential teaming of communities such as Bethlehem and Southbury was discussed to apply for PDM grants for Long Meadow Pond Dam maintenance.

- Another discussion involved inadequate communication during emergencies. The town Communications Plan specifies the use of Morris Fire House as a Command Center but radio communications are not possible inside the facility. Mr. Murphy explained that PDM grants are generally not available for communications but that it was necessary to describe the problem and recommend improvements in the plan.

- Mr. Vail believes that more tree and branch trimming is necessary due to vulnerability of power lines.

- Flooding at Swenson's farm reportedly prevents emergency response to the Woodlands, Cabbage Lane, and Hard Hill Road neighborhoods.

From: Ifkovic, Diane [Diane.Ifkovic@ct.gov]
Sent: Friday, December 12, 2008 8:54 AM
To: Jfdwk@aol.com; mmartin@thomastonct.org; susanacable@aol.com
Cc: Christian, Art; Virginia Mason; Shawn Goulet; Dave Murphy; Scott Bighinatti
Subject: No RLPs for Bethlehem, Beacon Falls or Thomaston

Importance: Low

Hi all,

According to FEMA's Repetitive Loss Property (RLP) database, there are NO RLPs in Bethlehem, Beacon Falls or Thomaston.

If you need any data, such as list of properties in town with flood insurance, please give a call or email.

diane

Diane S. Ifkovic

State NFIP Coordinator/Environmental Analyst III
Connecticut Department of Environmental Protection
Bureau of Water Protection & Land Reuse
Inland Water Resources Division
Flood Management Program
79 Elm Street, 3rd floor
Hartford, CT 06106-5127
Phone: (860) 424-3537
Fax: (860) 424-4075
Email: diane.ifkovic@ct.gov

APPENDIX C
HAZUS DOCUMENTATION

Hazus-MH: Flood Event Report

Region Name: Bethlehem

Flood Scenario: EastSpring100

Print Date: Monday, November 11, 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 19 square miles and contains 86 census blocks. The region contains over 1 thousand households and has a total population of 3,422 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 1,682 buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 87.57% of the buildings (and 78.88% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religion	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	155,900	75.9%
Commercial	26,468	12.9%
Industrial	7,886	3.8%
Agricultural	2,755	1.3%
Religion	7,784	3.8%
Government	1,345	0.7%
Education	3,270	1.6%
Total	**205,408**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds.
There are 3 schools, 1 fire station, 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:	Bethlehem
Scenario Name:	EastSpring100
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 36 hospital beds available for use. On the day of the scenario flood event, the model estimates that 36 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	1	0	0	0
Hospitals	1	0	0	0
Police Stations	1	1	0	1
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 206 tons of debris will be generated. Of the total amount, Finishes comprises 55% of the total, Structure comprises 26% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 8 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 60 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 60 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 3.35 million dollars, which represents 1.63 % 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 3.34 million dollars. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 29.13% 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	0.64	0.26	0.13	0.16	1.20
	Content	0.33	0.74	0.17	0.85	2.10
	Inventory	0.00	0.01	0.03	0.01	0.05
	Subtotal	**0.98**	**1.01**	**0.33**	**1.02**	**3.34**
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	0.01	0.01
	Subtotal	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**
ALL	**Total**	**0.98**	**1.02**	**0.33**	**1.03**	**3.35**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Total Study Region	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Flood Event Report

Region Name: Bethlehem

Flood Scenario: Weekeepeemee100

Print Date: Friday, November 08, 2013

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

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General Building Stock

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Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religion	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	180,464	78.9%
Commercial	31,885	13.9%
Industrial	6,797	3.0%
Agricultural	2,331	1.0%
Religion	5,718	2.5%
Government	995	0.4%
Education	426	0.2%
Total	**228,616**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds.
There are 3 schools, 1 fire station, 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:	Bethlehem
Scenario Name:	Weekeepeemee100
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

Building Damage

General Building Stock Damage

Hazus estimates that about 1 building will be at least moderately damaged. This is over 2% 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	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**0**		**1**		**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	1	100.00	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 36 hospital beds available for use. On the day of the scenario flood event, the model estimates that 36 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	1	1	0	1
Hospitals	1	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 808 tons of debris will be generated. Of the total amount, Finishes comprises 29% of the total, Structure comprises 46% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 32 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 93 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 111 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 5.47 million dollars, which represents 2.39 % 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 5.43 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 52.17% 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	1.68	0.45	0.23	0.07	2.43
	Content	1.17	1.15	0.28	0.35	2.95
	Inventory	0.00	0.01	0.04	0.01	0.05
	Subtotal	**2.85**	**1.61**	**0.54**	**0.43**	**5.43**
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	0.01	0.00	0.03	0.03
	Subtotal	**0.00**	**0.01**	**0.00**	**0.03**	**0.04**
ALL	**Total**	**2.85**	**1.62**	**0.54**	**0.46**	**5.47**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Total Study Region	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: Probabilistic 10-year Return Period

Print Date: Friday, August 23, 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

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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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 10 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	113	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	55	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	11	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	1,473	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Total	**1,682**		**0**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 10 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	7	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	79	100.00	0	0.00	0	0.00	0	0.00	0	0.00
MH	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	85	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	1,355	100.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 3,422) 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

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Friday, August 23, 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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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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Commercial	45,274	12.7%
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Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 50 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	99.57	0	0.42	0	0.01	0	0.00	0	0.00
Commercial	112	99.49	1	0.50	0	0.01	0	0.00	0	0.00
Education	3	99.43	0	0.57	0	0.00	0	0.00	0	0.00
Government	3	99.44	0	0.56	0	0.00	0	0.00	0	0.00
Industrial	55	99.45	0	0.55	0	0.00	0	0.00	0	0.00
Religion	11	99.59	0	0.41	0	0.00	0	0.00	0	0.00
Residential	1,469	99.74	4	0.26	0	0.00	0	0.00	0	0.00
Total	**1,677**		**5**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 50 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	7	99.41	0	0.59	0	0.00	0	0.00	0	0.00
Masonry	79	99.38	0	0.60	0	0.02	0	0.00	0	0.00
MH	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	85	99.42	0	0.58	0	0.01	0	0.00	0	0.00
Wood	1,352	99.78	3	0.22	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 62 tons of debris will be generated. Of the total amount, 49 tons (79%) is Other Tree Debris. Of the remaining 13 tons, Brick/Wood comprises 54% 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 6 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.3 million dollars, which represents 0.08 % of the total replacement value of the region’s buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 0 million dollars. 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 97% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	261.04	4.53	1.20	1.52	268.29
	Content	3.99	0.00	0.00	0.00	3.99
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**265.04**	**4.53**	**1.20**	**1.52**	**272.28**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.07	0.04	0.00	0.00	0.12
	Rental	0.06	0.00	0.00	0.00	0.06
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.14**	**0.04**	**0.00**	**0.00**	**0.18**
Total						
	Total	**265.17**	**4.56**	**1.20**	**1.53**	**272.46**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: Probabilistic 20-year Return Period

Print Date: Friday, August 23, 2013

Disclaimer:
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Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 20 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	24	99.85	0	0.15	0	0.00	0	0.00	0	0.00
Commercial	113	99.80	0	0.20	0	0.00	0	0.00	0	0.00
Education	3	99.77	0	0.23	0	0.00	0	0.00	0	0.00
Government	3	99.76	0	0.24	0	0.00	0	0.00	0	0.00
Industrial	55	99.77	0	0.23	0	0.00	0	0.00	0	0.00
Religion	11	99.83	0	0.17	0	0.00	0	0.00	0	0.00
Residential	1,473	99.99	0	0.01	0	0.00	0	0.00	0	0.00
Total	**1,681**		**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	7	99.75	0	0.25	0	0.00	0	0.00	0	0.00
Masonry	79	99.79	0	0.20	0	0.00	0	0.00	0	0.00
MH	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	85	99.76	0	0.24	0	0.00	0	0.00	0	0.00
Wood	1,355	100.00	0	0.00	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 3,422) 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	0.00	0.00	0.00	0.00	0.00
	Content	0.25	0.00	0.00	0.00	0.25
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.25**	**0.00**	**0.00**	**0.00**	**0.25**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.01	0.00	0.00	0.00	0.01
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.01**	**0.00**	**0.00**	**0.00**	**0.01**
Total						
	Total	**0.26**	**0.00**	**0.00**	**0.00**	**0.26**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name:	Bethlehem
Hurricane Scenario:	Probabilistic 100-year Return Period
Print Date:	Friday, August 23, 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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 2 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	23	97.89	0	1.86	0	0.20	0	0.06	0	0.00
Commercial	111	98.18	2	1.66	0	0.15	0	0.01	0	0.00
Education	3	98.06	0	1.90	0	0.04	0	0.00	0	0.00
Government	3	98.27	0	1.70	0	0.03	0	0.00	0	0.00
Industrial	54	98.23	1	1.70	0	0.06	0	0.01	0	0.00
Religion	11	98.36	0	1.61	0	0.03	0	0.00	0	0.00
Residential	1,434	97.32	38	2.59	1	0.08	0	0.00	0	0.00
Total	**1,639**		**42**		**1**		**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	7	98.37	0	1.61	0	0.02	0	0.00	0	0.00
Masonry	77	97.38	2	2.37	0	0.23	0	0.02	0	0.00
MH	5	99.98	0	0.02	0	0.01	0	0.00	0	0.00
Steel	83	98.20	1	1.67	0	0.12	0	0.01	0	0.00
Wood	1,320	97.44	34	2.50	1	0.06	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 3,926 tons of debris will be generated. Of the total amount, 3,420 tons (87%) is Other Tree Debris. Of the remaining 506 tons, Brick/Wood comprises 16% 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 3 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 423 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 1.0 million dollars, which represents 0.29 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 1 million dollars. 1% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	902.06	16.39	4.18	7.75	930.37
	Content	43.33	0.10	0.43	0.55	44.41
	Inventory	0.00	0.01	0.09	0.07	0.17
	Subtotal	**945.39**	**16.50**	**4.70**	**8.37**	**974.95**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	31.87	0.56	0.04	0.12	32.60
	Rental	12.56	0.00	0.00	0.00	12.56
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**44.43**	**0.56**	**0.04**	**0.12**	**45.16**
Total						
	Total	**989.81**	**17.06**	**4.74**	**8.50**	**1,020.11**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Friday, August 23, 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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 13 buildings will be at least moderately damaged. This is over 1% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	22	91.39	2	6.81	0	1.23	0	0.53	0	0.04
Commercial	106	93.47	6	5.56	1	0.88	0	0.09	0	0.00
Education	3	92.87	0	6.46	0	0.65	0	0.02	0	0.00
Government	3	94.16	0	5.38	0	0.45	0	0.01	0	0.00
Industrial	52	93.91	3	5.39	0	0.60	0	0.09	0	0.00
Religion	10	93.38	1	6.21	0	0.41	0	0.00	0	0.00
Residential	1,315	89.29	147	9.96	11	0.73	0	0.01	0	0.01
Total	**1,510**		**159**		**12**		**0**		**0**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	7	95.10	0	4.58	0	0.32	0	0.00	0	0.00
Masonry	72	91.14	6	7.41	1	1.26	0	0.18	0	0.01
MH	5	99.68	0	0.26	0	0.06	0	0.00	0	0.01
Steel	80	94.02	4	5.05	1	0.82	0	0.11	0	0.00
Wood	1,212	89.48	133	9.85	9	0.65	0	0.01	0	0.01

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 7,812 tons of debris will be generated. Of the total amount, 6,705 tons (86%) is Other Tree Debris. Of the remaining 1,107 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 11 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 829 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 2.6 million dollars, which represents 0.72 % 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 3 million dollars. 3% 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 93% 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	2,094.43	67.75	17.54	36.64	2,216.35
	Content	211.56	8.89	5.61	7.78	233.84
	Inventory	0.00	0.28	1.03	0.67	1.98
	Subtotal	**2,305.99**	**76.91**	**24.18**	**45.10**	**2,452.17**
Business Interruption Loss						
	Income	0.00	6.47	0.14	4.54	11.16
	Relocation	55.30	7.51	0.85	5.46	69.13
	Rental	23.83	3.43	0.08	0.40	27.74
	Wage	0.00	3.26	0.25	11.46	14.97
	Subtotal	**79.13**	**20.68**	**1.32**	**21.87**	**123.00**
Total						
	Total	**2,385.12**	**97.59**	**25.50**	**66.96**	**2,575.17**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Friday, August 23, 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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There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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
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Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 84 buildings will be at least moderately damaged. This is over 5% of the total number of buildings in the region. There are an estimated 4 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	18	73.53	4	18.22	1	5.33	1	2.58	0	0.33
Commercial	89	78.40	18	15.72	6	5.06	1	0.81	0	0.01
Education	2	75.80	1	17.53	0	6.08	0	0.59	0	0.00
Government	2	79.61	0	15.33	0	4.66	0	0.40	0	0.00
Industrial	44	79.38	8	14.97	3	4.82	0	0.78	0	0.05
Religion	9	77.30	2	18.17	0	4.21	0	0.32	0	0.00
Residential	1,036	70.37	365	24.75	64	4.33	4	0.28	4	0.28
Total	**1,200**		**398**		**74**		**6**		**4**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	6	82.94	1	13.36	0	3.52	0	0.18	0	0.00
Masonry	59	74.43	14	18.25	5	6.14	1	1.02	0	0.16
MH	5	97.46	0	1.65	0	0.73	0	0.02	0	0.14
Steel	68	79.69	12	13.90	5	5.39	1	1.01	0	0.01
Wood	956	70.58	337	24.86	55	4.04	3	0.25	4	0.27

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 15,471 tons of debris will be generated. Of the total amount, 12,950 tons (84%) is Other Tree Debris. Of the remaining 2,521 tons, Brick/Wood comprises 36% 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 37 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 1,601 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 9.2 million dollars, which represents 2.58 % 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 9 million dollars. 4% 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 88% 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	6,095.63	308.06	91.82	177.34	6,672.84
	Content	1,476.74	93.16	45.84	61.48	1,677.22
	Inventory	0.00	2.44	7.83	4.08	14.35
	Subtotal	**7,572.37**	**403.65**	**145.49**	**242.90**	**8,364.41**
Business Interruption Loss						
	Income	0.00	42.28	1.42	15.74	59.44
	Relocation	414.58	60.52	8.21	32.00	515.32
	Rental	138.34	29.15	0.65	2.28	170.42
	Wage	0.00	47.28	2.46	62.05	111.79
	Subtotal	**552.92**	**179.23**	**12.74**	**112.08**	**856.97**
Total						
	Total	**8,125.29**	**582.89**	**158.22**	**354.97**	**9,221.38**

Appendix A: County Listing for the Region

Connecticut
- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name:	Bethlehem
Hurricane Scenario:	Probabilistic 1000-year Return Period
Print Date:	Friday, August 23, 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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 206 buildings will be at least moderately damaged. This is over 12% of the total number of buildings in the region. There are an estimated 16 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	13	56.09	6	26.83	3	10.81	1	5.36	0	0.91
Commercial	70	61.67	27	23.56	14	12.06	3	2.70	0	0.02
Education	2	57.69	1	24.57	0	14.62	0	3.12	0	0.00
Government	2	62.59	1	22.85	0	12.35	0	2.21	0	0.00
Industrial	35	62.75	12	22.23	7	12.05	2	2.84	0	0.13
Religion	7	59.82	3	27.29	1	11.11	0	1.78	0	0.00
Residential	786	53.34	513	34.82	141	9.60	17	1.14	16	1.09
Total	**914**		**563**		**166**		**23**		**16**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	5	67.17	1	21.10	1	10.53	0	1.20	0	0.00
Masonry	46	57.73	20	25.64	10	13.23	2	2.87	0	0.53
MH	5	93.69	0	3.41	0	2.22	0	0.13	0	0.54
Steel	54	63.06	17	20.47	11	12.98	3	3.45	0	0.03
Wood	725	53.51	478	35.27	123	9.08	15	1.08	14	1.06

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 30,595 tons of debris will be generated. Of the total amount, 25,492 tons (83%) is Other Tree Debris. Of the remaining 5,103 tons, Brick/Wood comprises 38% 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 78 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 3,151 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 21.9 million dollars, which represents 6.13 % 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 22 million dollars. 4% 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 88% 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	13,249.12	775.16	243.20	428.46	14,695.94
	Content	4,249.70	319.35	139.23	180.86	4,889.14
	Inventory	0.00	7.57	22.93	9.59	40.09
	Subtotal	**17,498.82**	**1,102.08**	**405.35**	**618.91**	**19,625.16**
Business Interruption Loss						
	Income	0.00	56.35	2.71	17.68	76.73
	Relocation	1,321.03	154.18	22.21	80.25	1,577.67
	Rental	424.73	76.31	1.54	5.78	508.35
	Wage	0.00	65.79	4.61	73.29	143.69
	Subtotal	**1,745.76**	**352.63**	**31.06**	**176.99**	**2,306.44**
Total						
	Total	**19,244.58**	**1,454.71**	**436.41**	**795.90**	**21,931.61**

Appendix A: County Listing for the Region

Connecticut
- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: UN-NAMED-1938-4

Print Date: Friday, August 23, 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 19.63 square miles and contains 1 census tracts. There are over 1 thousand households in the region and has a total population of 3,422 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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	282,113	78.9%
Commercial	45,274	12.7%
Industrial	11,979	3.3%
Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	UN-NAMED-1938-4
Type:	Historic
Max Peak Gust in Study Region:	100 mph

Building Damage

General Building Stock Damage

Hazus estimates that about 31 buildings will be at least moderately damaged. This is over 2% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	20	85.11	3	11.17	1	2.47	0	1.15	0	0.10
Commercial	100	88.48	11	9.34	2	1.93	0	0.24	0	0.00
Education	3	87.17	0	10.81	0	1.95	0	0.07	0	0.00
Government	3	89.47	0	9.09	0	1.40	0	0.05	0	0.00
Industrial	49	89.17	5	8.97	1	1.62	0	0.22	0	0.01
Religion	10	88.08	1	10.62	0	1.26	0	0.04	0	0.00
Residential	1,213	82.33	234	15.86	25	1.71	1	0.05	1	0.05
Total	**1,397**		**254**		**29**		**1**		**1**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	6	91.35	1	7.65	0	0.98	0	0.02	0	0.00
Masonry	67	85.29	9	11.66	2	2.62	0	0.38	0	0.04
MH	5	99.13	0	0.65	0	0.19	0	0.00	0	0.03
Steel	76	89.39	7	8.36	2	1.96	0	0.29	0	0.00
Wood	1,118	82.54	214	15.80	21	1.57	1	0.04	1	0.05

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
Police Stations	1	0	0	1
Schools	3	0	0	2

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 8,897 tons of debris will be generated. Of the total amount, 7,504 tons (84%) is Other Tree Debris. Of the remaining 1,393 tons, Brick/Wood comprises 33% 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 19 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 928 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 4.3 million dollars, which represents 1.19 % 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. 3% 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 90% 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	3,186.00	128.08	35.13	73.79	3,423.00
	Content	487.18	25.69	14.41	19.95	547.22
	Inventory	0.00	0.76	2.58	1.56	4.90
	Subtotal	**3,673.18**	**154.53**	**52.12**	**95.30**	**3,975.12**
Business Interruption Loss						
	Income	0.00	18.33	0.53	7.86	26.72
	Relocation	127.08	22.44	2.55	12.31	164.38
	Rental	46.61	10.29	0.23	0.87	57.99
	Wage	0.00	18.41	0.92	26.13	45.46
	Subtotal	**173.68**	**69.47**	**4.23**	**47.16**	**294.55**
Total						
	Total	**3,846.86**	**224.00**	**56.35**	**142.46**	**4,269.66**

Appendix A: County Listing for the Region

Connecticut
- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Hurricane Event Report

Region Name: Bethlehem

Hurricane Scenario: GLORIA

Print Date: Friday, August 23, 2013

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study 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):

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Note:
Appendix A contains a complete listing of the counties contained in the region.

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There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 358 million dollars (2006 dollars). Approximately 88% of the buildings (and 79% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 1,682 buildings in the region which have an aggregate total replacement value of 358 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
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Agricultural	4,295	1.2%
Religious	9,392	2.6%
Government	1,345	0.4%
Education	3,270	0.9%
Total	**357,668**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and no emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	GLORIA
Type:	Historic
Max Peak Gust in Study Region:	63 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	24	99.80	0	0.21	0	0.00	0	0.00	0	0.00
Commercial	113	99.73	0	0.27	0	0.00	0	0.00	0	0.00
Education	3	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Government	3	99.68	0	0.32	0	0.00	0	0.00	0	0.00
Industrial	55	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Religion	11	99.78	0	0.22	0	0.00	0	0.00	0	0.00
Residential	1,473	99.97	0	0.03	0	0.00	0	0.00	0	0.00
Total	**1,681**		**1**		**0**		**0**		**0**	

Table 3: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	7	99.67	0	0.33	0	0.00	0	0.00	0	0.00
Masonry	79	99.71	0	0.28	0	0.01	0	0.00	0	0.00
MH	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	85	99.68	0	0.32	0	0.00	0	0.00	0	0.00
Wood	1,355	99.99	0	0.01	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 36 hospital beds available for use. On the day of the hurricane, the model estimates that 36 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% 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	1	0	0	1
Hospitals	1	0	0	1
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 tons of debris will be generated. Of the total amount, 15 tons (88%) is Other Tree Debris. Of the remaining 2 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 2 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 3,422) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.1 million dollars, which represents 0.02 % 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. 2% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 91% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	72.69	4.53	1.20	1.40	79.82
	Content	1.27	0.00	0.00	0.00	1.27
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**73.96**	**4.53**	**1.20**	**1.40**	**81.09**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.02	0.00	0.00	0.00	0.02
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.02**	**0.00**	**0.00**	**0.00**	**0.02**
Total						
	Total	**73.98**	**4.53**	**1.20**	**1.40**	**81.11**

Appendix A: County Listing for the Region

Connecticut

- Litchfield

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
Litchfield	3,422	282,113	75,555	357,668
Total	**3,422**	**282,113**	**75,555**	**357,668**
Study Region Total	**3,422**	**282,113**	**75,555**	**357,668**

Hazus-MH: Earthquake Event Report

Region Name: Bethlehem

Earthquake Scenario: East Haddam

Print Date: August 26, 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.

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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 19.62 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,422 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 357 (millions of dollars). Approximately 88.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 13 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 357 (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 82% 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 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 2 dams identified within the region. Of these, 1 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 13.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 7 bridges, 219 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7	13.20
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**13.20**
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	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**13.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.20**
Waste Water	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.30**
Natural Gas	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.90**
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	**4.40**

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
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 53 buildings will be at least moderately damaged. This is over 3.00 % 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	20	1.35	3	1.70	1	2.56	0	3.72	0	3.39
Commercial	91	6.26	14	7.97	7	14.54	1	20.61	0	24.18
Education	2	0.17	0	0.21	0	0.38	0	0.47	0	0.69
Government	2	0.17	0	0.21	0	0.41	0	0.51	0	0.70
Industrial	44	3.02	7	3.88	4	7.78	1	10.24	0	12.72
Other Residential	166	11.42	21	12.34	8	17.04	1	21.10	0	22.26
Religion	9	0.63	1	0.72	1	1.17	0	1.72	0	2.12
Single Family	1,121	76.99	125	72.99	27	56.12	2	41.63	0	33.93
Total	**1,456**		**172**		**48**		**6**		**1**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,221	83.84	134	78.04	26	53.83	2	29.17	0	11.94
Steel	77	5.30	12	7.01	7	15.33	1	19.28	0	24.04
Concrete	17	1.16	2	1.41	1	3.00	0	2.22	0	2.49
Precast	5	0.37	1	0.38	1	1.13	0	2.43	0	0.46
RM	28	1.94	2	1.40	2	3.76	0	5.95	0	0.53
URM	101	6.93	19	10.94	10	21.05	2	39.28	0	59.97
MH	7	0.45	1	0.82	1	1.91	0	1.66	0	0.57
Total	**1,456**		**172**		**48**		**6**		**1**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 36 hospital beds available for use. On the day of the earthquake, the model estimates that only 24 hospital beds (69.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 85.00% of the beds will be back in service. By 30 days, 97.00% 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	1	0	0	1
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	110	5	1
Waste Water	66	2	1
Natural Gas	44	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	1,246	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 62.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**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	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 4.16 (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 4.11 (millions of dollars); 18 % 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 60 % 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	0.15	0.01	0.01	0.17
	Capital-Related	0.00	0.00	0.11	0.00	0.00	0.12
	Rental	0.04	0.02	0.07	0.00	0.00	0.13
	Relocation	0.13	0.02	0.11	0.01	0.04	0.31
	Subtotal	**0.17**	**0.04**	**0.44**	**0.02**	**0.06**	**0.73**
Capital Stock Losses							
	Structural	0.32	0.04	0.13	0.03	0.06	0.58
	Non_Structural	1.33	0.16	0.37	0.10	0.13	2.08
	Content	0.38	0.04	0.18	0.05	0.07	0.71
	Inventory	0.00	0.00	0.00	0.01	0.00	0.02
	Subtotal	**2.03**	**0.23**	**0.69**	**0.18**	**0.26**	**3.39**
	Total	**2.19**	**0.27**	**1.13**	**0.21**	**0.31**	**4.11**

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	0.00	$0.00	0.00
	Bridges	13.23	$0.01	0.09
	Tunnels	0.00	$0.00	0.00
	Subtotal	**13.20**	**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	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**13.20**	**0.00**	

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	2.20	$0.02	0.97
	Subtotal	**2.20**	**$0.02**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.30	$0.01	0.81
	Subtotal	**1.32**	**$0.01**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	0.90	$0.00	0.42
	Subtotal	**0.88**	**$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	**4.39**	**$0.04**	

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

Litchfield,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Litchfield	3,422	282	75	357
Total State		**3,422**	**282**	**75**	**357**
Total Region		**3,422**	**282**	**75**	**357**

Hazus-MH: Earthquake Event Report

Region Name:	Bethlehem
Earthquake Scenario:	Haddam
Print Date:	August 26, 2013

Totals only reflect data for those census tracts/blocks included in the user's study region.

Disclaimer:
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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 19.62 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,422 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 357 (millions of dollars). Approximately 88.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 13 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 357 (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 82% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

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For essential facilities, there are 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 2 dams identified within the region. Of these, 1 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 13.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 7 bridges, 219 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7	13.20
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**13.20**
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	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**13.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.20**
Waste Water	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.30**
Natural Gas	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.90**
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	**4.40**

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
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 18 buildings will be at least moderately damaged. This is over 1.00 % 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	22	1.40	1	1.66	0	2.44	0	3.23	0	2.89
Commercial	104	6.56	6	8.12	2	14.14	0	19.08	0	22.10
Education	3	0.17	0	0.21	0	0.35	0	0.42	0	0.60
Government	3	0.17	0	0.20	0	0.36	0	0.41	0	0.51
Industrial	51	3.20	3	3.82	1	6.87	0	8.22	0	9.30
Other Residential	183	11.54	10	13.31	3	19.21	0	23.49	0	27.99
Religion	10	0.64	1	0.80	0	1.35	0	1.97	0	2.65
Single Family	1,210	76.31	56	71.88	9	55.29	1	43.18	0	33.96
Total	**1,585**		**78**		**17**		**2**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,315	82.96	59	75.06	8	49.07	0	25.78	0	0.00
Steel	91	5.71	5	6.47	2	11.81	0	11.83	0	10.29
Concrete	20	1.23	1	1.28	0	2.11	0	0.95	0	1.50
Precast	6	0.39	0	0.44	0	1.41	0	2.85	0	0.20
RM	31	1.93	1	1.64	1	4.52	0	6.32	0	0.00
URM	116	7.29	11	14.09	5	28.85	1	50.95	0	87.81
MH	8	0.49	1	1.02	0	2.24	0	1.32	0	0.19
Total	**1,585**		**78**		**17**		**2**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 36 hospital beds available for use. On the day of the earthquake, the model estimates that only 29 hospital beds (81.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 92.00% of the beds will be back in service. By 30 days, 99.00% 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	1	0	0	1
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	110	1	0
Waste Water	66	1	0
Natural Gas	44	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,246	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 71.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 1.41 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 1.40 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 61 % 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	0.05	0.00	0.00	0.05
	Capital-Related	0.00	0.00	0.03	0.00	0.00	0.04
	Rental	0.01	0.01	0.02	0.00	0.00	0.04
	Relocation	0.04	0.01	0.03	0.00	0.01	0.10
	Subtotal	**0.06**	**0.01**	**0.14**	**0.01**	**0.02**	**0.23**
Capital Stock Losses							
	Structural	0.12	0.01	0.04	0.01	0.02	0.20
	Non_Structural	0.47	0.05	0.13	0.03	0.04	0.72
	Content	0.12	0.01	0.06	0.02	0.02	0.23
	Inventory	0.00	0.00	0.00	0.00	0.00	0.01
	Subtotal	**0.70**	**0.08**	**0.23**	**0.06**	**0.09**	**1.17**
	Total	**0.76**	**0.10**	**0.37**	**0.07**	**0.11**	**1.40**

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	0.00	$0.00	0.00
	Bridges	13.23	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**13.20**	**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	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**13.20**	**0.00**	

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	2.20	$0.01	0.23
	Subtotal	**2.20**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.30	$0.00	0.19
	Subtotal	**1.32**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	0.90	$0.00	0.10
	Subtotal	**0.88**	**$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	**4.39**	**$0.01**	

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

Litchfield,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Litchfield	3,422	282	75	357
Total State		**3,422**	**282**	**75**	**357**
Total Region		**3,422**	**282**	**75**	**357**

Hazus-MH: Earthquake Event Report

Region Name: Bethlehem

Earthquake Scenario: Portland

Print Date: August 26, 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.

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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 19.62 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,422 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 357 (millions of dollars). Approximately 88.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 13 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 357 (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 82% 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 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 2 dams identified within the region. Of these, 1 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 13.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 7 bridges, 219 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7	13.20
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**13.20**
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	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**13.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.20**
Waste Water	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.30**
Natural Gas	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.90**
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	**4.40**

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
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 26 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	22	1.39	2	1.64	1	2.42	0	3.24	0	2.64
Commercial	101	6.50	8	7.94	3	13.99	0	18.80	0	19.90
Education	3	0.17	0	0.20	0	0.35	0	0.41	0	0.55
Government	3	0.17	0	0.20	0	0.37	0	0.42	0	0.50
Industrial	49	3.17	4	3.79	2	7.01	0	8.38	0	9.01
Other Residential	178	11.50	14	12.95	4	18.44	1	22.68	0	24.13
Religion	10	0.63	1	0.76	0	1.28	0	1.87	0	2.24
Single Family	1,185	76.45	76	72.51	14	56.15	1	44.20	0	41.04
Total	**1,550**		**105**		**24**		**3**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,289	83.17	80	76.33	12	51.28	1	28.55	0	15.13
Steel	87	5.64	7	6.54	3	12.59	0	12.92	0	12.79
Concrete	19	1.22	1	1.32	1	2.36	0	1.28	0	1.08
Precast	6	0.38	0	0.42	0	1.30	0	2.69	0	0.24
RM	30	1.94	2	1.53	1	4.21	0	6.12	0	0.18
URM	111	7.17	14	12.90	6	26.12	1	47.01	0	70.39
MH	7	0.48	1	0.96	1	2.14	0	1.43	0	0.20
Total	**1,550**		**105**		**24**		**3**		**0**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 36 hospital beds available for use. On the day of the earthquake, the model estimates that only 27 hospital beds (77.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 90.00% of the beds will be back in service. By 30 days, 98.00% 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	1	0	0	1
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	110	2	0
Waste Water	66	1	0
Natural Gas	44	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,246	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 69.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 2.14 (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 2.12 (millions of dollars); 16 % 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 61 % 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	0.07	0.00	0.01	0.08
	Capital-Related	0.00	0.00	0.05	0.00	0.00	0.05
	Rental	0.02	0.01	0.03	0.00	0.00	0.06
	Relocation	0.07	0.01	0.05	0.01	0.02	0.15
	Subtotal	**0.08**	**0.02**	**0.20**	**0.01**	**0.03**	**0.34**
Capital Stock Losses							
	Structural	0.17	0.02	0.06	0.01	0.03	0.29
	Non_Structural	0.70	0.08	0.19	0.05	0.07	1.10
	Content	0.20	0.02	0.10	0.03	0.04	0.38
	Inventory	0.00	0.00	0.00	0.01	0.00	0.01
	Subtotal	**1.07**	**0.12**	**0.35**	**0.10**	**0.13**	**1.78**
	Total	**1.16**	**0.14**	**0.55**	**0.11**	**0.16**	**2.12**

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	0.00	$0.00	0.00
	Bridges	13.23	$0.00	0.01
	Tunnels	0.00	$0.00	0.00
	Subtotal	**13.20**	**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	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**13.20**	**0.00**	

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	2.20	$0.01	0.32
	Subtotal	**2.20**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.30	$0.00	0.27
	Subtotal	**1.32**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	0.90	$0.00	0.14
	Subtotal	**0.88**	**$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	**4.39**	**$0.01**	

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

Litchfield,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Litchfield	3,422	282	75	357
Total State		**3,422**	**282**	**75**	**357**
Total Region		**3,422**	**282**	**75**	**357**

Hazus-MH: Earthquake Event Report

Region Name: Bethlehem

Earthquake Scenario: Stamford

Print Date: August 26, 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 19.62 square miles and contains 1 census tracts. There are over 1 thousand households in the region which has a total population of 3,422 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 1 thousand buildings in the region with a total building replacement value (excluding contents) of 357 (millions of dollars). Approximately 88.00 % of the buildings (and 79.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 13 and 0 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 1 thousand buildings in the region which have an aggregate total replacement value of 357 (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 82% 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 1 hospitals in the region with a total bed capacity of 36 beds. There are 3 schools, 1 fire stations, 1 police stations and 0 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 2 dams identified within the region. Of these, 1 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 13.00 (millions of dollars). This inventory includes over 0 kilometers of highways, 7 bridges, 219 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	7	13.20
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**13.20**
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	0	0.00
	Runways	0	0.00
		Subtotal	**0.00**
		Total	**13.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	2.20
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**2.20**
Waste Water	Distribution Lines	NA	1.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**1.30**
Natural Gas	Distribution Lines	NA	0.90
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.90**
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	**4.40**

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
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 14 buildings will be at least moderately damaged. This is over 1.00 % 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	23	1.41	1	1.69	0	2.47	0	3.06	0	2.82
Commercial	106	6.58	5	8.30	2	14.34	0	18.23	0	21.42
Education	3	0.18	0	0.21	0	0.35	0	0.40	0	0.57
Government	3	0.18	0	0.21	0	0.35	0	0.38	0	0.47
Industrial	52	3.21	2	3.87	1	6.85	0	7.74	0	8.59
Other Residential	185	11.56	9	13.57	3	19.71	0	23.14	0	28.46
Religion	10	0.64	1	0.82	0	1.39	0	1.94	0	2.68
Single Family	1,223	76.24	46	71.33	7	54.53	1	45.11	0	34.99
Total	**1,604**		**64**		**13**		**1**		**0**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,329	82.84	47	74.10	6	47.41	0	28.13	0	0.00
Steel	92	5.73	4	6.48	1	11.47	0	10.70	0	8.62
Concrete	20	1.24	1	1.26	0	1.96	0	0.84	0	0.36
Precast	6	0.39	0	0.47	0	1.48	0	2.82	0	0.28
RM	31	1.93	1	1.71	1	4.71	0	6.06	0	0.00
URM	118	7.36	10	14.93	4	30.67	1	50.25	0	90.48
MH	8	0.50	1	1.06	0	2.30	0	1.19	0	0.26
Total	**1,604**		**64**		**13**		**1**		**0**	

*Note:

RM Reinforced Masonry

URM Unreinforced Masonry

MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 36 hospital beds available for use. On the day of the earthquake, the model estimates that only 29 hospital beds (82.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 93.00% of the beds will be back in service. By 30 days, 99.00% 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	1	0	0	1
Schools	3	0	0	3
EOCs	0	0	0	0
PoliceStations	1	0	0	1
FireStations	1	0	0	1

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	0	0	0	0	0
	Bridges	7	0	0	7	7
	Tunnels	0	0	0	0	0
Railways	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	0	0	0	0	0
	Runways	0	0	0	0	0

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, Hazus performs a simplified system performance analysis. Table 9 provides a summary of the system performance information.

Table 7 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	0	0	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	0	0	0	0	0

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	110	1	0
Waste Water	66	0	0
Natural Gas	44	0	0
Oil	0	0	0

Table 9: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	1,246	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 72.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 3,422) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

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

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
2 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**
5 PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**0**	**0**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 1.07 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 1.06 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 61 % 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	0.04	0.00	0.00	0.04
	Capital-Related	0.00	0.00	0.03	0.00	0.00	0.03
	Rental	0.01	0.01	0.02	0.00	0.00	0.03
	Relocation	0.03	0.00	0.03	0.00	0.01	0.08
	Subtotal	**0.04**	**0.01**	**0.11**	**0.00**	**0.02**	**0.18**
Capital Stock Losses							
	Structural	0.10	0.01	0.03	0.01	0.02	0.16
	Non_Structural	0.36	0.04	0.09	0.02	0.03	0.55
	Content	0.08	0.01	0.05	0.01	0.02	0.17
	Inventory	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.53**	**0.06**	**0.17**	**0.05**	**0.07**	**0.88**
	Total	**0.58**	**0.07**	**0.28**	**0.05**	**0.08**	**1.06**

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	0.00	$0.00	0.00
	Bridges	13.23	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Subtotal	**13.20**	**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	0.00	$0.00	0.00
	Runways	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
	Total	**13.20**	**0.00**	

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	2.20	$0.00	0.18
	Subtotal	**2.20**	**$0.00**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	1.30	$0.00	0.15
	Subtotal	**1.32**	**$0.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	0.90	$0.00	0.08
	Subtotal	**0.88**	**$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	**4.39**	**$0.01**	

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

Litchfield,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Litchfield	3,422	282	75	357
Total State		**3,422**	**282**	**75**	**357**
Total Region		**3,422**	**282**	**75**	**357**

APPENDIX D
FEMA SNOW LOAD GUIDANCE

FEMA Snow Load Safety Guidance

FEMA

www.FEMA.gov

This flyer summarizes warning signs of overstress conditions during a snow event, key safety issues and risks a snow event poses to buildings, and what to do after a snow event.

Warning Signs of Overstress Conditions during a Snow Event

Overstressed roofs typically display some warning signs. Wood and steel structures may show noticeable signs of excessive ceiling or roof sagging before failure. The following warning signs are common in wood, metal, and steel constructed buildings:

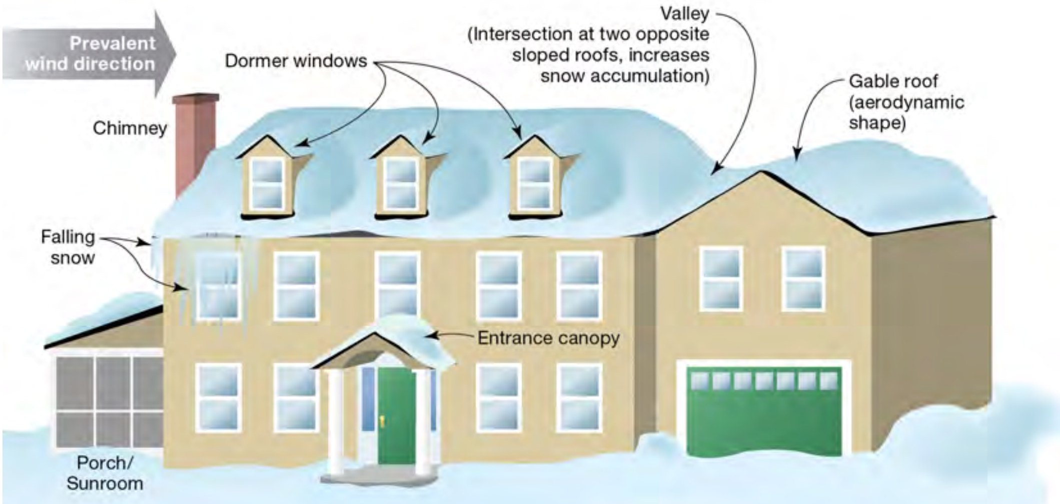
- Sagging ceiling tiles or boards, ceiling boards falling out of the ceiling grid, and/or sagging sprinkler lines and sprinkler heads
- Sprinkler heads deflecting below suspended ceilings
- Popping, cracking, and creaking noises
- Sagging roof members, including metal decking or plywood sheathing
- Bowing truss bottom chords or web members
- Doors and/or windows that can no longer be opened or closed
- Cracked or split wood members
- Cracks in walls or masonry
- Severe roof leaks
- Excessive accumulation of water at nondrainage locations on low slope roofs

Warning! If any of these warning signs are observed, the building should be promptly evacuated and a local building authority and/or a qualified design professional should be contacted to perform a detailed structural inspection.

Key Safety Issues and Risks

Snow accumulation in excess of building design conditions can result in structural failure and possible collapse. Structural failure due to roof snow loads may be linked to several possible causes, including but not limited to the following:

- **Unbalanced snow load from drifting and sliding snow.** When snow accumulates at different depths in different locations on a roof, it results in high and concentrated snow loads that can potentially overload the roof structure.
- **Rain-on-snow load.** Heavy rainfall on top of snow may cause snow to melt and become further saturated, significantly increasing the load on the roof structure.
- **Snow melt between snow events.** If the roof drainage system is blocked, improperly designed or maintained, ice dams may form, which creates a concentrated load at the eaves and reduces the ability of sloped roofs to shed snow. On flat or low slope roof systems, snow melt may accumulate in low areas on roofs, creating a concentrated load.
- **Roof geometry.** Simple roofs with steep slopes shed snow most easily. Roofs with geometric irregularities and obstructions collect snow drifts in an unbalanced pattern. These roof geometries include flat roofs with parapets, stepped roofs, saw-tooth roofs, and roofs with obstructions such as equipment or chimneys.



Unbalanced Snow Load from Drifting and Sliding Snow on Residential Structure

What to Do After a Snow Event

After a snow event, snow removal may be in order. To determine whether snow removal is necessary, one may enlist valuable resources such as a local building authority and/or a qualified design professional, who will be familiar with the snow conditions of the region and the design capacities of local buildings per the building code. If it is determined that the snow should be removed, snow removal should only be performed by qualified individuals. The qualified individual should follow necessary protocols for safe snow removal to minimize risk of personal injury and lower the potential for damaging the roof covering during the snow removal process.

> Warning! Snow removal is a dangerous activity that should only be done by qualified individuals following safety protocols to minimize risks. If at any time there is concern that snow loads may cause a collapse of the roof structure, cease all removal activity and evacuate the building.

If subsequent snow events are anticipated, removing snow from the roof will minimize the risk of accumulating snow causing structural damage. One benefit of immediate snow removal is that the effort required to remove the snow from the rooftop is reduced.

Safety Measures for Snow Removal

Below are some safety measures to take during snow removal to minimize risk of personal injury.

- Any roof snow removal should be conducted following proper OSHA protocol for work on rooftops. Use roof fall arrest harnesses where applicable.
- Always have someone below the roof to keep foot traffic away from locations where falling snow or ice could cause injuries.
- Ensure someone confirms that the area below removal site is free of equipment that could be damaged by falling snow or ice.
- Whenever snow is being removed from a roof, be careful of dislodged icicles. An icicle falling from a short height can still cause damage or injury.
- When using a non-metallic snow rake, be aware that roof snow can slide at any moment. Keep a safe distance away from the eave to remain outside of the sliding range.
- Buried skylights pose a high risk to workers on a roof removing snow. Properly mark this hazard as well as other rooftop hazards.

Methods of Snow Removal

Below are some recommended methods of snow removal that allow the qualified individual to remove snow safely and minimize risk of personal injury and property damage.

- Removing snow completely from a roof surface can result in serious damage to the roof covering and possibly lead to leaks and additional damage. At least a couple of inches of snow should be left on the roof.
- Do not use mechanical snow removal equipment. The risk of damaging the roof membrane or other rooftop items outweighs the advantage of speed.
- Do not use sharp tools, such as picks, to remove snow. Use plastic rather than metal shovels.
- Remove drifted snow first at building elevation changes, parapets, and around equipment.
- Once drifted snow has been removed, start remaining snow removal from the center portion of the roof.
- Remove snow in the direction of primary structural members. This will prevent unbalanced snow loading.
- Do not stockpile snow on the roof.
- Dispose of removed snow in designated areas on the ground.
- Keep snow away from building exits, fire escapes, drain downspouts, ventilation openings, and equipment.
- If possible, remove snow starting at the ridge and moving toward the eave for gable and sloped roofs.
- In some cases a long-handled non-metallic snow rake can be used from the ground, thereby reducing the risk. Metal snow rakes can damage roofing material and pose an electrocution risk and should be avoided.
- Upon completion of snow removal, the roofing material should be inspected for any signs of damage. Additionally, a quick inspection of the structural system may be prudent after particularly large snow events.

If you have any additional questions on this topic or other mitigation topics, contact the FEMA Building Science Helpline at FEMA-Buildingsciencehelp@fema.dhs.gov or 866-927-2104.

You may also subscribe to the FEMA Building Science e-mail list serve, which is updated with publication releases and FEMA Building Science activities.

Subscribe at https://public.govdelivery.com/accounts/USDHSFEMA/subscriber/new?topic_id=USDHSFEMA_193

Visit the Building Science Branch of the Risk Reduction Division at FEMA's Federal Insurance and Mitigation Administration at http://www.fema.gov/building-science.

Please scan this QR code to visit the FEMA Building Science web page.

APPENDIX E
MITIGATION PROJECT STATUS WORKSHEET

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 F
RECORD OF MUNICIPAL ADOPTION

Town of Bethlehem
Selectmen's Office
36 Main Street South * PO Box 160
Bethlehem, CT 06751-0160
(203) 266-7510 * fax (203) 266-7670

CERTIFICATE OF ADOPTION
TOWN OF BETHLEHEM BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE TOWN OF BETHLEHEM HAZARD MITIGATION PLAN UPDATE, 2015

WHEREAS, the Town of Bethlehem 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 Bethlehem Board of Selectmen approved the previous version of the Plan in 2009; and

WHEREAS, the Town of Bethlehem 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 in 2013 and 2014 regarding the development and review of the Hazard Mitigation Plan Update, 2015; and

WHEREAS, the Plan specifically addresses hazard mitigation strategies and Plan maintenance procedure for the Town of Bethlehem; and

WHEREAS, the Plan recommends several hazard mitigation actions/projects that will provide mitigation for specific natural hazards that impact the Town of Bethlehem, 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 Bethlehem 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 Bethlehem;
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.

Adopted this 6th **day of** Oct**, 2015 by the Board of Selectmen of Bethlehem, Connecticut**

First Selectman

IN WITNESS WHEREOF, the undersigned has affixed his/her signature and the corporate seal of the Town of Bethlehem this 8th day of Oct, 2015.

Kathleen Gallo

Town Clerk Kathleen Gallo