VALLEY COUNCIL OF GOVERNMENTS MULTI-JURISDICTION HAZARD MITIGATION PLAN

For Ansonia, Derby, Seymour, and Shelton

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LIST OF ACRONYMS

AEL	Annualized Earthquake Losses
ARC	American Red Cross
ARMS	Ansonia Rescue Medical Services
ASDSO	Association of Dam Safety Officials
ASFPM	Association of State Floodplain Managers
BCA	Benefit Cost Analysis
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BOCA	Building Officials and Code Administrators
CAM	Coastal Area Management
CDBG	Community Development Block Grant
CFS	Cubic Feet Per Second
CLEAR	Center for Land Use Education and Research (University of Connecticut)
CL&P	Connecticut Light & Power
CM	Centimeter
CRS	Community Rating System
CSPR	Coastal Site Plan Review
CTSDC	Connecticut State Data Center
DEEP	Department of Energy & Environmental Protection
DEMHS	Department of Emergency Management and Homeland Security
DEP	Department of Environmental Protection
DESPP	Department of Emergency Services and Public Protection
DFA	Dam Failure Analysis
DFIRM	Digital Flood Insurance Rate Map
DMA	Disaster Mitigation Act
DOT	Department of Transportation
EMD	Emergency Management Director
EMI	Emergency Management Institute
EMHS	Emergency Management and Homeland Security
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
FPMS	Floodplain management Services
GBRPA	Greater Bridgeport Regional Planning Agency
GIS	Geographic Information System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMTAP	Hazard Mitigation Technical Assistance Program

LIST OF ACRONYMS (Continued)

HUD	Housing and Urban Development
HURDAT	Hurricane Database (NOAA's)
HURISK	Hurricane Center Risk Analysis Program
ICC	International Code Council
IDF	Inflow Design Flood
ISTEA	Intermodal Surface Transportation Efficiency Act
KM/HR	Kilometers Per Hour
KT	Knot
LOMC	Letter of Map Change
MCEER	Multidisciplinary Center for Earthquake Engineering and Research
MMI	Milone & MacBroom, Inc.
MPH	Miles Per Hour
M/S	Meters Per Second
NAFSMA	National Association of Flood & Stormwater Management Agencies
NCDC	National Climatic Data Center
NEFSMA	New England Flood and Stormwater Managers Association, Inc.
NEHRP	National Earthquake Hazards Reduction Program
NEMA	National Emergency Management Association
NESEC	Northeast States Emergency Consortium
NESIS	Northeast Snowfall Impact Scale
NETAC	National Earthquake Technical Assistance Contract
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act
NOAA	The National Oceanic and Atmospheric Administration
NWS	National Weather Service
OLISP	Office of Long Island Sound Programs
PA	Public Assistance
PAL	Provisionally Accredited Levee
PDM	Pre-Disaster Mitigation
PMF	Probable Maximum Flood
RCP	Reinforced Concrete Pipe
RFC	Repetitive Flood Claims
RLP	Repetitive Loss Property
RWA	Regional Water Authority
SDF	Spillway Design Flood
SFHA	Special Flood Hazard Area
SLOSH	Sea, Lake and Overland Surges from Hurricanes
SRL	Severe Repetitive Loss
SRLP	Severe Repetitive Loss Property
SSURGO	Soil Survey Geographic
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental

LIST OF ACRONYMS (Continued)

TAC	Technical Assistance Contract
UI	United Illuminating
USD	United States Dollars
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VCOG	Valley Council of Governments
WAWTAC	Wind and Water Technical Assistance Contract
WPCA	Water Pollution Control Authority
WRSAME	Weather Radio Specific Area Message Encoder
WTP	Wastewater Treatment Plant

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EXECUTIVE SUMMARY

Valley Council of Governments
Multi-Jurisdiction Hazard Mitigation Plan

The Valley Council of Governments (VCOG) oversees regional planning for the four communities situated at the confluence of the Housatonic River and the Naugatuck River – the cities of Ansonia, Derby, and Shelton; and the town of Seymour. Although the regional planning area for the four communities is small in geographic extent, the region has a rich industrial history and comprises a portion of Connecticut's "All-American Valley" extending along the Naugatuck River. The region is bounded to the north, southwest, and southeast by the metropolitan areas of Waterbury, Bridgeport, and New Haven, respectively. As such, the VCOG region is a key crossroads in Connecticut, with close ties to the surrounding cities while maintaining its own distinct identity.

The VCOG coordinated the development of the region's first Multi-Jurisdiction Hazard Mitigation Plan. This plan represents the initial effort for hazard mitigation planning for Ansonia, Derby, and Seymour. The City of Shelton previously developed and adopted a hazard mitigation plan, and, with this regional effort, it has become a part of the Multi-Jurisdiction Hazard Mitigation Plan.

The purpose of a Hazard Mitigation Plan is to identify natural hazards and risks, existing capabilities, and activities that can be undertaken by communities to prevent loss of life and reduce property damages associated with identified hazards. The Disaster Mitigation Act of 2000 requires local communities to have a Federal Emergency Management Agency (FEMA)-approved mitigation plan in order to be eligible to receive Pre-Disaster Mitigation Program grants and Post-Disaster Hazard Mitigation Grant Program funds.

The Valley region's landscape has many different features that make the member communities particularly vulnerable to an array of natural hazards. These hazards include flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failures, wildfires, and landslides. This plan discusses each of these hazards in detail with the understanding that a particular hazard effect (i.e., damage from falling trees) can be caused by a variety of hazard events (e.g., high winds) that can be caused by a variety of storms (e.g., hurricanes, tropical storms, and winter storms).

The Valley communities are very resilient to disasters, with active emergency management officials in each municipality. None of the four Emergency Operations Centers are located within a FEMA-designated Special Flood Hazard Area (SFHA). The communities have a good understanding of their critical facilities, capabilities, and vulnerable populations. Shelters are available for residents of each community.

The Valley communities enjoy a relatively high level of flood protection from the Naugatuck River due to the dams and levee systems that were constructed subsequent to the devastating flood of 1955. However, flooding is persistent along the Housatonic River, which does not enjoy the same level of upstream flood protection, and significant flooding occurred three times in 2011, with the most recent flooding due to Tropical Storms Irene and Lee in August and September of that year. The City of Shelton has pursued funds for elevating homes in the Maples neighborhood on the west bank of the river, but additional mitigation is desired. Across the river in Derby, mitigation has not yet been undertaken on a large scale in the McConney Grove neighborhood along the river.

The Valley communities have different measures in place to prevent flood damage including regulations, codes, and ordinances preventing encroachments and development near floodplains and floodways. In the four VCOG municipalities, a total of 1,090 acres is located within the 500-year flood zone boundary, 2,574 acres are located within the SFHA (commonly known as the 100-year flood zone), four acres are located within the infrequently mapped Zone AO, and 291 acres are located within the "Zone X Protected by Levee" flood zone along the Naugatuck River levee system. Nuisance flooding occurs outside mapped flood zones throughout the municipalities as a result of poorly functioning drainage, low-lying roads, bridges and culverts with insufficient capacity, and other factors. Although development pressures are relatively low in the four communities, care must be taken to design new development and redevelopment such that flood damage prevention is ensured.

In the Valley region, wind damage occurs throughout the year as a result of thunderstorms, nor'easters and other winter storms, and the tropical systems that advance up the east coast. The amount of damage incurred from wind events is variable. Like many communities in Connecticut, the Valley communities suffered crippling tree damage and power outages from Tropical Storm Irene in August 2011 and then Winter Storm Alfred only two months later. These two events exposed weak points in the response capabilities of the two power utility companies that serve the region but have also spurred local governments to review their tree maintenance practices. The City of Derby noted that its aggressive tree maintenance program helped reduce power outages in Derby after storms Irene and Alfred.

There are two ancient geologic faults in the region: an overturned thrust fault called the East Derby Fault, which runs through the eastern portions of Ansonia, Derby, and Shelton and a high angle fault that runs through the middle portion of Seymour and the northwestern section of Ansonia, culminating in the middle of Osbornedale State Park. Both faults are inactive, and the Valley communities are unlikely to experience a damaging earthquake in any given year. However, as the region was reminded in 2011 when a quake struck northern Virginia and was felt throughout Connecticut, bedrock transmits earthquake waves great distances. The Valley communities were developed rapidly during the early part of the 20th century, and the building stock is comprised of many vulnerable structures. The redundancies offered by multiple shelters and municipal facilities in each community will help maximize resilience if an earthquake should occur.

Based on potential hazard as determined through the Connecticut Department of Energy & Environmental Protection's (CT DEEP) Dam Safety Section of the Inland Water Resources Division, the Valley municipalities include 11 Class C (high hazard) dams, seven Class B dams, seven Class BB dams, 22 Class A dams, and eight unclassified dams. Although none of the dams are believed to be in imminent danger of failure, the four communities are very interested in maintaining dams in good condition and developing emergency operations plans (EOPs) for the high hazard dams.

The VCOG municipalities are all at a relatively low risk for wildfires given the developed nature of the landscape and proximity to public water systems. Those areas at the highest risk are limited access forests outside the downtown areas where tanker and brush trucks must be relied on to fight a fire. In addition, agricultural fields and pastures are considered to be higher risk areas as they pose the potential to burn quickly during drought conditions.

Unlike many other communities in Connecticut, the Valley communities experience damaging landslides. For example, a home was in great danger of succumbing to a landslide in downtown Shelton in 2009. These landslide hazards will continue to be a problem because of the dense development located on steep slopes in all four of the communities. Although much of this development dates back many years, this plan encourages the municipalities to carefully regulate new development that may be on or near slopes.

A variety of recommendations are listed in this plan. These recommendations are applicable to each hazard type. Recommendations are summarized in Sections 11.1 and 11.2. Section 11.3 summarizes the highest-ranking recommendations based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) analysis and a review of the communities' vulnerabilities. Some of the top recommendations include elevation of floodprone structures, acquisition of lands within SFHAs, technical assistance for owners of repetitive loss properties, providing standby power to shelters, developing site-specific evacuation plans for critical facilities located in flood zones, replacement of drainage facilities and culverts to reduce nuisance flooding in a number of specific areas, increased tree and tree limb maintenance, and development of EOPs for high-hazard dams.

1.0 INTRODUCTION

1.1 Background and Purpose

The term *hazard* refers to an extreme natural event that poses a risk to people, infrastructure, or resources. In the context of 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. This HMP is prepared specifically to identify hazards in the VCOG municipalities (Ansonia, Derby, Seymour, and Shelton) or "communities" as FEMA would call them. This HMP is relevant not only in emergency management situations but should also be used within the VCOG communities' land use, environmental, and capital improvement frameworks and wherever else is reasonable.

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 five competitive grant programs designed to mitigate the impacts of natural hazards.

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

Pre-Disaster Mitigation (PDM) Program

The PDM program was authorized by Part 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133. In Connecticut, the PDM program is administered by the Connecticut Department of Energy & Environmental Protection (DEEP), formerly known as the Department of Environmental Protection (DEP) until its consolidation with another agency in 2011.

The PDM program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and implementation of mitigation projects prior to disasters, providing an opportunity to reduce the nation's disaster losses through pre-disaster mitigation planning and the implementation of feasible, effective, and cost-efficient mitigation measures. Funding of pre-disaster plans and projects is meant to reduce overall risks to populations and facilities. PDM funds should be used primarily to support mitigation activities that address natural hazards. In addition to providing a vehicle for funding, the PDM program provides an opportunity to raise risk awareness within communities. The grant to prepare this HMP was through the PDM program.

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

Hazard Mitigation Grant Program (HMGP)

The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. In Connecticut, the HMGP is administered by the Connecticut Department of Emergency Services and Public Protection (DESPP), formerly known as the Department of Emergency Management and Homeland Security (DEMHS) until its consolidation with another agency in 2011.

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 City of Shelton has previously applied for HMGP grants for flood mitigation in the Maples neighborhood as described in Section 3.0 of this HMP.

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 NFIP. In Connecticut, the FMA program is administered by the DEEP.

FEMA provides FMA funds to assist states and communities with implementing measures that reduce or eliminate the long-term risk of flood damage to buildings, homes, and other structures insurable under the NFIP. The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. Three types of grants are available under FMA. These are planning, project, and technical assistance grants. FMA funds have not been utilized in the VOCG region.

Repetitive Flood Claims (RFC) Program

The RFC grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the National Flood Insurance Act (NFIA) of 1968. In Connecticut, the RFC program is administered by the DEEP.

Up to $10 million is available annually for FEMA to provide RFC funds to assist states and communities in reducing flood damages to insured properties that have had one or more damage claims under the NFIP. FEMA may contribute up to 100% of the total amount approved under the RFC grant award to implement approved activities if the applicant has demonstrated that the proposed activities cannot be funded under the FMA program. RFC funds have not been utilized in the VCOG region.

Severe Repetitive Loss (SRL) Program

The SRL grant program was authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, which amended the NFIA of 1968 to provide funding to reduce or eliminate the long-term risk of flood damage to SRL structures insured under the NFIP. In Connecticut, the SRL program is administered by the DESPP.

The SRL program is meant to reduce or eliminate claims under the NFIP through project activities that will result in the greatest savings to the NFIP. A SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and (a) has at least four NFIP claim payments (including building and contents) over $5,000 each, with the cumulative amount of such claims payments exceeding $20,000; or (b) for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both (a) and (b), at least two of the claims must have occurred within any 10-year period and must be greater than 10 days apart. SRL funds have not been utilized in the VCOG region

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 HMP is expected to:

- ***Increase access to and awareness of funding sources for hazard mitigation projects.*** Certain funding sources, such as the PDM and HMGP, may be available if the HMP is in place and approved.

- ***Identify mitigation initiatives to be implemented if and when funding becomes available.*** This HMP will identify a number of mitigation recommendations, which can then be prioritized and acted upon as funding allows.

- ***Connect hazard mitigation planning to other community planning efforts.*** This HMP can be used to guide the VCOG communities' development through interdepartmental and intermunicipal coordination.

- ***Improve the mechanisms for pre-disaster and post-disaster decision-making efforts.*** This HMP 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.

- ***Complement future Community Rating System (CRS) efforts.*** Implementation of certain mitigation measures may increase a community's rating with the NFIP program and thus the benefits that it derives from FEMA. At this time, the municipalities of VCOG do not participate in the CRS, but they may in the future.

1.3 Identification of Hazards and Document Overview

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

Flooding	Earthquakes
Hurricanes and Tropical Storms	Dam Failure
Summer Storms and Tornadoes	Wildfires
Winter Storms and Nor'easters	Landslides

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 1-1, 1-2, and 1-3 on the following pages provide summaries of the hazard events and hazard effects that impact the VCOG towns 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. 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.

TABLE 1-1
Effects of Natural Hazards

Natural Hazard	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Wildfires	Earthquakes	Landslides	Dam Failure
Inland Flooding	X	X					X
Flooding from Poor Drainage	X	X					
Coastal Flooding (tidal portion of Housatonic River)	X		X				
Storm Surge (tidal portion of Housatonic River)	X		X				
Wind	X	X	X				
Falling Trees/Branches	X	X	X				
Lightning	X	X					
Hail		X					
Snow			X				
Blizzard			X				
Ice			X				
Fire/Heat				X			
Smoke				X			
Shaking					X		
Dam Failure					X	X	X
Power Failure	X	X	X	X	X	X	
Landslides	X	X	X		X	X	

Table 1-2
Hazard Event Ranking

Each hazard may have multiple effects; for example, a hurricane causes high winds, inland flooding, and a storm surge. Some hazards may have similar effects; for example, hurricanes and tornadoes both cause high winds.

Natural Hazards	**Location**	**Frequency of Occurrence**	**Magnitude / Severity**	**Rank**
	1 = small **2 = medium** **3 = large**	**0 = unlikely** **1 = possible** **2 = likely** **3 = highly likely**	**1 = limited** **2 = significant** **3 = critical** **4 = catastrophic**	
Winter Storms	3	3	2	8
Hurricanes and Tropical Storms	3	2	3	8
Summer Storms and Tornadoes	2	3	2	7
Earthquakes	3	1	2	6
Landslides	1	3	1	5
Wildfires	1	2	1	4
Dam Failure	1	1	1	3

Location

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

Frequency of Occurrence

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

Magnitude / Severity

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

Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA National Climatic Data Center

Table 1-3
Hazard Effect Ranking

Some effects may have a common cause; for example, a hurricane causes high winds, inland flooding, and a storm surge.
Some effects may have similar causes; for example, hurricanes and tornadoes both cause high winds.

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

Location

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

Frequency of Occurrence

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

Magnitude / Severity

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

Frequency of Occurrence, Magnitude / Severity, and Potential Damages based on historical data from NOAA National Climatic Data Center

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

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

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

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

- ***Existing Programs, Policies, Capabilities, and Mitigation*** gives an overview of the measures that the VCOG towns are currently undertaking to mitigate the given hazard. These may take the form of ordinances and codes, structural measures such as dams, or public outreach initiatives.

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

- ***Potential Mitigation Measures, Strategies, and Alternatives*** identifies mitigation alternatives, including those that may be the least cost effective or inappropriate for the VCOG towns.

- ***Summary of Recommended Mitigation Measures, Strategies, and Alternatives*** provides a summary of the recommended courses of action for the VCOG towns that is included in the STAPLEE analysis described below.

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

1.4 Discussion of STAPLEE Ranking Method

To prioritize recommended mitigation measures, it is necessary to determine how effective each measure will be in reducing or preventing damage. A set of criteria commonly used by public administration officials and planners was applied to each proposed strategy. The method, called STAPLEE, is outlined in FEMA planning documents such as *Developing the Mitigation Plan* (FEMA 386-3) and *Using Benefit-Cost Review in Mitigation Planning* (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic, and Environmental" criteria for making planning decisions.

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

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

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

- **Administrative**:
  - Benefits: Does the project make it easier for the communities to administer future mitigation or emergency response actions?
  - Costs: Do the VCOG towns have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the VCOG towns 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: Do the VCOG towns have the authority to implement the proposed action? Are there any potential legal consequences? Will the communities be liable for the actions or support of actions or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

- **Economic**:
  - Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals, such as capital improvements or economic development?
  - Costs: Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? What proposed actions should be considered but be 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 or a "0" if the project would have a negligible effect or if the questions were not applicable to the strategy.
- For potential costs, a score of "-1" was assigned if the project would have an unfavorable impact for that particular criterion or a "0" if the project would have a negligible impact or if the questions were not applicable to the strategy.
- Technical and economic criteria were double weighted (x2) in the final sum of scores.
- The total benefit score and cost score for each mitigation strategy were summed to determine each strategy's final STAPLEE score.

An evaluation matrix with the total scores from each strategy can be found in Appendix A. Strategies are prioritized in Section 11.3 according to final score. The highest scoring is determined to be of more importance economically, socially, environmentally, and politically and, hence, prioritized over those with lower scoring.

1.5 Discussion of Benefit-Cost Ratio

Although a community may implement recommendations as prioritized by the STAPLEE method, an additional consideration is important for those recommendations that may be funded under the FEMA mitigation grant programs. To receive federal funding, the mitigation action must have a benefit-cost ratio (BCR) that exceeds one. Calculation of the BCR is conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation may be complex, varying with the mitigation action of interest, and 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.

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

Provision of cost estimates for recommendations is inappropriate 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. However, the potential cost of each recommendation is listed as "low," "intermediate," or "high" in Part 2 of Appendix A. These are defined as follows:

- "Low" costs have either no cost or they can be handled by existing municipal personnel with few outside expenses.
- "Intermediate" costs would require less than $100,000 to implement and may include studies or investigations.
- "High" costs would require a greater level of funding with identified sources of the funding and may include capital expenditures for construction or infrastructure.

1.6 Documentation of the Planning Process

The development of the plan was funded through a PDM planning grant received from FEMA via the Connecticut DEEP.

Each VCOG municipality's Emergency Management Director (EMD) coordinated the development of this HMP. Additionally, Mr. David Elder and Mr. Rick Dunne at VCOG offered support of the subject HMP throughout its development. The representatives from each municipality are listed below:

- Kevin Hale, City of Ansonia Chief of Police Department and EMD
- Charles Sampson, City of Derby EMD
- Thomas Eighmie, Town of Seymour EMD
- John Millo, City of Shelton EMD

Milone & MacBroom, Inc. (MMI) developed the subject plan working with the EMDs and VCOG personnel listed above. In addition, the following individuals from the VCOG member municipalities provided information, data, studies, reports, photographs, and observations and were involved in the development of the HMP for their communities:

Ansonia

- Fred D'Amico, City of Ansonia City Engineer
- Michael Schryver, City of Ansonia Director of Public Works

Derby

- Ron Culmo, Derby Public Works Department
- Michael Joyce, Derby City Engineer

Shelton

- Daniel Bednarsky, Assistant Director of the Office of Emergency Management
- Joel Hurliman, Chief of Police Department
- Jim Tortora, Fire Marshal
- Nick Verdicchio, Assistant Chief of the Fire Department
- John Anglace, Shelton Board of Aldermen
- Karen Spargo, Naugatuck Valley Health District Director of Health
- Matt Lawrence, Shelton Fire No. 3
- William Dimas, Shelton Fire No. 3
- Charlene DeFilippo, Grants Coordinator of the City of Shelton
- Bob Kulacz, City of Shelton
- Paul DiMauro, City of Shelton
- Michael Chaffee, Echo House Ambulance
- Eugene Kiever, Guest

Seymour

- Tim Willis, Deputy Fire Marshal and Deputy EMD

An extensive data collection, evaluation, and outreach program was undertaken to compile information about existing hazards and mitigation in the VCOG municipalities as well as to identify areas that should be prioritized for hazard mitigation. Appendices B through D contain copies of meeting minutes, the public information meeting presentation, and other records that document the development of this HMP. The following is a list of meetings that were held as well as other efforts to develop this HMP:

- ***Field reconnaissance was conducted on September 8, 2011.*** Observations were made of problem areas within the VCOG municipalities based on preliminary correspondence with local officials following Tropical Storm Lee.

- ***A project kickoff meeting with the Pre-Disaster Mitigation Committee and both VCOG representatives was held October 17, 2011 at the VCOG office.*** The scope of the project was overviewed, and a conversation about necessary information (with little collection) and a discussion of more formal data collection with each VCOG municipality took place. Meeting minutes and a *PowerPoint* presentation are attached in Appendix B.

- ***A project meeting with City of Ansonia department heads was held on November 3, 2011.*** Necessary documentation was collected, and problem areas within the town were discussed. Meeting minutes are attached in Appendix B.

- ***A project meeting with City of Derby department heads was held on November 9, 2011.*** Necessary documentation was collected, and problem areas within the town were discussed. Meeting minutes are attached in Appendix B.

- ***A project meeting with City of Shelton department heads was held on November 17, 2011.*** Necessary documentation was collected, and problem areas within the town were discussed. Meeting minutes are attached in Appendix B.

- ***A project meeting with Town of Seymour department heads was held on November 30, 2011.*** Necessary documentation was collected, and problem areas within the town were discussed. Meeting minutes are attached in Appendix B.

- ***A public information meeting was held on December 1, 2011 at 7:00 p.m.*** Announcements for the meeting were distributed to the *Connecticut Post*, the *Huntington Herald*, the "Valley" section of the *New Haven Register*, the *Shelton Patch*, the *Valley Gazette*, and the *Valley Independent Sentinel*. The announcements in the *Shelton Patch*, the *Valley Independent Sentinel*, the *Huntington Herald*, and the *Valley Gazette* were observed. The project was presented, and public comments were solicited. The newspaper announcements, a copy of the *PowerPoint* presentation, and the sign-in sheet are provided in Appendix C.

The adoption of this plan in each municipality will be conducted by the Board of Aldermen (Ansonia, Derby, Shelton) and the Board of Selectmen (Seymour). Meetings to adopt the plan will be held in late 2012 subsequent to conditional approval from FEMA. Resolutions for each community are included in Appendix D.

<u>Public Involvement</u>

Residents, business owners, and other stakeholders of the VCOG municipalities, neighboring communities, and local and regional agencies were invited to the public information meeting via the press releases announcing the December 1, 2011 meeting in the newspapers and the community-specific news and information internet-based web site. A press release described the planning process in these sources of media. Copies of these announcements are included in Appendices C and D as noted above.

A total of six residents attended the initial public meeting on December 1, 2011. Mr. David Elder of VCOG and Ms. Holly Dominie of FEMA also attended. Some of the comments were related to the response of the utility companies and the municipalities after Winter Storm Alfred, which had occurred only four weeks earlier. One resident offered that the Route 8 on ramp in Seymour flooded with up to three feet of water during an intense storm on June 8, 2011.

Final opportunities for the public to review the HMP will be implemented in advance of the public hearings to adopt this HMP, tentatively scheduled for late 2012, contingent on receiving conditional approval from FEMA. The draft that is sent for FEMA review will be posted on the VCOG's and municipalities' websites as follows:

- http://www.valleycog.org/
- http://www.cityofansonia.com/
- http://electronicvalley.org/derby/
- http://www.seymourct.org/
- http://www.cityofshelton.org/

A draft of the HMP will be made available in the main library of each municipality. All locations will provide a public platform giving residents opportunities for public review and comment. Comments received from the public will be incorporated into the final draft where applicable.

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

1.7 Coordination with Neighboring Communities

The VCOG communities have coordinated with neighboring municipalities in the past relative to hazard mitigation and emergency preparedness and continue to do so. The adjacent municipalities (and their status relative to developing their own hazard mitigation plans) are as follows:

- Stratford – Local hazard mitigation plan approved and adopted
- Trumbull – Multi-jurisdiction hazard mitigation plan developed by the Greater Bridgeport Regional Planning Agency (GBRPA), approved, and adopted
- Monroe – Multi-jurisdiction hazard mitigation plan developed by the GBRPA and approved
- Oxford – Local hazard mitigation plan approved and adopted
- Beacon Falls – Local hazard mitigation plan approved and adopted
- Bethany – Multi-jurisdiction hazard mitigation plan to be developed in 2012-2013
- Woodbridge – Multi-jurisdiction hazard mitigation plan to be developed in 2012-2013
- Orange – Multi-jurisdiction hazard mitigation plan to be developed in 2012-2013
- Milford – Local hazard mitigation plan approved and adopted

Watercourses and maps referenced below are described more fully in Section 3.0 of this HMP.

The towns of Stratford and Trumbull share few common watersheds with Shelton. However, the Farmill River forms the Shelton-Stratford boundary for a short distance, and this part of the river is moderately floodprone (Figure 3-23). Upstream, the headwaters of the Farmill River (where the Shelton, Trumbull, and Monroe boundaries meet) are moderately floodprone, as noted in the Multi-jurisdiction Hazard Mitigation Plan for the GBRPA. If any future efforts are undertaken for comprehensively evaluating flood mitigation opportunities along the Farmill River (Figures 3-15, 3-18, 3-20, and 3-23), the towns of Trumbull, Monroe, and Stratford should be encouraged to work with the City of Shelton.

The town of Oxford shares the same flooding issues along the Housatonic River that are experienced in Shelton, Seymour, and Derby (Figures 3-9, 3-12, and 3-22). In fact, some of the more significant residential losses along the river have occurred in Oxford, immediately upstream of Seymour and Shelton. If the operators of the Stevenson Dam and the Derby Dam are approached in the future regarding opportunities to reduce flooding or increase notification of flood conditions, then Oxford should be encouraged to work with the VCOG communities.

The headwaters of the Little River (Figure 3-14) are located in Oxford, upstream of Seymour. Although the Little River is not a significantly floodprone river, flooding does occur occasionally, and the towns of Oxford and Seymour should work together to address flooding on a watershed basis if necessary.

The headwaters of Bladens River (Figure 3-13) are located in Bethany and Woodbridge, upstream of Seymour. The Bladens River is relatively more floodprone than the Little River. The towns of Bethany, Woodbridge, and Seymour should work together to address flooding on a watershed basis if necessary.

Beacon Falls is the community upstream of Seymour, Ansonia, and Derby along the Naugatuck River. However, the Naugatuck River flood control projects completed in the 1950s and 1960s by the U.S. Army Corps of Engineers are located well upstream of Beacon Falls. Actions in Beacon Falls have little impact on flood conditions of the Naugatuck River, so opportunities for coordinated planning of Beacon Falls with the VCOG communities are limited.

The town of Orange shares few watershed areas with Derby although the Two Mile Brook has some watershed area in Orange prior to flowing through parts of eastern Derby. This brook is moderately floodprone in Derby (in the Sodom Lane area, Figure 3-10) and, therefore, coordinated efforts for flood mitigation with the town of Orange may be appropriate.

Because it is located across the tidal portion of the Housatonic River from Shelton, the community of Milford does not share watersheds, steep slopes, or other geographic features with the VCOG communities.

Most of the wildfire risk areas in the VCOG communities (Figure 9-1) are located internal to the municipalities. However, one of the risk areas in Seymour is located in close proximity to the Woodbridge border. Woodbridge fire personnel may be invited to fight fires in this area if they occur.

The VCOG communities anticipate that future coordination with surrounding municipalities will be described in updates to this HMP.

2.0 COMMUNITY PROFILES

2.1 Physical Setting

The VCOG communities are located in the section of Connecticut famously termed "the Valley" as the geographic features include a classic valley that the two major flowing water bodies (the Housatonic and Naugatuck Rivers) both flow through. With a northeast to southwest orientation, the VCOG municipalities span a distance of 12 miles from northeast to southwest and are approximately seven and one half miles wide at the area's widest point from the northwest corner of Shelton to the easternmost point in Derby. These size characteristics result in a total land area of roughly 58.5 square miles. Refer to Figure 2-1 for a map showing the regional location of the VCOG municipalities.

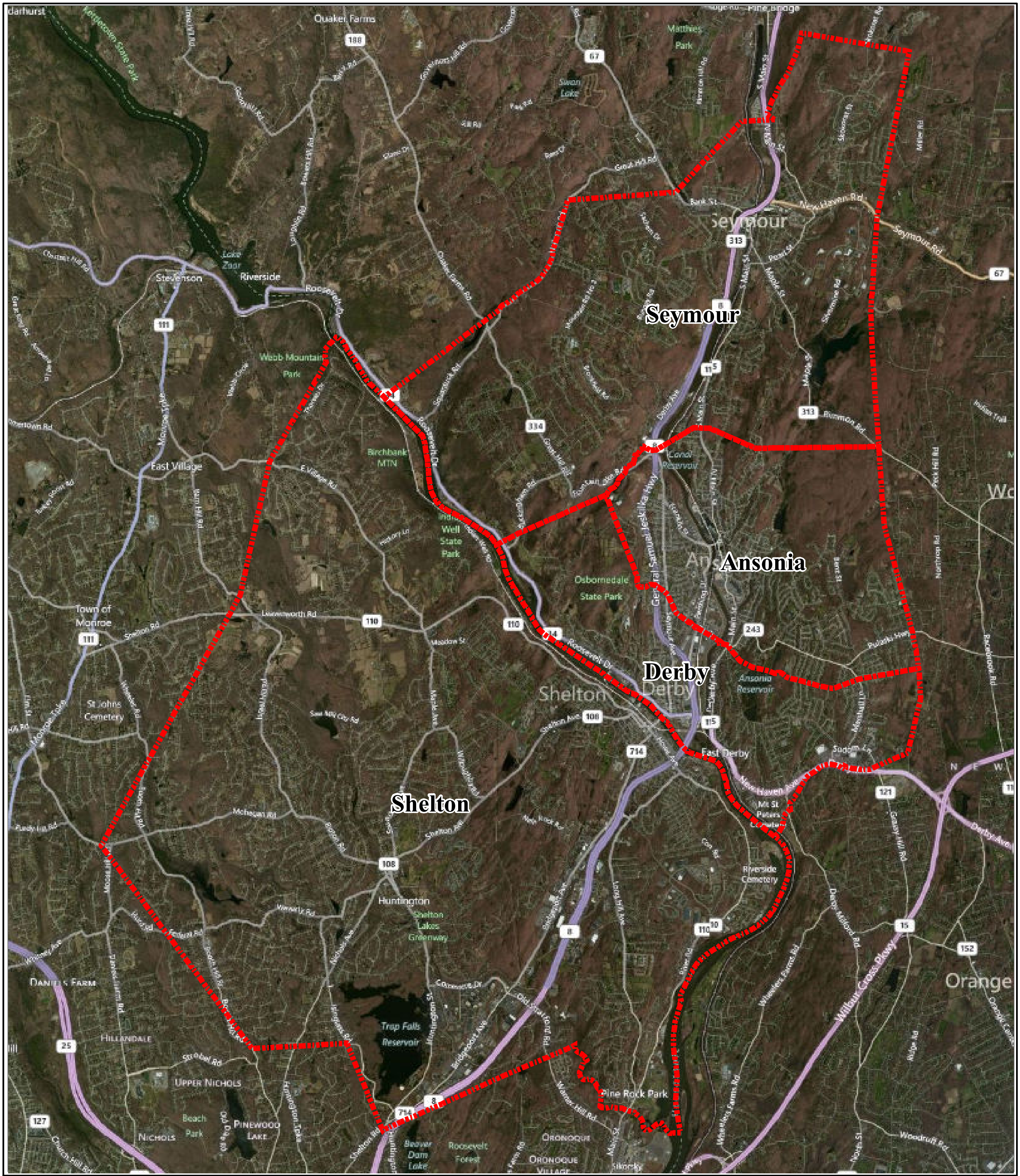
The VCOG region straddles the New Haven County/Fairfield County line at the Housatonic River. The New Haven County municipalities (Ansonia, Derby, and Seymour) are three of the 27 municipalities that comprise New Haven County while the City of Shelton is one of the 23 municipalities that comprise Fairfield County. Ansonia was first settled in 1652 and named in honor of Anson Phelps, who was a well-established area businessman. Derby and Seymour were both first settled in 1642 when land that covers both municipalities was settled as an Indian trading post under the name Paugasset. Shelton was first settled by the English in 1639 as part of the town of Stratford and subsequently split from Stratford in 1789.

Ansonia, Derby, and Seymour specifically lie within the landscape region of Connecticut called the "Naugatuck River Valley," which extends from Torrington to Derby and includes the city of Waterbury. The Route 8 corridor and the Waterbury branch of the Metro-North railroad line span this region. The "Lower Naugatuck Valley" is sometimes known to include the towns of Oxford, Bethany, Beacon Falls, and Woodbridge in addition to Ansonia, Derby, and Seymour.

Conversely, the City of Shelton is often associated with its fellow communities of Fairfield County given the suburban nature of much of the city. Nevertheless, the downtown area of Shelton has much in common with the Lower Naugatuck Valley communities.

All four Valley communities are members of the VCOG. For this reason, this HMP refers to them collectively as the "VCOG region," "Valley region," or simply the "region" from this point forward.

In general, the topography of the region increases in elevation moving from the shorelines of the major rivers (the Housatonic and Naugatuck Rivers, which are nearly at sea level) to the east and/or west of either river. Within the region, elevations of 500 feet or greater are found along western and southwestern Seymour and western Shelton while there are a few other smaller, more concentrated areas of this elevation in northern and eastern Seymour and northeastern Ansonia.



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
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Figure 2-1: Location Map

LOCATION:
Ansonia, Derby, Seymour & Shelton, CT

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\LocMap_8.5x11.mxd
1st Version: 3/1/2012
Revision: 3/12/2012
Scale: 1 inch = 7,000 feet

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The highest elevation in Shelton is approximately 620 feet just north of Walnut Tree Hill Road near the Monroe town line while the highest elevation in Ansonia is approximately 530 feet just to the north of the military reserve at the end of Osborne Lane in Woodbridge. Derby has a high elevation of 440 feet in the Derby Hill section, in the area of Iannotti Lane, along the border with Ansonia. Seymour has a peak of approximately 640 feet in the southwestern part of the town on Great Hill along Route 334/Great Hill Road. The mean elevation of the region is approximately 310 feet.

The areas with greatest relief are found in western Shelton (west of Walnut Tree Hill Road) and southwestern Seymour (at Great Hill) where elevations of 630 feet to 640 feet can be found.

2.2 Existing Land Use

High-density industrial centers developed in the 19th and 20th centuries in downtown Ansonia, Derby, Seymour, and Shelton, and these remain the highest-density parts of the region. A decrease in developed land cover is evident with greater distance from either river. The majority of the rural and farmland cover is found in northwest Shelton, northwest Derby, and southwest Seymour. Smaller pockets of open space and rural land cover are found in other sections of the region.

According to the University of Connecticut Center for Land Use Education and Research (CLEAR), land use in the region includes but is not limited to agriculture, barren land, deciduous and coniferous forests, forested wetlands, nonforested wetlands, tidal wetlands, open water, and developed land cover. Despite their urban cores, the VCOG municipalities are suburban on the whole, with populations that flourished during the last century as Connecticut's highway network was superimposed on its historical industrial centers.

Table 2-1 summarizes the VCOG municipalities' 2006 land cover data, which was derived from satellite imagery. According to this data, close to 40% of the VCOG region's approximately 58.5 square miles is either developed or deciduous forest.

TABLE 2-1
Land Cover by Area (2006)

Land Cover	Area (acres)	Percent of VCOG Municipalities
Deciduous Forest	14,837.51	39.40
Developed	13,109.76	34.81
Agricultural Field	1,363.66	3.62
Water	1,656.40	4.40
Coniferous Forest	1,016.85	2.70
Turf & Grass	4,112.65	10.92
Forested Wetland	485.77	1.29

Land Cover	Area (acres)	Percent of VCOG Municipalities
Other Grasses	386.40	1.03
Barren	568.30	1.51
Non-Forested Wetland	47.35	0.13
Tidal Wetland	1.69	0.004
Utility ROWs (Forest)	71.71	0.19
Total	**37,658.05**	**100**

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

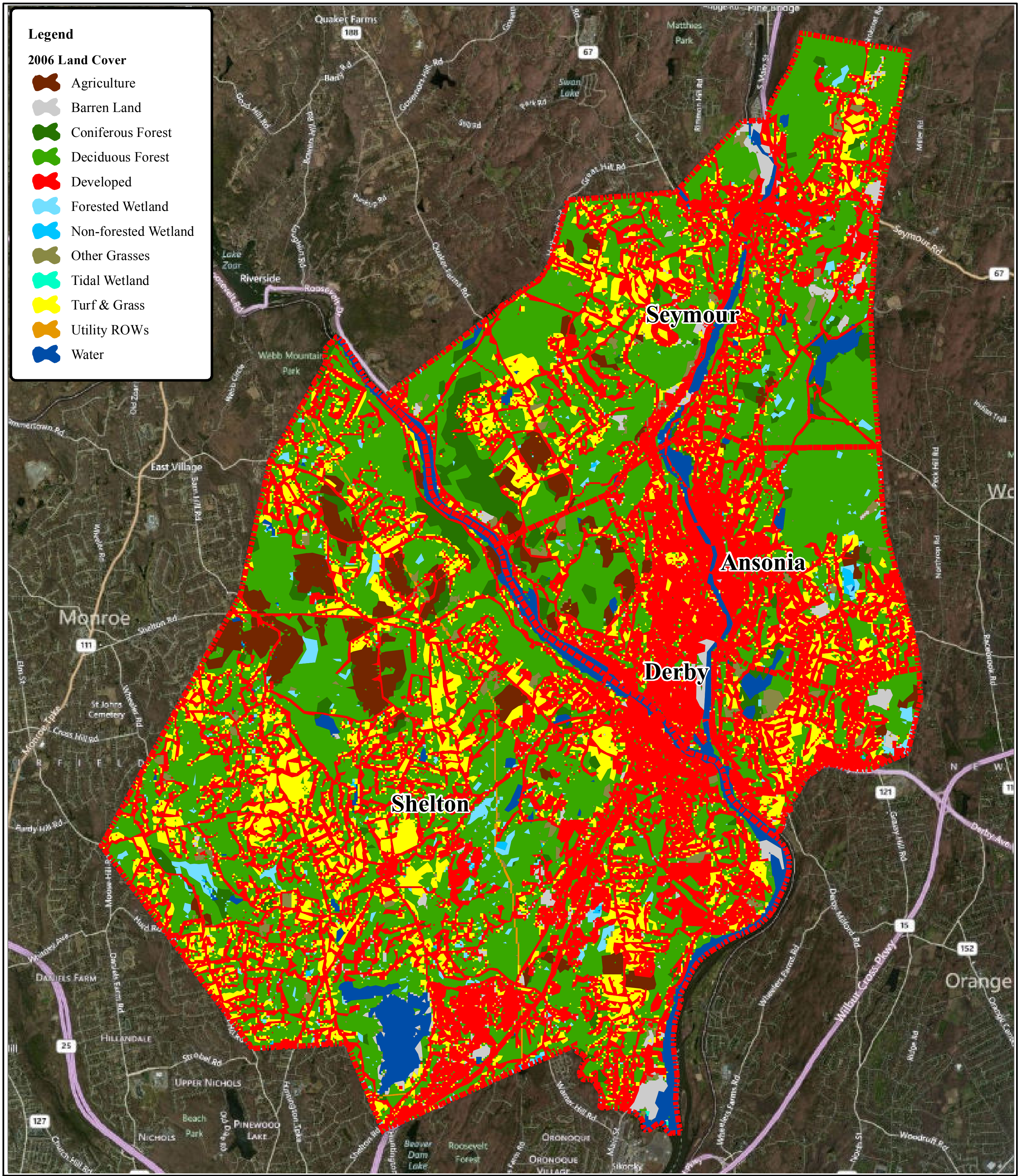
Figure 2-2 presents generalized land uses based on the 2006 land cover data. Areas shown as turf and grass are maintained grasses such as residential and commercial lawns or golf courses. The far western portion of the region in Shelton is predominantly forested along with northeastern Ansonia and southeastern and northern Seymour. Agricultural land use is minimal in Ansonia while the landcover type is distributed sparsely throughout Seymour and Derby and more densely concentrated in the northern section of Shelton. A few areas in southeastern Shelton are covered by agricultural land as well. Although residential land uses are interspersed throughout the VCOG municipalities, higher density residential and nonresidential land uses are situated near the Naugatuck and Housatonic Rivers and the Route 8 corridor as previously mentioned.

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 the region. The following discussion highlights the region's geology at several scales. Geologic information discussed in the following section was acquired in Geographic Information System (GIS) format from the United States Geological Survey and the Connecticut DEEP.

> ***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.

In terms of North American bedrock geology, the VCOG municipalities are located in the northeastern part of the Appalachian Orogenic Belt, also known as the Appalachian Highlands, which extend from Maine southward to Mississippi and Alabama. The Appalachian Highlands were formed when Pangaea assembled during the late Paleozoic era. The region is generally characterized by deformed sedimentary rocks cut through by numerous thrust faults.



SOURCE(S):

Base Map:
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"2006 Land Cover" Datalayer
2009 University of Connecticut
Center for Land Use Eduacation
and Research (CLEAR)

Figure 2-2: 2006 Land Cover

LOCATION: **Ansonia, Derby, Seymour & Shelton, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-2_LandCover.mxd
1st Version: 3/1/2012
Revision: 3/26/2012
Scale: 1 inch = 7,000 feet

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The region contains various bedrock types, which lie in fairly diagonal bands stretching from northeast to southwest in the same general orientation as the region. The region accounts for 15 different bedrock zone types. The various bedrock types are depicted in Figure 2-3. Bedrock maps are generalized, so many borders between rock types are approximate. Table 2-2 lists the bedrock geology within the VCOG municipalities.

TABLE 2-2
Bedrock Geology

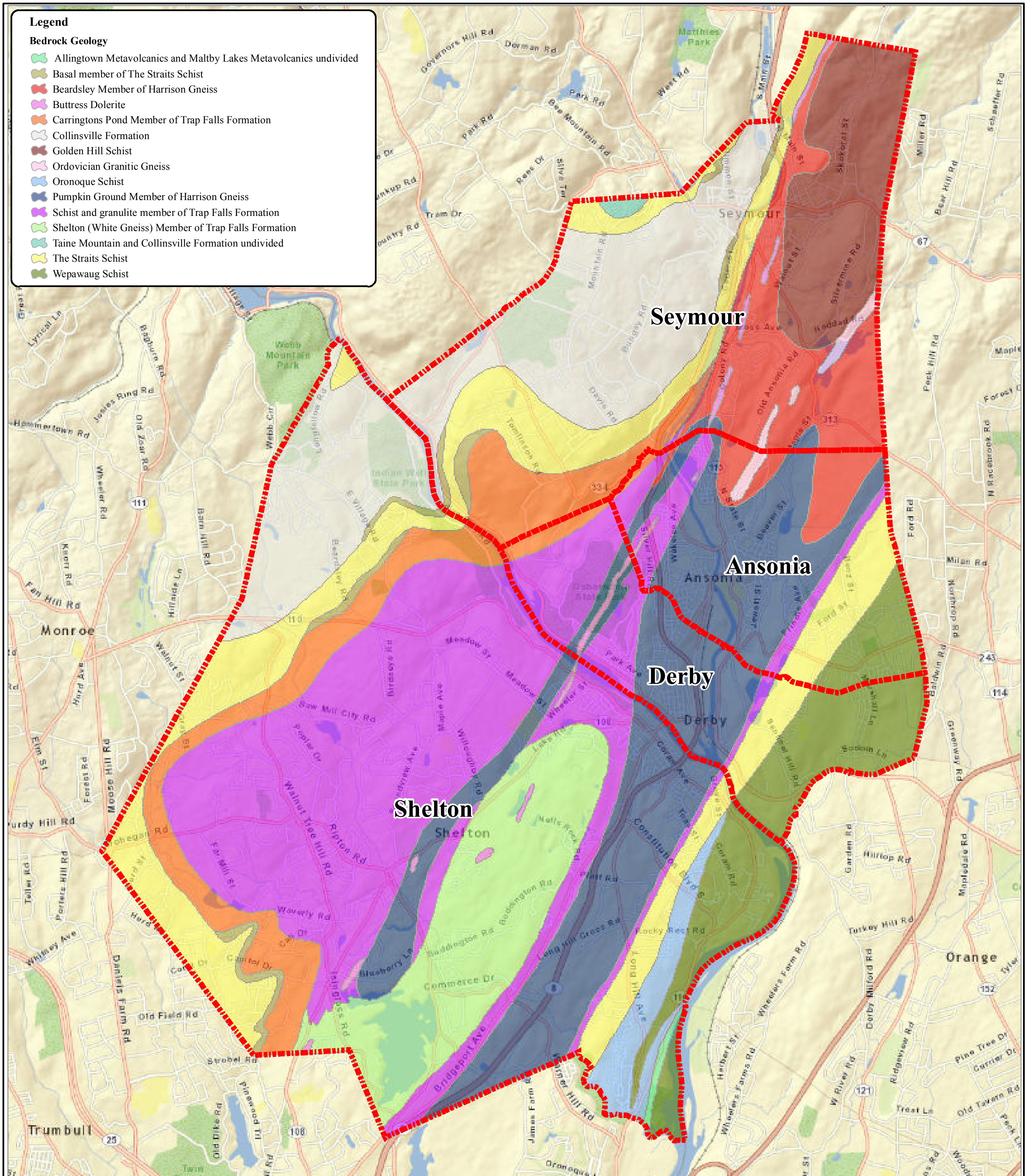
Formation	Area (acres)	Percent of Region
Wepawaug Schist	2,652.35	7.08
The Straits Schist	4,519.10	12.07
Buttress Dolerite	183.16	0.49
Taine Mountain and Collinsville Formation Undivided	51.14	0.14
Shelton (White Gneiss) Member of Trap Falls Formation	2,974.88	7.94
Schist and Granulite Member of Trap Falls Formation	8,592.36	22.95
Pumpkin Ground Member of Harrison Gneiss	5,706.50	15.24
Oronoque Schist	604.42	1.61
Ordovician Granite Gneiss	144.60	0.39
Golden Hill Schist	1,891.44	5.05
Collinsville Formation	5,035.16	13.45
Carringtons Pond Member of Trap Falls Formation	2,468.30	6.59
Basal Member of The Straits Schist	361.83	0.97
Beardsley Member of Harrison Gneiss	2,201.49	5.88
Allingtown Metavolcanics and Maltby Lakes Metavolcanics Undivided	57.98	0.15
Total	**37,444.71**	**100%**

Source: Connecticut Department of Energy & Environmental Protection GIS Data

As shown numerically in Table 2-2 and visually in Figure 2-3, the Schist and Granulite Member of the Trap Falls Formation dominates the bedrock geology of the region, accounting for almost 23% of the land coverage. The Schist and Granulite Member of the Trap Falls Formation is interlayered gray to silvery, medium- to coarse-grained schist and fine-grained granofels. The Schist and Granulite Member of the Trap Falls Formation is of the Iapetos (Oceanic) Terrane of the Connecticut Valley Synclinorium and is of the middle or lower Ordovician geologic age.

The next three largest formations in order from largest to smallest are:

- Pumpkin Ground Member of Harrison Gneiss Formation: This formation contains gray to spotted, medium- to coarse-grained, foliated gneiss.
- Collinsville Formation: Comprised of gray and silvery, medium- to coarse-grained schist and dark, fine- to medium-grained amphibolites and hornblende gneiss.
- The Straits Schist Formation: Consists of silvery to gray, coarse-grained schist.



SOURCE(S):

Base Map:
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and its data suppliers

"Bedrock Geology" Datalayer
1985 CT DEEP

Figure 2-3: Bedrock Geology

LOCATION: **Ansonia, Derby, Seymour & Shelton, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-3_Bedrock.mxd
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Revision: 3/26/2012
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One main fault, the "East Derby Fault," is orientated from northeast to southwest and runs to the east of Route 8 through the eastern portion of Ansonia, Derby, and Shelton. Upon reaching the Shelton town line, the fault and the roadway are generally positioned in the same orientation from northeast to southwest. The East Derby Fault stretches from Bethany southwest to Bridgeport over a span of approximately 16.25 miles. The fault is classified as "FTO," an overturned thrust fault, and is currently inactive. There is one geologic contact (classified as "C") that branches off the East Derby Fault in Shelton.

Glaciers began forming in the northern hemisphere about three million years ago. Since then, the southernmost portions of these glaciers covered the region on at least two occasions. At the end of the ice age, the last of the glaciers' mineral holdings were released with the melting ice. The region's different formations born of bedrock while exposed to hydrological, atmospheric, and glacial processes include glacial till, stratified drift, rivers and lakes, outwash plains, and coastal formations. Refer to Table 2-3 and Figure 2-4 for a depiction of surficial geology.

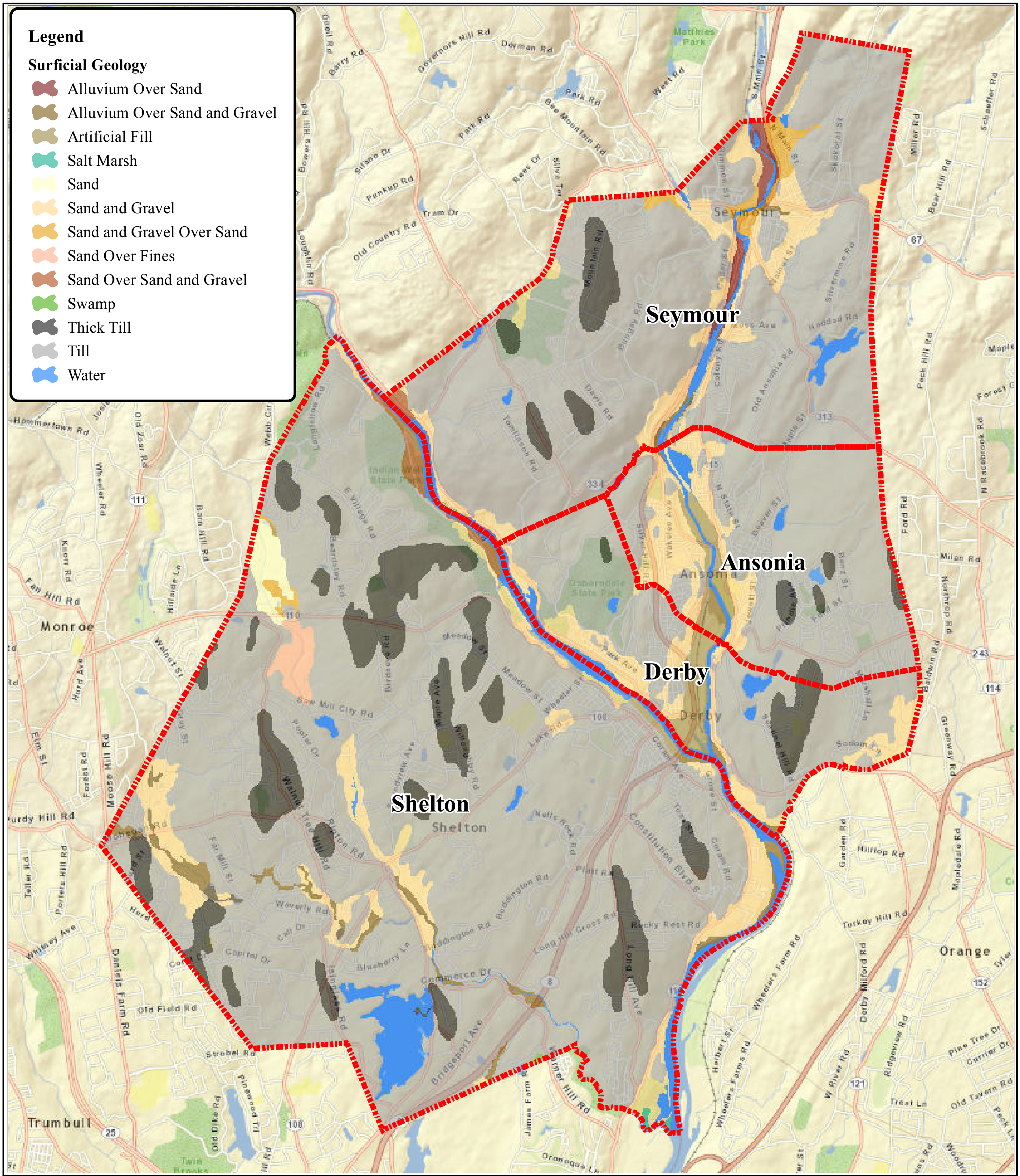
The amount of stratified drift present in the region is important as areas of stratified materials are generally coincident with inland floodplains. These materials were deposited at lower elevations by glacial streams, and these valleys were later inherited by the larger of our present day streams and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

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

TABLE 2-3
Surficial Geology

Surficial Material	Area (acres)	Percent of Region
Alluvium overlying sand	115.54	0.31
Alluvium overlying sand and gravel	390.04	1.04
Artificial fill	442.83	1.18
Salt marsh and estuarine deposits	16.49	0.04
Sand	179.39	0.48
Sand and gravel	3,287.71	8.78
Sand and gravel overlying sand	224.54	0.60
Sand overlying fines	160.21	0.43
Sand overlying sand and gravel	140.93	0.38
Swamp	6.04	0.02
Thick till	2,830.56	7.56
Till	28,218.57	75.36
Water	1,431.86	3.82
Total	**37,444.71**	**100%**

Source: Connecticut Department of Energy & Environmental Protection GIS Data



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"Surficial Geology" Datalayer
1995 USGS, CT DEEP
Geological & Natural History
Survey

Figure 2-4: Surficial Geology

LOCATION: **Ansonia, Derby, Seymour & Shelton, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-4_Surficial.mxd
1st Version: 3/1/2012
Revision: 3/26/2012
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As shown above in the table, both in acreage and percent coverage, the region is covered primarily by glacial till; 82.92% of the region is covered by either "till" or "thick till." Till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. Till is present in each municipality in virtually every location lacking any association with a significant watercourse. Significant sand and gravel stratified drift deposit corridors follow the general paths of the Housatonic River through Seymour, Shelton, and Derby and the Naugatuck River through Seymour, Ansonia, and Derby. Additionally, smaller but significant sand and gravel stratified drift deposit corridors follow the general paths of Means Brook and the Farmill River in Shelton. This is displayed graphically in Figure 2-4.

In terms of soil types, the region has much diversity. The region's most common soil types are those that make up the Charlton-Chatfield complex, the Hollis-Chatfield Rock outcrop complex, and the Canton and Charlton soils. The remaining approximately 55% of the region contains 43 other various soils that are listed in Table 2-4. The following soil descriptions for those soil types exceeding 10% of the region are taken in part from the official series descriptions from the United States Department of Agriculture (USDA) website.

- 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 3% to 45%. Crystalline bedrock is at depths of 20 to 40 inches. Saturated hydraulic conductivity is moderately high to high in the mineral soil.

- The Hollis-Chatfield-Rock outcrop complex soils are characterized as being undulating to very steep, shallow to moderately deep, well drained and somewhat excessively drained, medium and moderately textured soils, and rock outcrop on uplands. The unit contains soils that were formed in glacial till dominated by granite, gneiss, and schist. The landscape consists of hillsides and hilltops with very complex topography and steep microrelief. A major portion of the landscape underlain by these soils includes bedrock exposures, with very steep to nearly vertical bedrock escarpments with slopes ranging from 3% to 45%.

TABLE 2-4
Soil Classifications

Soil Type	Area (acres)	Percentage of Region
Agawam-Urban land complex	690.00	1.84
Agawam fine sandy loam	658.57	1.76
Bash silt loam	16.43	0.04
Broadbrook silt loam	1.77	0.005
Canton and Charlton soils	2,932.75	7.83
Catden and Freetown soils	292.19	0.78

Soil Type	Area (acres)	Percentage of Region
Charlton-Chatfield complex	8843.37	23.62
Charlton-Urban land complex	1298.12	3.47
Cheshire fine sandy loam	1.03	0.003
Dumps	67.87	0.18
Fluvaquents-Udifluvents complex	20.46	0.05
Haven and Enfield soils	11.98	0.03
Hinckley-Urban land complex	460.10	1.23
Hinckley gravelly sandy loam	943.95	2.52
Hollis-Chatfield-Rock outcrop complex	5085.79	13.58
Leicester fine sandy loam	47.28	0.13
Manchester gravelly sandy loam	5.47	0.01
Merrimac-Urban land complex	15.59	0.04
Merrimac sandy loam	34.27	0.09
Ninigret and Tisbury soils	152.07	0.41
Paxton-Urban land complex	601.08	1.61
Paxton and Montauk fine sandy loams	2,724.51	7.28
Pits, quarries	33.19	0.09
Pootatuck fine sandy loam	44.93	0.12
Raypol silt loam	85.80	0.23
Ridgebury fine sandy loam	106.41	0.28
Ridgebury, Leicester, and Whitman soils	2164.80	5.78
Rippowam fine sandy loam	127.39	0.34
Rock outcrop-Hollis complex	481.67	1.29
Saco silt loam	113.10	0.30
Scarboro muck	135.85	0.36
Sutton-Urban land complex	35.21	0.09
Sutton fine sandy loam	617.39	1.65
Timakwa and Natchaug soils	379.63	1.01
Udorthents-Pits complex	163.17	0.44
Udorthents-Urban land complex	2249.12	6.01
Udorthents, smoothed	297.10	0.79
Urban land	695.81	1.86
Urban land-Charlton-Chatfield complex	682.22	1.82
Urban land-Chatfield-Rock outcrop complex	92.02	0.25
Urban land-Chatfield complex	131.81	0.35
Walpole sandy loam	115.89	0.31
Water	1523.07	4.07
Westbrook mucky peat	24.29	0.06
Woodbridge-Urban land complex	191.90	0.51
Woodbridge fine sandy loam	2048.30	5.47
Total	**37,444.71**	**100%**

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

2.4 Climate

The VCOG municipalities have an agreeable climate characterized by moderate but distinct seasons. Summer temperatures regularly rise in the mid 80s, and winter temperatures regularly dip into the upper 20s to mid 30s as measured in Fahrenheit. Extreme conditions raise summer temperatures to near 100 degrees and winter temperatures to below zero. Additionally, according to CLRChoice, Inc., median snowfall is approximately 25 inches per year. An extremity within this trend was the winter of 2010-2011, which saw upwards of 80 inches of snow fall on parts of Connecticut. Mean annual precipitation is 42 inches.

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

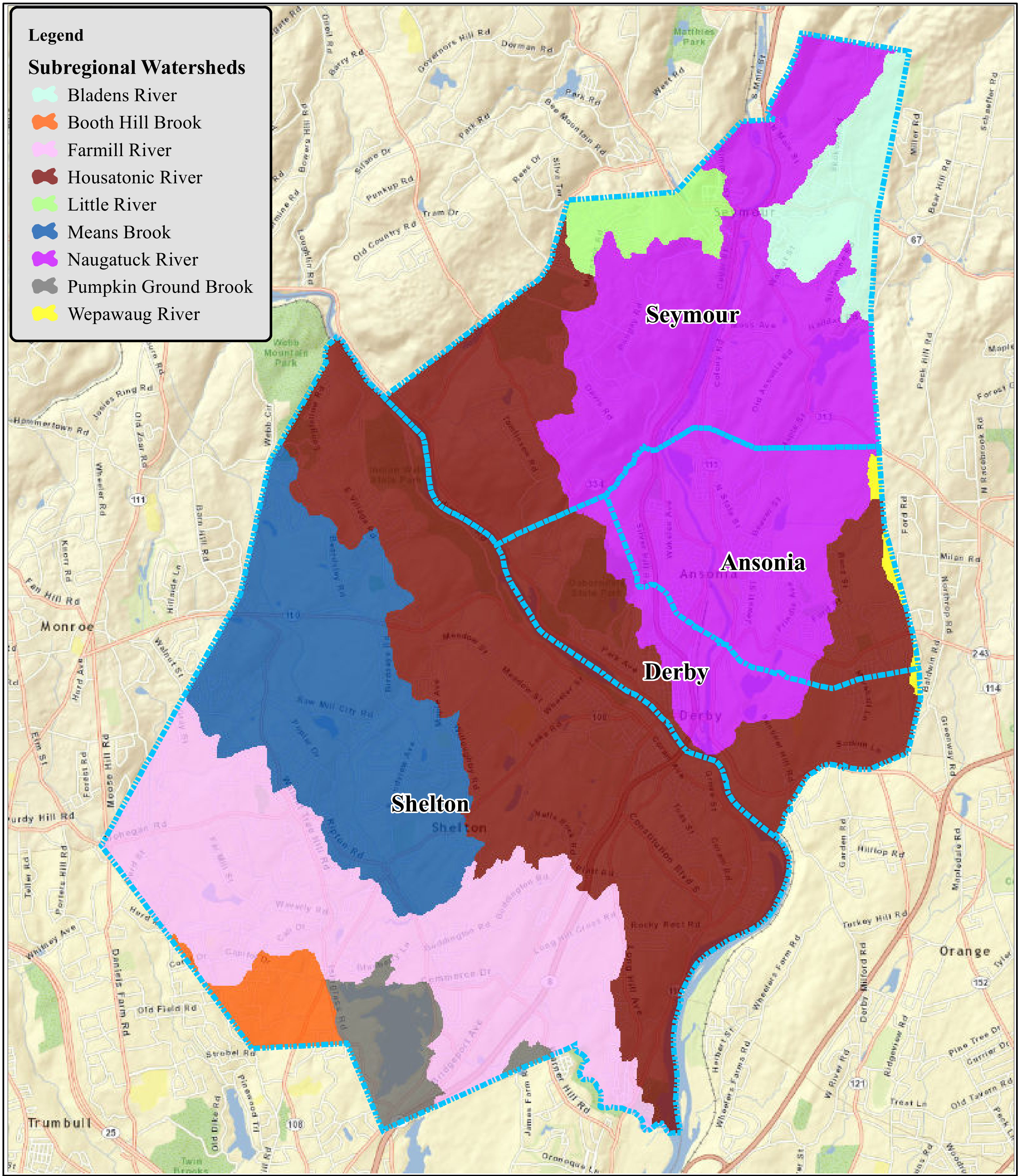
However, average annual precipitation in Connecticut has been increasing by 0.95 inches per decade since the end of the 19th century (Miller et al., 1997; NCDC, 2005). Likewise, total annual precipitation in the region has increased over time. The increase in precipitation must be accounted for in the region's planning for long-term mitigation of natural hazards.

2.5 Drainage Basins and Hydrology

The region is divided among nine subregional watersheds as shown in Figure 2-5. The three northernmost subregional watersheds (Bladens River, Little River, and Naugatuck River) drain to the Naugatuck River, and the four central subregional watersheds (Means Brook, Farmill River, Pumpkin Ground Brook, and Housatonic River) drain to the Housatonic Main Stem. A small portion of the Wepawaug River subregional basin (102.50 acres, or only 0.27% of the region) drains to the South Central Western Complex, and a small portion of the Booth Hill Brook drainage basin (657.56 acres, or only 1.76% of the region) drains to the Southwest Eastern subregional basin.

Housatonic River – The Housatonic River originates in Massachusetts and flows 149 miles before it discharges into Long Island Sound at Milford Point. From north to south, the Housatonic flows through the Connecticut towns of North Canaan, Salisbury, Canaan, Sharon, Cornwall, Kent, Sherman, New Milford, Bridgewater, Brookfield, Southbury, Oxford, Newtown, Seymour, Monroe, Shelton, Derby, Orange, Stratford, and Milford.

The Housatonic River has a total elevation change of 1,430 feet and a watershed that encompasses 1,948 square miles. In Connecticut, the Housatonic River valley has narrow walls that are flanked by hills on either side. The northwestern portion of the watershed in Connecticut supports some agricultural uses, taking advantage of the river's nutrient-rich floodplains. Just south of the Bulls Bridge power station in New Milford, Connecticut, water is diverted from the river and pumped uphill through a penstock to Candlewood Lake, the first pump storage reservoir built in the country. Constructed in 1926, it is also the largest of its kind, spanning 5,400 acres.



SOURCE(S):

Base Map:
"World Street Map" Datalayer
Sources: Esri, DeLorme, NAVTEQ, TomTom, USGS, Intermap, et al.
http://goto.arcgisonline.com/maps/World_Street_Map

"Surficial Geology" Datalayer
1995 USGS, CT DEEP
Geological & Natural History Survey

Figure 2-5: Subregional Watersheds

LOCATION: **Ansonia, Derby, Seymour & Shelton, CT**

VCOG Hazard Mitigation Plan

Map By: SMG
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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-5_SubSheds.mxd
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Upon leaving New Milford, the Housatonic River again changes dramatically, becoming a series of three lakes. Each lake is formed by a hydroelectric power dam. The Shepaug Dam forms Lake Lillinonah (1,900 acres) in Bridgewater. Further south in Monroe, the Stevenson Dam impounds Lake Zoar (975 acres). The third lake is Lake Housatonic (328 acres), formed by the Derby Dam that spans between downtown Derby and downtown Shelton. The flow rate of the Housatonic River is managed in this reach of the river. River flows are periodically ponded behind the dams. The water is then released to turn the turbines to produce electric power. Despite this control, the Lake Housatonic part of the river is generally a flowing, run-of-the-river reach, and this is where much of the flooding described in this HMP has occurred.

Below the Derby Dam, the Housatonic River begins its final transition, becoming an estuary where salt water and fresh water mix. In this lower 12-mile section, the river is tidal, supporting wetlands and salt marshes that provide important habitat for plants, birds, shellfish, finfish, and other aquatic life. The entire southeastern riverfront in Shelton is tidal.

Naugatuck River – The Naugatuck River originates as part of two branches: the East Branch, which originates as a tributary of Lake Winchester in the town of Winchester, and the West Branch, which begins following the confluence of Jakes Brook, Hart Brook, and Hall Meadow Brook in the western portion of the town of Torrington. The two branches conjoin in downtown Torrington and flow south forming the Litchfield/Harwinton border, then through Thomaston, eastern Watertown, Waterbury, Naugatuck, and Beacon Falls before entering the region at Seymour. The river ultimately joins the Housatonic River in Derby.

Means Brook and Farmill River – From northeastern to central Shelton, numerous unnamed streams flow to Means Brook before Means Brook joins the Farmill River. Means Brook is an important stream as it flows through historical Huntington Center in Shelton. The Farmill River receives water from Harvey Pete Brook, Sharps Brook, Boehm Brook, Walnut Tree Hill Brook, Hazelton Brook, Wells Brook, Black Brook, and other unnamed streams through southern Shelton. The river then forms the border with Stratford for a short distance before emptying into the Housatonic River.

Watercourses in Seymour – The Bladens River, Rimmons Brook, Little River, Nickel Mine Brook, Muds Brook, Beaver Brook, and Kinneytown Brook and unnamed tributaries and streams all flow toward the Naugatuck River. Spruce Brook, Four Mile Brook, and Great Hill Brook and some unnamed tributaries and streams flow toward the Housatonic River.

Watercourses in Ansonia – Beaver Brook, its unnamed tributaries, and other streams flow to the Naugatuck River while Twomile Brook flows southward toward Derby and the Housatonic Main Stem.

Watercourses in Derby – Pink House Cove Brook and Twomile Brook flow toward the Housatonic River while some smaller, unnamed tributaries and streams flow toward the Housatonic River and/or the Naugatuck River.

Watercourses in Shelton – From north to south along the Housatonic River in Shelton are White Hills Community Brook, Upper White Hills Brook, Indian Hole Brook, Curtiss Brook, Burying Ground Brook, Ivy Brook, Butternut Hollow Brook, and unnamed streams flowing into the Housatonic River.

The lone watersheds of the region not contributing to the Naugatuck or Housatonic Rivers are the Wepawaug River in eastern Ansonia and northeastern Derby and Booth Hill Brook in southwestern Shelton.

2.6 Population and Demographic Setting

Demographic trends for the region are similar to many other communities in Connecticut and are closely tied to the state's economy. New Haven plays a role in the region's demographics and population as it is located only two to 10 miles east of the region. However, the region is also closely tied to the city of Bridgeport to the southwest and the remainder of Fairfield County.

Shelton is the largest municipality of the region, ranked 24th out of the 169 Connecticut municipalities. Shelton's 2010 population is 39,559 people while Ansonia was listed at 19,249 people, Seymour at 15,957 people, and Derby at 12,902 people.

The Lower Naugatuck Valley was one of the main manufacturing centers in New England and was a hub of mills. What is today known as Connecticut Route 8 was originally chartered in 1801 and collected tolls until 1862. The portion through Seymour was chartered in 1825 and known as the Humphreysville and Salem Turnpike. The roadway was used for the many manufacturing facilities in the area through this time. It was not until 1922 that the New England states began a regionwide highway numbering system, and it became known as Route 8. Today's Connecticut Route 8 was not completed in full until 1982. Today, the roadway is largely used as a connection between the greater Waterbury area and the greater Bridgeport area for businesses, commuters, and others. Additionally, the Waterbury spur of the Metro-North Rail Line is used largely by the same people.

According to Census 2010, approximately 24% of the population of Ansonia was under 18 years of age, 63% was between the ages of 18 and 64, and only 13% was 65 years and older. According to the same source of data for Derby, approximately 21% of the population was under 18 years of age, 63% was between the ages of 18 and 64, and only 16% was 65 years and older. In Seymour, approximately 22% of the population was under 18 years of age, 64% was between the ages of 18 and 64, and only 14% was 65 years and older. Shelton's data indicates that approximately 21% of the population was under 18 years of age, 62% was between the ages of 18 and 64, and only 17% was 65 years and older. The estimated current population density of Ansonia is approximately 3,105 people per square mile compared to 2,390 in Derby, 1,103 in Seymour, and 1,240 in Shelton. Population density by census block for all VCOG municipalities is illustrated in Figure 2-6.

The Connecticut State Data Center (CTSDC) projects the 2020 population of Ansonia to be 19,612 people (363 greater than the 2010 U.S. Census), Derby to be 13,790 people (888 greater), Seymour to be 17,230 people (690 greater), and Shelton to be 40,842 (1,283 greater). The projections reveal a moderate growth in the region in the coming years.

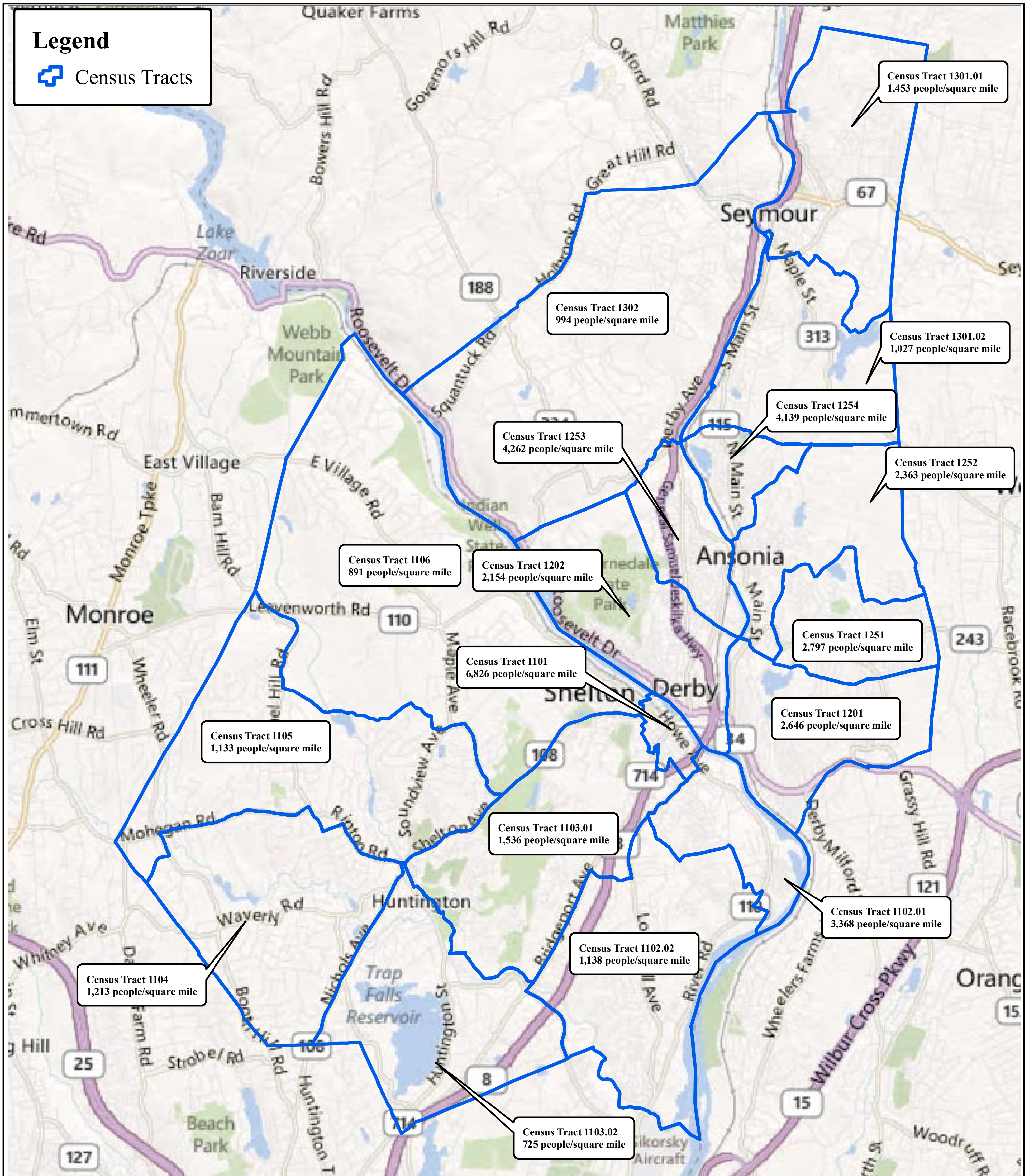
The region has concentrated areas of populations who are elderly and/or possess disabilities. These are depicted by census blocks in Figures 2-7 and 2-8. Not surprisingly, the more populated census block groups include a higher percentage of individuals who may require special assistance or different means of notification before and during natural hazards.

2.7 Development Trends

Similar to many communities in the Naugatuck Valley, residential development in the region is concentrated along the Route 8 corridor and the Naugatuck and Housatonic Rivers. On the whole, almost all developable parcels surrounding the Route 8 corridor within the region have been developed to date. Shelton, with the largest land area in size as was previously mentioned, has the most rural areas that largely exist away from the Route 8 corridor, the Housatonic River, and the Huntington section of Shelton. Due to the smaller land area size of the other VCOG municipalities, developable parcels are generally sparse throughout.

Aside from a general lack of developable parcels in Ansonia, Derby, and Seymour, the VCOG municipalities have seen a virtual halt in development during the economic hardships over the past few years beginning in 2008, similar to residential and commercial development trends across the state and the rest of the United States.

Ansonia – In Ansonia, four developments, including residential and commercial/industrial, are either seeking approval, approved, or undergoing construction. One subdivision is awaiting a rebound in the state of the economy to proceed while the second has been proposed to the city. The former has been approved in the southeastern portion of Ansonia near the Derby and Woodbridge municipal borders while the latter is proposed to be at the Ansonia-Seymour municipal line in northern Ansonia.



SOURCE(S):
Base Map:
"Bing Maps Road" Datalayer
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Figure 2-6: Population Density

LOCATION:
Ansonia, Derby, Seymour & Shelton, CT

N

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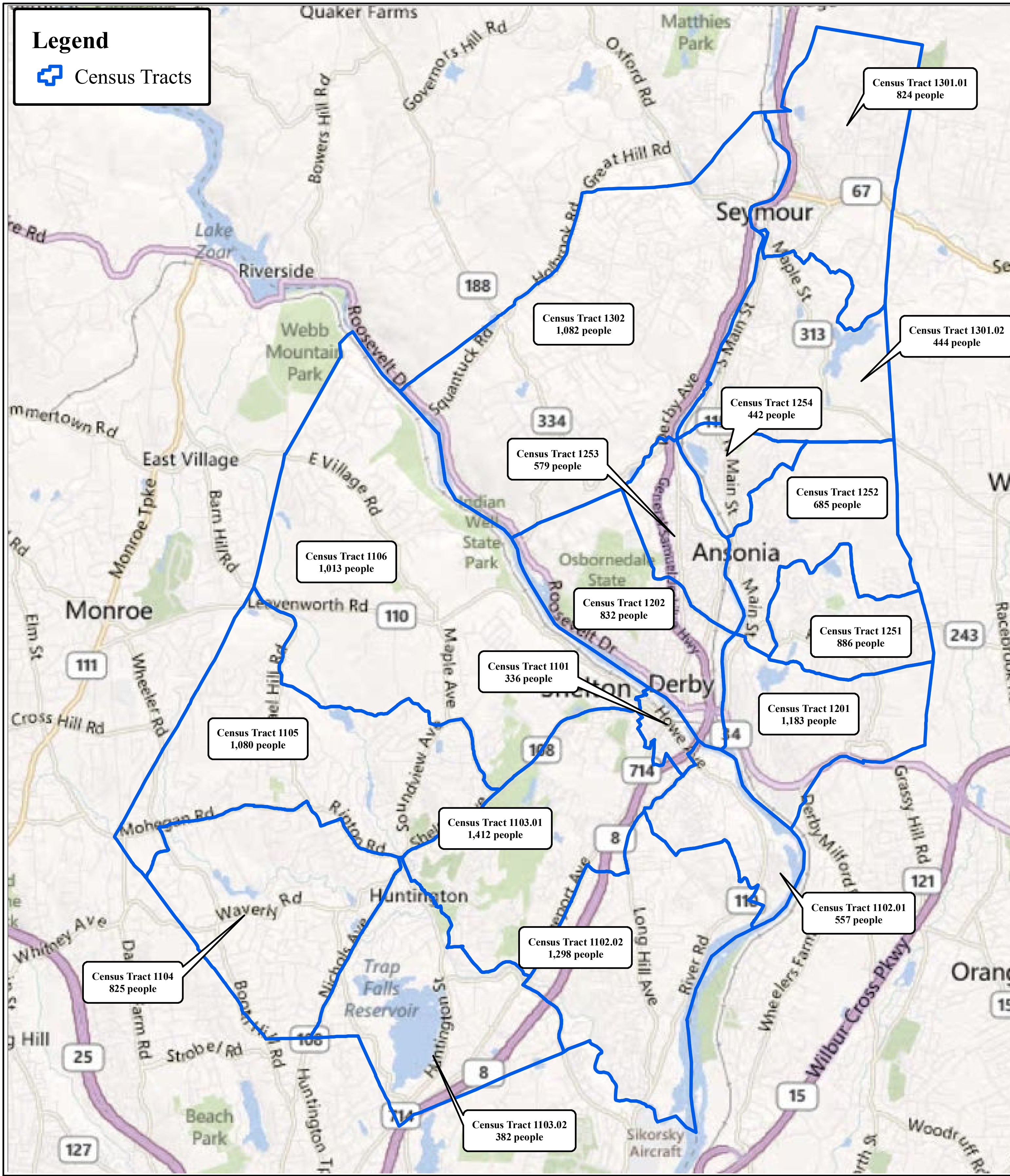

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Figure 2-7: Elderly Population

LOCATION:
Ansonia, Derby, Seymour & Shelton, CT

N

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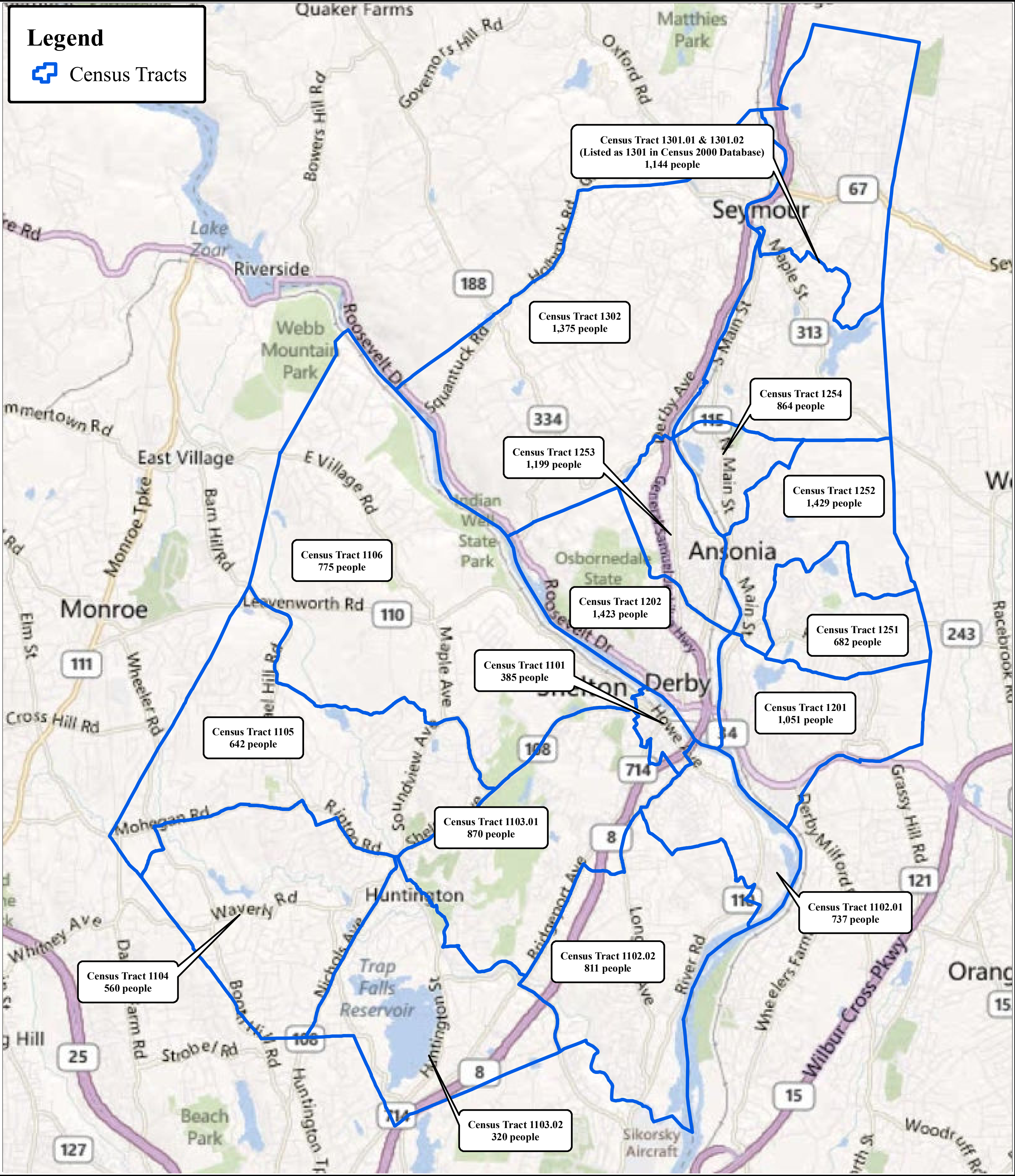

SOURCE(S):	Figure 2-8: Disabled Population	LOCATION: Ansonia, Derby, Seymour & Shelton, CT
Base Map: "Bing Maps Road" Datalayer (c) 2010 Microsoft Corporation and its data suppliers		

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The demolition and rebuild of apartments has been proposed to Ansonia officials at a location within the 500-year flood zone (Zone X, described in Section 3.0) while construction has begun on buildings in an industrial park. The apartments are on the west bank of the Naugatuck River in central Ansonia while the industrial park is in the northeast corner of Ansonia at the Ansonia-Seymour municipal line. The proposed demolition and rebuild of the apartment complex is the only project currently in discussions in Ansonia within a designated floodplain.

Derby – City officials in Derby generally consider the city to be built out and lacking space. However, four potential areas of development that are notable aside from local infill are listed below:

- Main Street redevelopment (vacant land exists on the south side of Main Street)
- A proposed commerce park between Route 8 and the Naugatuck River
- A possible four-lot residential subdivision off Belleview Drive
- A potential Industrial/Commercial zoned industrial park off Hine Terrace

The Main Street Redevelopment project and the proposed commerce park both are in central Derby along the Route 8 corridor, located in areas protected by levees and thus in flood zones. The possible subdivision and the potential industrial park are both in eastern Derby near the Orange and Woodbridge municipal lines.

Seymour – Three residential and four commercial/industrial developments are at different stages in Seymour. Of the three residential developments, the largest is in the northeast corner of Seymour near the Beacon Falls-Seymour town line and is undergoing construction while a townhouse development is awaiting a sewer system along the Housatonic River in the southwestern portion of town. Finally, a small subdivision has been approved for 2012 construction in the northern part of the downtown section of Seymour to the west of the Naugatuck River and Route 8.

In regard to the four commercial-industrial developments in Seymour, an inn and banquet hall plans to construct a convention center in the same area as the approved townhouse development and is also awaiting the installation of a sewer system before advancing to construction. Additionally, an expansion of the current restaurant/banquet hall facility is in the plans. Secondly, a small commercial/retail development in the same area of town has been approved while another small commercial development was approved along Route 67 to the east of downtown. Finally, a single building is being constructed in the northeastern section of Seymour near the Bethany and Woodbridge town lines.

Shelton – A few residential projects and industrial/commercial projects are at different stages of development. One of the residential projects is an apartment complex development that is undergoing construction just north of Route 8 in the downtown area of Shelton while additional residential and commercial projects have been proposed in the same area. A new utilities substation is proposed in the southern part of the city while a redevelopment of a commercial property has been given conceptual approval along the Route 8 corridor in south-central Shelton.

2.8 Governmental Structure

Ansonia, Derby, and Shelton are each managed by a mayor and Board of Aldermen system. The mayor appoints the Board of Aldermen following election. In contrast, Seymour is managed by a Board of Selectmen with a First Selectman appointing board members.

The mayors and the First Selectman oversee many of the municipal departments, commissions, and boards and are directly responsible for appointing members of many commissions and boards. Within each municipality, appropriate municipal departments, commissions, and boards are involved with natural hazard mitigation. The following subsections describe general departmental responsibilities, and duties related to natural hazard mitigation within each VCOG municipality. These are grouped, and each municipality is described either together or separately where applicable. Where applicable, one or more of the six types of mitigation (prevention, property protection, natural resource protection, structural projects, emergency services, and public education) are identified as relevant for each department.

Public Works Department and Commission

In Ansonia, Derby, and Shelton, the Public Works/Public Works and Highway Department are under the general supervision of the Board of Aldermen while in Seymour, the Board of Selectmen takes the responsibility. These departments are responsible for planning, organizing, and administering the public works operations as well as managing the public works staff and budget. Responsibilities include directing highway construction and maintenance procedures.

As is common throughout Connecticut, the Public Works Departments of the region are often charged with implementing numerous structural projects that are related to hazard mitigation. Specifically, roadway/infrastructure maintenance and complaint logging/tracking are the two primary duties of the Public Works Departments. For example, the Public Works Departments track, plan, prepare for, and respond to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. The Public Works Departments also conduct snow removal and deicing on roads; tree and tree limb maintenance; and the appropriate maintenance and upgrades of storm drainage systems to prevent flooding caused by rainfall.

Because of the duties described above, the Public Works Departments are often the de facto first responders during emergencies within the region. The Public Works Departments must maintain access for the Police and Fire Departments to respond to emergencies.

Within Ansonia and Seymour, the Public Works Commission is appointed by either the Board of Selectmen (Seymour) or the Board of Aldermen (Ansonia). Collectively, the commissions are charged with the following:

- Management and oversight of the Public Works Department
- Development of a proposed budget estimating anticipated expenditures and revenues for the operations of the Public Works Commission for each fiscal year
- Review of the municipality's needs with respect to public works and making such recommendations to the Board of Selectmen or Aldermen and other municipal agencies and departments as it deems appropriate
- Establishment of regulations for the effective operation of the Public Works Department including the duties of the department and its superintendent or director with respect to construction and maintenance of municipal buildings, highways, sidewalks, sewers and drains, the care of trees and grounds, collection and disposal of garbage and rubbish, and maintenance of apparatus and equipment used by the Department of Public Works
- Review and approval of the department's maintenance and repair of such other apparatus and equipment as may be used by other agencies or departments of the municipality upon request of such agencies or departments

Building and Engineering Departments

The four VCOG municipalities each have Building and Engineering personnel although in Derby the engineering responsibilities are contracted by an outside firm. The Building Official (Ansonia and Shelton) or Building Inspector (Derby and Seymour) administers the municipality's building inspection program adhering to and enforcing all code requirements of the State of Connecticut relating to building construction. Additional responsibilities include administering and enforcing all related state codes for the safety, health, and welfare of persons and properties in the municipality, supervising departmental policies and procedures, and providing technical assistance to municipal officials.

Each Building Official/Inspector has a unique responsibility when it comes to hazard mitigation as he or she is responsible for overseeing a number of codes such as those related to wind damage prevention as well as those related to inland flood damage prevention. Although other departments and commissions may review development plans and develop or revise regulations, many important types of pre-disaster mitigation are funneled through and enforced by the Building Department/Building Inspector's Office. For example, the Building Department/Building Inspector's Offices enforce standards for floodproof construction and building elevations, maintain elevation certificates, and enforce building codes that protect against wind and fire damage. Thus, the types of mitigation that are administered by the Building Department/Building Inspector's Office include prevention and property protection.

In the different municipalities, the municipality's Engineer plans, directs, and coordinates engineering contracts and construction projects, including bridges, sanitary, and different developments. The Engineer provides technical consultation to municipal boards and commissions and serves as the municipal liaison with various state agencies. As such, the Engineer will often need to review issues related to drainage, flood conveyance, and flood mitigation and related elements of structural hazard mitigation.

Fire Department and Emergency Management Department

The Fire Departments and Emergency Management Departments are the primary entities involved with hazard mitigation through emergency services in the region, except in Ansonia where the Police Department is the primary department involved. Derby and Shelton have Emergency Management Departments, and Seymour has an Emergency Services Department. The EMDs for each community are the primary municipal contacts for this HMP.

Police Departments

In each VCOG municipality, typical day-to-day duties of the Police Departments include crime prevention, criminal investigations, traffic enforcement, motor vehicle accident investigations, and patrols. Duties related to natural hazard mitigation include planning and coordination of personnel, equipment, shelters, and other resources necessary during an emergency. The types of mitigation that are directly administered by the Police Departments include mainly emergency services and public education. Communication and coordination with the Fire Departments is critical before, during, and after natural hazard emergencies.

Planning Departments

All four communities have Planning and Zoning Commissions and municipal planning or land use staff. Those officials in charge of planning provide assistance to other applicable departments within the municipality, including the Building and Engineering personnel, and are responsible for housing and economic development planning. The Zoning Enforcement Officers/Inland Wetlands Enforcement Officers enforce the zoning regulations and are the administrators of the inland wetlands regulations on issues of zoning compliance.

Because the Planning staff assist the applicable commissions with administration of the Zoning Regulations, Subdivision Regulations, and Inland Wetland Regulations (described below in Section 2.8), the municipal departments are responsible for elements of almost all six facets of mitigation (prevention, property protection, natural resource protection, structural projects, emergency services, and public education).

Commissions Related to Hazard Mitigation

In addition to the Public Works Commissions and Emergency Management Committees described above where applicable, several commissions are involved with hazard mitigation:

- Conservation Commissions – Charged with the development, conservation, supervision, and regulation of natural resources and water resources (hazard mitigation through natural resource protection)
- Inland Wetlands and Watercourses Commissions – Charged with implementing and enforcing all provisions of the Connecticut General Statutes as regards the Inland Wetlands and Watercourses Act (hazard mitigation through prevention, natural resource protection, and structural projects)
- Planning and Zoning Commissions – Charged with establishing, implementing, and overseeing planning and zoning regulations as provided by the Connecticut General Statutes (hazard mitigation through prevention, property protection, natural resource protection, structural projects, emergency services, and public education)
- Public Works Commission (Seymour and Ansonia) – As noted above
- Board of Fire Commissioners (Shelton)
- Fire Commission (Ansonia)

2.9 Review of Existing Plans

Each VCOG community possesses a Plan of Conservation and Development (POCD) and EOP. These are described below.

Plans of Conservation and Development

Ansonia

The Ansonia Planning and Zoning Commission adopted the most recent update to the POCD in June 2008. The POCD is organized into six sections that cover conservation, development, and infrastructure strategies and recommendations. Section 3 identifies SFHAs, slopes in excess of 25%, wetlands as "significant conservation areas," and 500-year floodplains as "important conservation areas." The POCD notes that Ansonia already protects wetlands and SFHAs but notes that Ansonia "should consider strengthening regulations related to development on steep slopes and… 500-year floodplain areas." The listed conservation strategies are:

- Continue to enforce the 100-foot regulated area from wetlands.
- Consider adopting regulations to provide green space between development and the Naugatuck River.
- Discourage building and road development on steep slopes (15% or greater).
- Continue to allow exceptions for preservation of natural features.
- Create inventory of open spaces and identify opportunities for creation of parks.

- Preserve more open space to preserve natural resources.
- Study the feasibility of an elevated walkway along the Naugatuck River flood retaining wall.
- Encourage preservation of open space by private organizations.

All eight strategies are considered consistent with the goals of this HMP.

Section 5 of the POCD notes that "In order to lessen the effects of more utility poles and aboveground wires, all wired utilities should be placed underground. In addition, as improvements and redevelopment occurs in commercial and residential areas, consideration should be given to burying existing utilities." Infrastructure strategies numbers 18 and 19 articulate these goals and are considered consistent with the goals of this HMP.

Derby

The Derby Planning and Zoning Commission adopted the most recent update to the POCD in 2008. The POCD is organized into six sections that cover conservation, development, and infrastructure strategies and recommendations. Section 3 identifies SFHAs, slopes in excess of 25%, and wetlands as "significant conservation areas." The POCD notes that Derby already protects wetlands and SFHAs but notes that Derby "should consider strengthening regulations related to development on steep slopes and… 500-year floodplain areas." The listed conservation strategies for natural resources and open space are as follows:

- Continue to protect watercourses, waterbodies, wetlands, floodplains, vernal pools, and other important water resources in order to maintain water quality, wildlife habitats, water supply, and ecological balance.
- Continue to require buffer zones to protect important water resources.
- Consider regulations to protect slopes in excess of 25%.
- Continue to acquire land around aquifers and public water supply watersheds to aid in their protection.
- Seek to reduce the amount of impervious surface in Derby by promoting less density in future development and redevelopment efforts.
- Require alternatives to paving entire parking lots and driveways and encourage natural drainage systems to decrease polluted runoff.
- Identify local animal habitats and protect them at the time of development.
- Seek city funds to prepare an Open Space Plan overseen by the Derby Open Space Commission, with recommendations made to the Derby Board of Aldermen.
- Interconnect open space and recreational areas in Derby through a system of greenbelt trails.
- Establish small parks and recreation areas in all redevelopment efforts. Examine all vacant parcels of land owned by the city as possible locations for well landscaped "pocket parks."

- Require that open space or fees in lieu of open space be a part of every new development or redevelopment effort in Derby.
- Establish a Land Acquisition Fund as authorized by the Connecticut General Statutes and strive to set aside funds from the annual municipal budget and other sources for open space acquisition.
- Pursue state funding, rights of first refusals, rights-of-way or easements, and other methods of obtaining desired open space.
- Make preservation of farmland a priority and seek to preserve remaining farms through purchase of development rights.

Strategies for utilities include "encourage all replacement and new wired utilities to be placed underground" and "work with utility companies to establish a reasonable tree-trimming schedule that balances reliability and community character."

Many of the above strategies are considered consistent with the goals of this HMP.

Seymour

The Seymour Planning and Zoning Commission adopted the most recent update to the POCD in 2002. The POCD is organized into six sections that cover conservation, development, and infrastructure strategies and recommendations. Section 3 identifies SFHAs, slopes in excess of 25%, wetlands as "significant conservation areas," and 500-year floodplains as "important conservation areas." The listed conservation strategies for natural resources and open space are as follows:

- Continue to protect ground water quality and surface water quality throughout Seymour.
- Continue to encourage the 100-foot regulated upland review areas.
- Monitor areas served by septic system to protect ground water supplies.
- Encourage more wildlife enhancement programs such as the fish walk around the Great Falls.
- Encourage the identification of hilltops and consider adopting regulation to preserve the hilltops.
- Encourage minimizing timber harvesting in environmentally sensitive areas.
- Consider adopting aquifer protection regulation to protect water quality.
- Tie both existing and new open space and recreational areas together into an integrated greenbelt system.
- Identify vacant land along major rivers for the purpose of future river greenways.
- Focus on preserving environmentally sensitive land through the purchase of open space.
- Support of the local land trust.
- Establishing a fund for open space purchases.
- Educate property owners on their eligibility for PA-490 designations.

Strategies for utilities include "Continue to encourage buried utilities in all types of development, including the downtown."

Many of the above strategies are considered consistent with the goals of this HMP.

Shelton

The Shelton Planning and Zoning Commission adopted the most recent update to the POCD in 2006. The POCD is organized into eight sections that cover resources, development, community needs, future land use, and implementation. The majority of the Shelton POCD is focused on describing goals and strategies for enhancing transportation, development, housing, and community facilities for a diverse community containing urban, suburban, and rural neighborhoods.

The Shelton POCD includes a detailed section about open space. The POCD recommends a variety of methods of increasing open space as well as continuing the extension of greenways along the Housatonic River, Farmill River, and Means Brook. The POCD also promotes the prioritization of open space along the coastal portion of the Housatonic River. These goals and strategies are all consistent with the goals of this HMP.

The POCD briefly addresses a few inaccessible homes along the Housatonic River in the extreme northern part of Shelton. These homes are only accessible by boat from across the river. The POCD discourages the year-round use of these homes. This is important in the context of this HMP as the area is floodprone, and residents have no means of evacuating during floods.

Emergency Operations Plans

The Ansonia EOP was most recently updated in 2009, the Derby EOP in __, the Shelton EOP in 2012, and the Seymour EOP in 2011.

Sections I and II of each community's EOP provide its purpose and assumptions. Section III of each EOP describes mitigation, increased readiness, emergency phase operations, and recovery phase operations. The EOP may list snowfall, ice storms, blizzards, hazardous material incidents, aircraft accidents, hurricanes, tornadoes, flooding, electrical storms, major fires, energy/fuel shortages, forest fires, dam failures, water contamination, earthquakes, and highway accidents as hazards covered by the EOP. Specific mitigation measures typically include the following:

1. Carry out hazard mitigation activities appropriate to the functions of departments, agencies, and offices
2. Restrict development in hazardous areas consistent with the degree of risk
3. Promote fire prevention

4. Work with commerce and industry to improve hazardous materials storage, use, transport, and disposal
5. Encourage public safety at all levels
6. Maintain a stock of sandbags
7. Develop and maintain all-hazard evacuation and mass care annexes with predesignated evacuation routes and shelter facilities
8. Maintain mutual aid agreements with neighboring communities
9. Maintain a radiological protection reference guide

Section IV of each EOP sets and describes roles and responsibilities. The EMD coordinates with the Chief Elected Official and other agencies. Roles of the Fire Department, Police Department, Health District, Public Works Department, and other specific people are also described (for example in Ansonia these are the Warning Coordinator, Emergency Operations Center [EOC] Manager, Communications Coordinator, Public Information Officer, Evacuation Coordinator, Shelter/Mass Care Coordinator, Resource Manager, Superintendent of Schools, and Animal Care Coordinator).

Section V of each EOP describes administration and logistics. This section also describes the duties of the American Red Cross (ARC) and Salvation Army such as provision of food, clothing, and various types of assistance. Section VI of each EOP describes plan maintenance. Section VII of each provides various attachments, such as templates for declaring an emergency.

2.10 Review of Existing Regulations

The Valley municipalities have a number of codes and regulations on the books that fall within the categories of natural hazard mitigation known as property protection, natural resource protection, emergency services, and prevention. These regulations are incorporated into the Zoning Regulations, the Inland Wetlands Regulations, and the Subdivision regulations. Flood damage prevention is included in the municipal codes for three Valley municipalities. These sets of codes and regulations are presented below.

Flood Damage Prevention

Ansonia

Flood damage prevention is not addressed in the Ansonia municipal code. Instead, the city's primary means of regulating flood damage prevention is through the Zoning Regulations (described below).

Derby

Flood damage prevention is covered by Chapter 92 of the Code of the City of Derby. The Flood Damage Prevention Code was adopted in 1991 and is essentially a local, abbreviated articulation of the NFIP regulations. The code includes a brief explanation of the standards for residential and nonresidential construction in A zones and floodways. The code was amended on November 18, 2010 to make reference to the December 2010 Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) for New Haven County Digital Flood Insurance Rate Maps (DFIRMs). As requested by the Connecticut DEEP, the code requires compensatory storage in flood zones and also requires that floodplain encroachments shall not result in any ("0.00 feet") increase in base flood elevations.

Seymour

Flood damage prevention is covered by Chapter 7 of the Town of Seymour Code, adopted October 2010. The code sets forth the policies for administration and the detailed standards for flood damage prevention, which are generally a duplicate of the NFIP regulations. The code requires compensatory storage in flood zones and also requires that floodplain encroachments shall not result in any ("0.00 feet") increase in base flood elevations.

Shelton

Flood damage prevention is covered by Chapter 5 of the City of Shelton Code, adopted June 1991. The code sets forth the policies for administration and the detailed standards for flood damage prevention, which are generally a duplicate of the NFIP regulations. The code requires compensatory storage in flood zones and also requires that floodplain encroachments shall not result in any ("0.00 feet") increase in base flood elevations.

The code also requires that, in the Zone A, base flood elevation data shall be provided for subdivision proposals and other proposed development (including manufactured home parks and subdivisions) that are five acres or 50 lots, whichever occurs first. This is consistent with FEMA's recommended regulations and will require, in some instances, that detailed flood studies accompany development proposals.

Zoning Regulations

Ansonia

The Ansonia Zoning Regulations were adopted in 1977 and have been amended through April 2011. The regulations are administered by the Planning and Zoning Commission.

- Section 220 of the Ansonia Zoning Regulations describes the Flood Plain District. The section sets forth the policies for administration and the detailed standards for flood damage prevention, which are generally a duplicate of the NFIP regulations. The Zoning Regulations were amended in 2011 to make reference to the December 2010 FIS and FIRM for New Haven County. Ansonia's regulations require that new residential structures must have the lowest floor elevated to one foot above the base flood elevation. The regulations require compensatory storage in flood zones and also require that floodplain encroachments shall not result in any ("0.00 feet") increase in base flood elevations.

- Sections 260.8 and 260.9 describe appeals and variances for the Flood Plain District. These sections limit the conditions under which a variance can be issued and also restrict variances to lots that are less than one-half acre in size and generally surrounded by lots with structures below base flood elevations.

- Section 520 describes soil erosion and sediment control, including the standards for soil erosion and sediment control and the need for developing soil erosion and sediment control plans.

Derby

In Derby, the Planning and Zoning Commission is charged with administering the Zoning Regulations. Zoning was covered by Chapter 195 of the Code of the City of Derby from 1976 through 2000, at which point the Zoning Regulations were adopted and superseded the chapter in the code. The Zoning Regulations were most recently amended in August 2010.

- Section 195-21 of the Derby Zoning Regulations describes the Floodplain (FP) Zone and states that "Applicable standards on the construction and the use of land, buildings and other structures and the filling or excavation of land are established to protect life and property, avoid health problems, and avoid increase in flood danger." The FP zone is an overlay zone such that the underlying zone standards also apply.

- Section 195-100 through 195-106 of the Derby Zoning Regulations (Article XIV) describes Soil Erosion and Sediment Control. The article requires the development and approval of a certified soil erosion and sediment control plan in connection with most development projects.

- Section 195-107 through 195-112 of the Derby Zoning Regulations (Article XV) describes Floodplain Management Controls. The article requires issuance of a zoning permit from the Planning and Zoning Commission for a variety of activities in the FP overlay zone. However, the article does not include a set of standards such as the NFIP regulations; these are in Chapter 92 of the city code. Exemptions are listed in Section 195-110 (repairs equal to less than 50% of the market value and repairs to historic structures), and procedures are described in Section 195-112. Section 195-112(C) explains that an applicant must be notified that flood insurance premiums will be higher than typical if permission is granted for construction of a structure below the base flood elevation. This implies that the Planning and Zoning Commission has the authority to permit such construction below the base flood elevation, which could occur as a result of an exemption.

Seymour

The Zoning Regulations were approved August 2000 and amended January 2010.

- Section 7.6 describes requirements related to drainage. If grading or construction is altered, no increase of runoff is allowed. Detention basins that collect water from streets shall not be on private lots.

- Section 15 describes the requirements for soil erosion and sediment control and the need for developing a soil erosion and sediment control plan.

- The Flood Plain district is an overlay zone. Section 16 describes the district. This section of the Zoning Regulations clearly states that the standards for construction shall be as defined in the Flood Damage Prevention section (Chapter 7) of the town code. This section also prohibits development that increases the base flood elevation more than one foot, except in floodways where there is no allowable increase.

Shelton

The Shelton Zoning Regulations were adopted in 1977 and have been amended through July 2009. Unlike other Valley communities, the flood zone is not a distinct overlay district in Shelton.

- Sections 31.5.2, 33.6.4, and 33.13.6 state that all utilities in residential developments shall be underground. Section 36.11 requires the same in the Central Business District (downtown Shelton).

- Shelton's Coastal Site Plan Review (CSPR) requirements are in Section 45.5 of the Zoning Regulations. Shelton is the only Valley community with land in the state's coastal boundary and therefore subject to the CSPR. The coastal boundary is found along the Housatonic River in southeastern Shelton. Shelton's CSPR regulations are typical of those found in Connecticut, with exemptions similar to most coastal communities.

- Section 46 of the Zoning Regulations includes the standards for soil erosion and sediment control.

Subdivision Regulations

Ansonia

The Planning and Zoning Commission administers the Subdivision Regulations. These regulations were adopted in 1983 and have been amended through April 2011. Components of the regulations that directly or indirectly address hazard mitigation (flooding, public safety, etc.) are listed below:

- Section 2.3.10 requires assurances that a subdivision in a SFHA will not decrease the carrying capacity of a watercourse and that flood elevations will not increase as a result of construction, grading, excavation, etc.

- Section 2.3.11 requires a soil erosion and sediment control plan, and Section 3.9 provides the standards for such plan.

- Section 3.5 describes special considerations for flood hazard areas and floodways. When land to be subdivided is within a flood hazard area or floodway, the section requires that lots, streets, drainage, and other improvements shall be designed to be capable of use without danger from flooding. When base flood elevations are not available, the applicant must commission an engineering study to generate base flood elevations.

- Schedule C provides right-of-way and paved roadway widths, grades, etc. The design storm for on-site drainage is 25 years, and culverts are designed for the 50-year storm.

Derby

Like Ansonia, the Planning and Zoning Commission is charged with administering the Subdivision Regulations in Derby. These regulations were adopted in 1970 and have been amended through February 1992. Components of the regulations that directly or indirectly address hazard mitigation (flooding, public safety, etc.) are listed below:

- Section 2.3.6 describes the need for soil erosion and sediment control plans.

- Section 3.6 describes streets. Permanent dead-end streets "should be avoided" and may not serve more than 20 lots. Street right-of-way widths are set at 50 feet (local) or 60 to 100 feet (thoroughfares and commercial streets). Paved widths must be 32 to 36 feet depending on type of street, with turnarounds of 80 to 100 feet.

- Section 3.7 describes drainage provisions. Street drainage systems must be designed to handle two inches of rain per hour, and culverts must be designed to handle four inches per hour.

- Section 3.12 describes special considerations for flood hazard areas and floodways. When land to be subdivided is within a flood hazard area or floodway, the section requires that lots, streets, drainage, and other improvements shall be designed to be capable of use without danger from flooding. Streets shall be "of such elevation or shall be suitably protected as to allow access during flood."

Seymour

The Seymour Subdivision Regulations are administered by the Planning and Zoning Commission. These regulations have been revised through 1992. Components of the regulations that directly or indirectly address hazard mitigation (flooding, public safety, etc.) are listed below:

- Section 3.3 describes the need for a soil erosion and sediment control plan.

- Section 4.3 describes streets. Subdivisions containing more than 20 lots shall have two connections to existing streets. Dead-end streets shall not exceed 700 feet in length. Widths of rights-of-way and paved widths are set as well.

- Section 4.5.4 (Detention) disallows a net increase in stormwater runoff from a site but allows such runoff if the site is within a "reasonable" distance of the Naugatuck River or Housatonic River, and a watershed analysis demonstrates downstream capacity.

- Section 8 (Flood Damage Prevention) requires that any subdivision in a flood hazard area must be designed to minimize flood damage; utilities must be designed to minimize flood damage; adequate drainage shall be provided; and base flood elevation must be indicated on plans.

Shelton

The Subdivision Regulations are administered by the Planning and Zoning Commission. These regulations have been revised through 2001. Components of the regulations that directly or indirectly address hazard mitigation (flooding, public safety, etc.) are listed below:

- Section 2-3-11 (Flood Plain Areas) requires that applications for subdivisions in flood hazard areas shall include written assurance that the flood-carrying capacity of a watercourse will be maintained; that encroachments into a floodway will result in no increase in the base flood elevation; and that base flood elevation data will be furnished for any subdivision of 50 lots or five acres.

- Section 2-4-5 (Flood Plain Development Permit) notes that the subdivision process must include verification of receiving a Development Permit as required by the Flood Damage Prevention code.

- Section 4.4.2 sets the required widths for roadway rights-of-way, and Section 4.4.3 sets the required widths for pavement.

- Section 4.4.10 discourages the use of dead-end streets. When included in a proposal, the dead-end street shall not exceed a length of 10 lots per side.

- Section 4.6 describes drainage provisions. Street drainage systems must be designed to handle two inches of rain per hour, and culverts must be designed to handle four inches per hour. Design of pipe systems must take entire drainage areas into account rather than just the site. The discharge of stormwater shall be into drains, ditches, or other facilities with adequate capacity.

- Section 4.10 (Special Flood Hazard Areas) explains that lots, streets, drainage, and other improvements shall be designed to be capable of use without danger from flooding and must conform to the Flood Prevention Ordinance (code). Streets must be elevated or otherwise suitably protected from flooding for continued access.

- Section 4.10.3 (Preservation) allows the commission to prohibit the subdivision of any portion of a property lying in a flood zone and to protect those areas from damage resulting from clearing, grading, or dumping.

- Section 4.20 describes the information required in sedimentation and erosion control plans.

- Section 4.21 requires installation of underground utilities if five or more units are being constructed.

Inland Wetland and Watercourses Regulations

Ansonia

In Ansonia, the Inland Wetlands Commission is charged with administering the Inland Wetlands and Watercourses Regulations. These regulations were adopted in 1976 and amended in December 2000. In Connecticut, wetlands are identified as related to flood hazard mitigation within the state enabling regulations, and this is often stated as such in the title section of local regulations. The same is true in the Ansonia Inland Wetlands and Watercourses Regulations. Section 2.1.7 of the regulations sets a regulated review area of 100 feet from edge of wetlands. The majority of the regulations describe procedures, appeals, amendments, etc.

Derby

In Derby, the Inland Wetlands Commission is charged with administering the Inland Wetlands and Watercourses Regulations. These regulations are revised through August 1993. In Connecticut, wetlands are identified as related to flood hazard mitigation within the state enabling regulations, and this is often stated as such in the title section of local regulations. The same is true in the Derby Inland Wetlands and Watercourses Regulations. Section 6.2 of the regulations sets a regulated review area of 50 feet from edge of wetlands. Section 6.4 prohibits the increase of stormwater flows from a development site and requires that detention be sized for the 100-year storm with six hours of retention time. The remainder of the regulations describe procedures, appeals, amendments, etc.

Seymour

The Inland Wetlands Commission is charged with administering the Inland Wetlands Regulations. These regulations are revised through September 2008. Section 3.2.4 of the regulations sets an upland review area of 100 feet. The regulations describe permit procedures, enforcement, appeals, etc.

Shelton

The Inland Wetlands Commission is charged with administering the Inland Wetlands and Watercourses Regulations. These regulations are revised through July 2010 and mainly describe permit procedures, enforcement, appeals, etc. Appendix A of the regulations includes a list of setbacks that are necessary between certain activities and watercourses. Interestingly, the setbacks for septic systems vary by watercourse and range from 50 feet from unnamed streams to 100 feet from the Housatonic River, Far Mill River, and Means Brook. Setbacks are 75 feet from most of the remaining named streams. The variable setback likely helps prevent activities in floodplains.

2.11 Critical Facilities, Sheltering Capacity, and Evacuation

The VCOG municipalities consider that several categories of facilities are critical for these are needed to ensure that emergencies are addressed while day-to-day management of the community continues:

- Emergency Services – Include Police and Fire Departments
- Municipal Facilities – Include shelters, Public Works facilities, schools
- Health Care – assisted living and other facilities

A list of critical facilities is provided in Table 2-5 on the next page. Figures 2-9, 2-10, 2-11, and 2-12 depict locations of critical facilities. A few notable categories of critical facilities are discussed after the table.

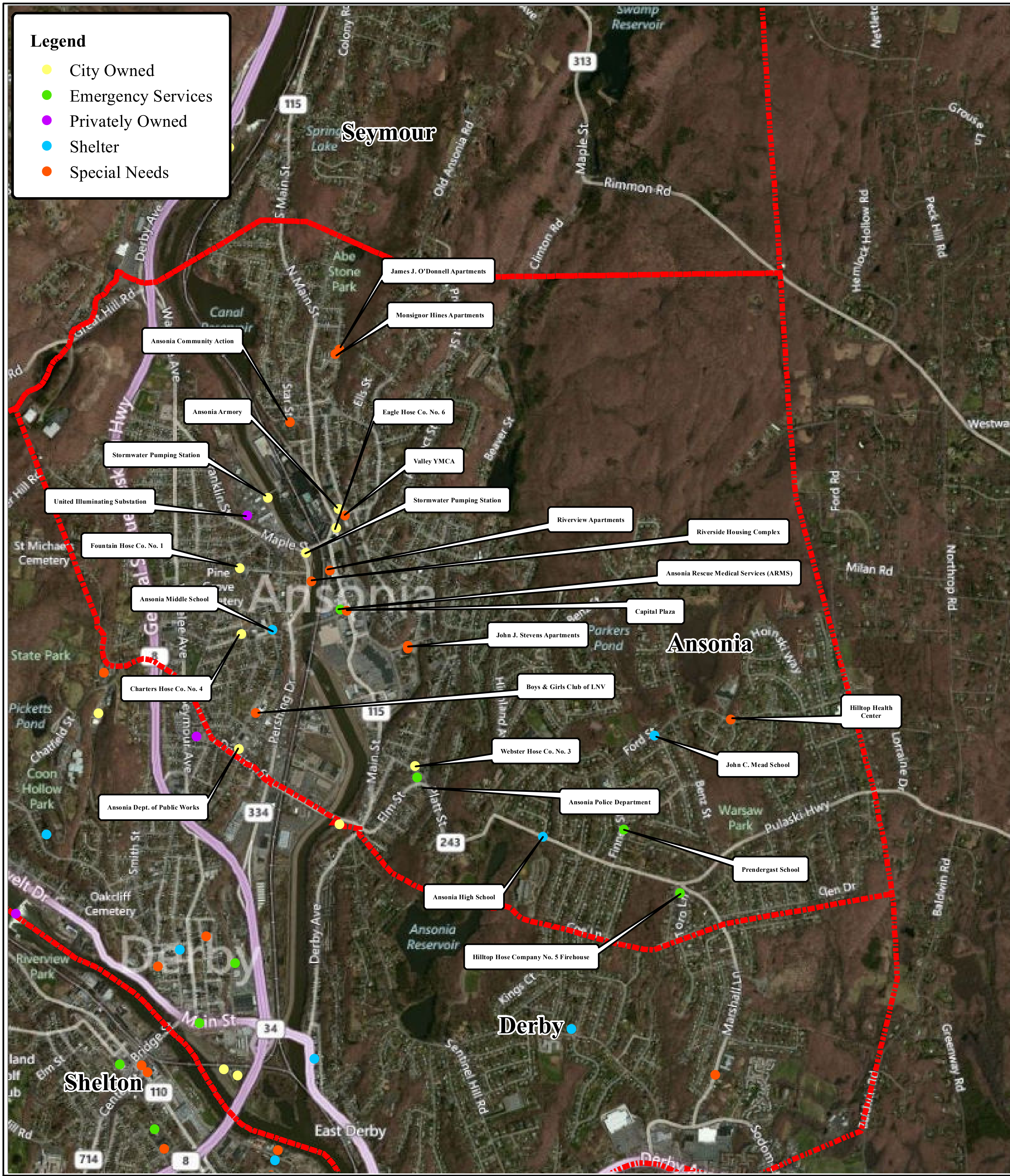
TABLE 2-5
Critical Facilities

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain?
ANSONIA				
Emergency Services				
Police Department (EOC)	2 Elm Street	Yes	No	No
Fountain Hose Company No. 1	191 Howard Street	No	No	No
Webster Hose Company No. 3	67 Platt Street	No	No	No
Charters Hose Company No. 4	4 Murray Street	No	No	No
Hilltop Hose Company No. 5	80 Pulaski Highway	No	No	No
Eagle Hose Company No. 6	1 Main Street	No	No	No
Municipal Facilities				
High School	20 Pulaski Highway	Yes	Yes	No
John C. Mead School	75 Ford Street	Yes	Yes	No
Middle School (ARC-recognized Fall 2012)	115 Howard Avenue	Yes	Yes	No
Prendergast School	59 Finney Street	No	No	No
Ansonia Rescue Medical Services (ARMS)	22 West Main Street	Yes	No	Yes
Public Works	100 Division Street	No	No	No
Armory	6 State Street	No	No	No
Water Pollution Control Authority Sewage Pump Stations	Multiple Locations	Yes	No	Yes
Health Care, Senior Living, Disabled, Elderly, Nursing, Multi-Lingual/Limited Transportation and Rehabilitation Facilities and Daycare Facilities				
Hilltop Health Center (Nursing and Rehabilitation)	126 Ford Street	No	No	No
Julia Day Nursery and Kindergarten (Daycare)	76 Central Street	No	No	Yes
Ansonia Community Action (Daycare)	4 Fourth Street	No	No	No
Valley YMCA (Daycare)	12 State Street	No	No	No
Boys and Girls Club of the Lower Naugatuck Valley (Daycare)	28 Howard Avenue	No	No	No
John J. Stevens Apartments (Elderly)	75 Central Street	No	No	Yes
Monsignor Hynes Apartments (Elderly)	70 Woodlawn Avenue	No	No	No
James J. O'Donnell Apartments (Elderly)	63 Woodlawn Avenue	No	No	No
Riverside Housing Complex (Multi-Lingual/Limited Trans.)	36 Olsen Drive	No	No	Yes
Riverview Apartments (Disabled and Elderly)	15 West Main Street	No	No	Yes
Capital Plaza (Disabled and Elderly	290 Main Street	No	No	Yes
Other Facilities				
United Illuminating Company Substation	Riverside Drive	Yes	No	Yes

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain?
DERBY				
Emergency Services				
Police Department	125 Water Street	Yes	No	Yes (Parking Lot)
Hotchkiss Hose Company No. 1	200 David Humphrey Road	Yes	Temporary	No
Storm Engine Company No. 2	151 Olivia Street	No	Temporary	No
East End Hose Company No. 3	Derby Milford Road	No	Temporary	No
Paugassett Hook & Ladder Company No. 4	57 Derby Avenue	No	Temporary	No
City Hall (EOC)	1 Elizabeth Street	Yes	No	No
Municipal Facilities				
Middle School	10 Nutmeg Avenue	No	Yes	No
Bradley School	155 David Humphrey Road	No	Yes	No
Public Works	65 Coon Hollow Road	No	No	No
Wastewater Treatment Plant	South End of Factory Street	No	No	Yes
WPCA Sewer Pump Stations	8 Locations: (2) Roosevelt Drive, (2) South Division Street, (2) Burtville Avenue, (2) Patty Ann Terrace	Yes	No	No
WPCA Stormwater Pump Stations	6 Locations: Division Street (Derby), Ansonia City Line (Derby), Derby WWTF, Ansonia City Line (Ansonia), Maple Street (Ansonia), Riverside Drive (Ansonia)	Yes	No	Yes
Assisted Living, Elderly, and Health Facilities				
Marshall Lane Manor (Assisted Living)	101 Marshall Lane	Yes	No	No
Birmingham Health Center (Assisted Living)	219 Chatfield Street	Yes	No	No
Stygar Terrace (Elderly)	Stygar Terrace	No	No	No
Guardino Terrace (Elderly)	Guardino Terrace	No	No	No
Cicia Manor (Elderly)	West Fourth, Anson & Fifth Streets	No	No	No
Old Derby High School (Hallock's Landing) (Elderly)	Minerva Street	No	No	No
Griffin Hospital	130 Division Street	Yes	No	No
Griffin Hospital Cancer Center	350 Seymour Avenue	Yes	No	No
Lakeview Apartments (Elderly)	Roosevelt Drive (Route 34)	No	No	No
Other Facilities				
Derby Dam (Owner: McCallum Enterprises)	Housatonic River Near Galiardi Street	No	No	Yes

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain?
SEYMOUR				
Emergency Services				
Police Department	11 Franklin Street	Yes	No	Yes (500-Year)
Great Hill Hose Fire Company (EOC)	140 Botsford Road	Yes	No	No
Citizens Engine No. 2	26 DeForest Street	Yes	No	Yes (500-Year)
Seymour EMS	4 Wakeley Street	Yes	No	No
Municipal Facilities				
Middle School	211 Mountain Road	Yes	Yes	No
Paul E. Chatfield Elementary School (ARC-recognized Fall 2012)	51 Skokorat Street	Yes	Yes	No
Water Pollution Control Facility	723 Derby Avenue	Yes	No	Yes
Public Works	721 Derby Avenue	Yes	No	Yes
Assisted Living and Elderly Housing				
Smithfield Gardens (Assisted Living)	26 Smith Street	Yes	No	No
Shady Knoll Health Care (Assisted Living)	43 Skokorat Street	No	No	No
Norman Ray House (Elderly Housing)	133 Walnut Street	No	No	No
Reverend Callahan House	32 Smith Street	No	No	No
Other Facilities				
Regional Water Authority Wellfield	Route 34 East of Jefferson Street	Yes	No	Yes
SHELTON				
Emergency Services				
Police Department (Backup EOC)	85 Wheeler Street	No	No	No
Echo Hose Hook & Ladder Company No. 1	379 Coram Street	No	No	No
Huntington Fire Company No. 3	44 Church Street	No	No	No
Pine Rock Fire Company No. 4	722 Long Hill Avenue	No	No	No
White Hills Fire Company No. 5	2 School Street	No	No	No
Municipal Facilities				
Shelton High School	120 Meadow Street	No	Yes	No
Community Center	41 Church Street	Yes	Yes	No
Animal Shelter	20 Riverdale Avenue	Yes	Yes	No
City Hall (EOC)	54 Hill Street	Yes	No	No
Public Works	41 Myrtle Street	No	No	No
Water Pollution Control Facility	10 Riverdale Avenue	Yes	No	Yes
Elderly, Assisted Living, Convalescent, Daycare, and Mobile Home Park Facilities				
Sinsabaugh Heights (Elderly Housing)	187 Meadow Street	No	No	No
Wesley Village (Elderly Housing)	580 Long Hill Avenue	No	No	No

Facility	Address or Location	Emergency Power Supply?	Shelter?	In Floodplain?
The Ripton (Elderly Housing)	423 Howe Avenue	No	No	No
Helen DeVeaux House (Elderly Housing)	Howe Avenue	No	No	No
Crosby Commons (Assisted Living)	580 Long Hill Avenue	No	No	No
Shelton Lakes (Convalescent Home)	5 Lake Road	No	No	No
Bishop Wicke Health Center (Convalescent Home)	580 Long Hill Avenue	No	No	No
Gardner Heights (Convalescent Home)	172 Rocky Rest Road	No	No	No
Hewitt Memorial Hospital (Convalescent Home)	45 Maltby Street	No	No	No
The Hideout (Daycare)	49 Mohegan Road	No	No	No
Apple Tree Daycare (Daycare)	117 Long Hill Cross Road	No	No	No
A Child's Garden (Daycare)	20 Ivy Brook Road	No	No	No
Bright Horizons (Daycare)	3 Corporate Drive	No	No	No
Happy Day (Daycare)	41 Church Street	No	No	No
Kidstop (Daycare)	215 Bridgeport Avenue	No	No	No
Little Academy (Daycare)	250 River Road	No	No	No
Pumpkin Preschool (Daycare)	100 Beard Saw Mill Road	No	No	No
Wonder Years (Daycare)	188 Rock Rest Road	No	No	No
Woodland Park (Mobile Home Park)	515 Bridgeport Avenue	No	No	No
Fairchild Heights (Mobile Home Park)	804 Bridgeport Avenue	No	No	No
Sunnyside (Mobile Home Park)	South Main Street	No	No	No



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
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Figure 2-9: Ansonia Critical Facilities

LOCATION: **Ansonia, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-9_CFsAns.mxd
1st Version: 3/1/2012
Revision: 3/12/2012
Scale: 1 inch = 2,500 feet

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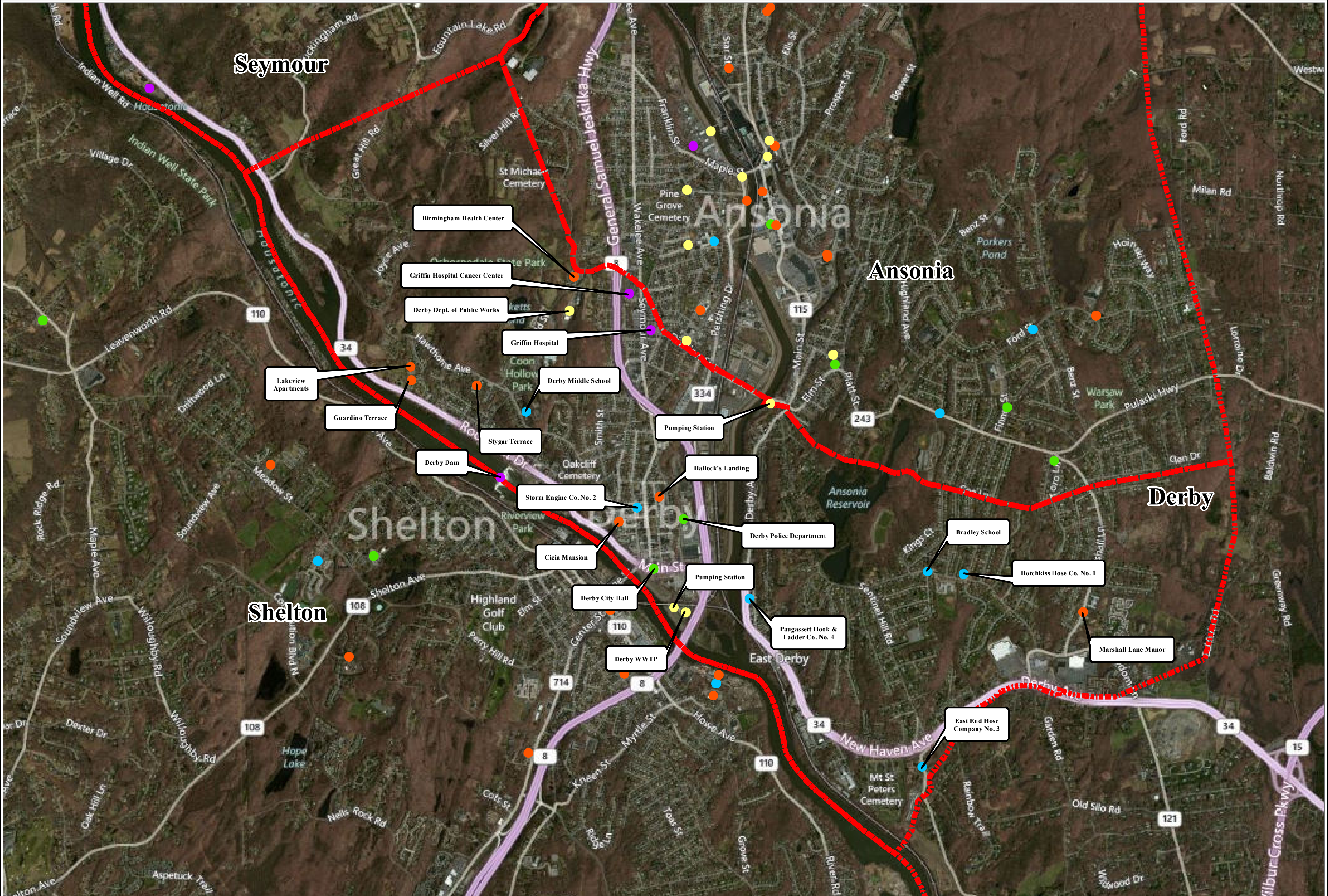

SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
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Figure 2-10: Derby Critical Facilities

VCOG Hazard Mitigation Plan

LOCATION: **Derby, CT**

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig2-10_CFs.mxd
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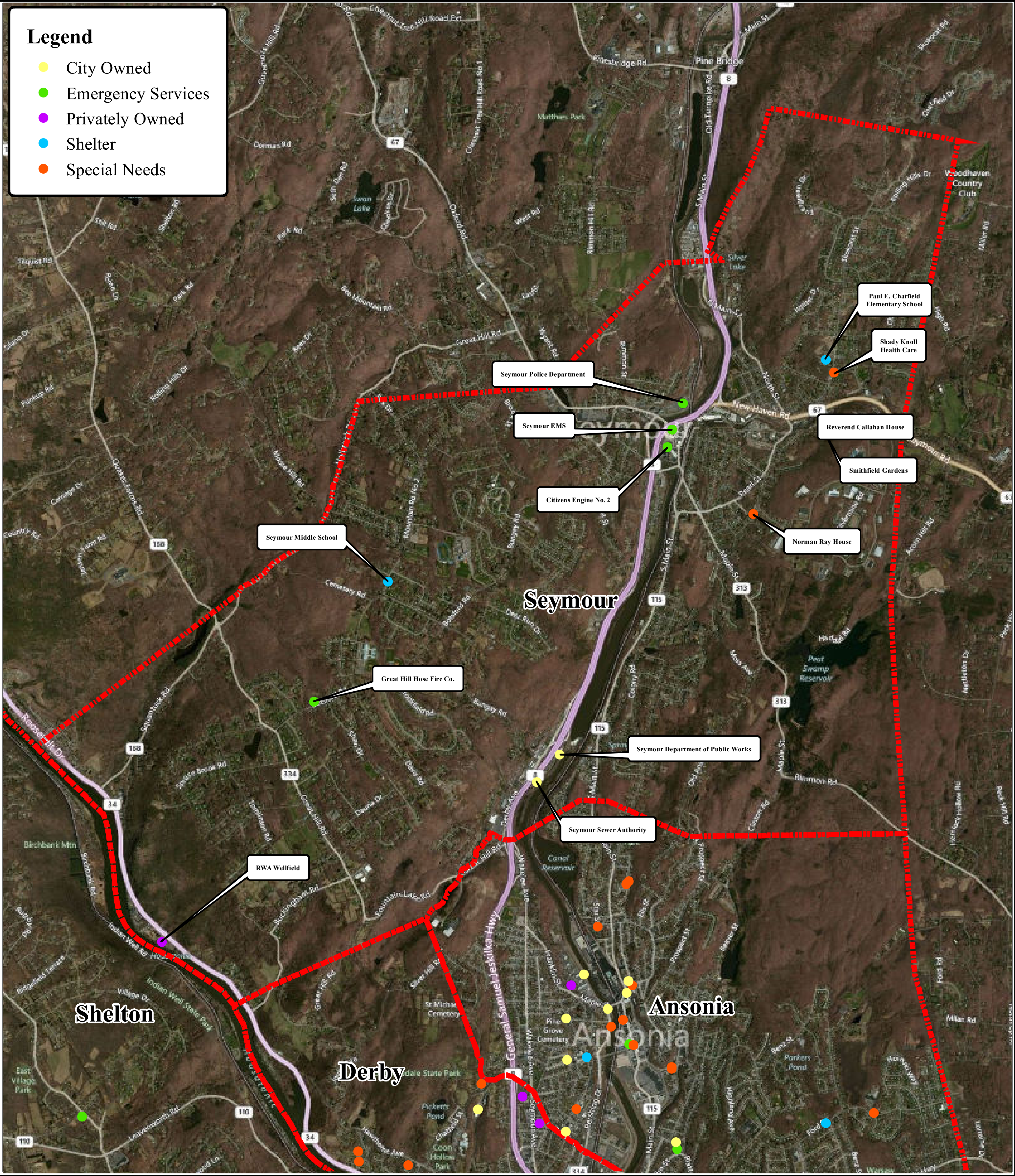

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Figure 2-9: Seymour Critical Facilities

LOCATION: **Seymour, CT**

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VCOG Hazard Mitigation Plan

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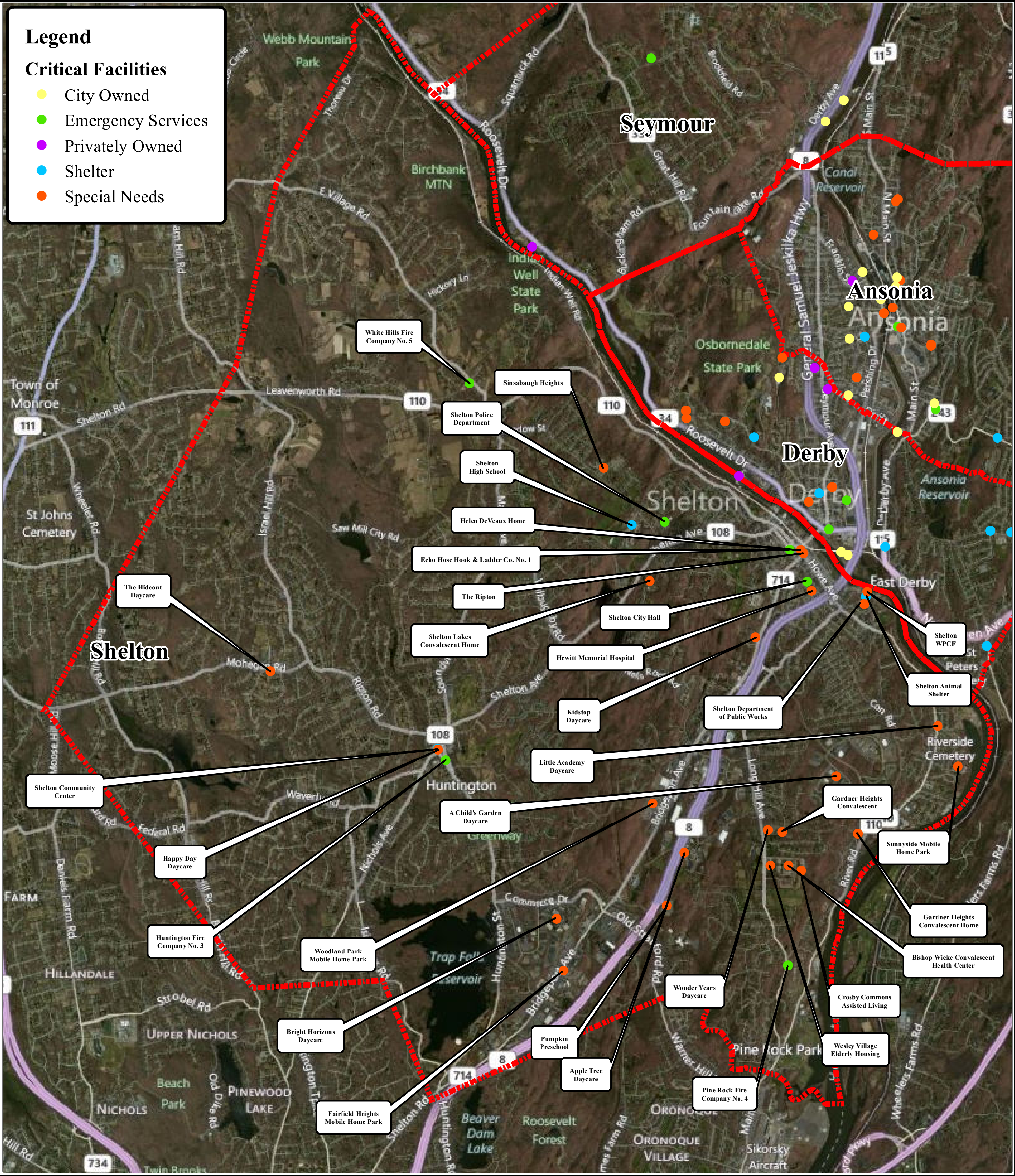

SOURCE(S):
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Figure 2-12: Shelton Criticial Facilities

LOCATION: **Shelton, CT**

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Fire and Police Department Facilities

Ansonia

The Ansonia Fire Department is comprised of five firehouses that are staffed by volunteer men and women who train year-round to develop and maintain their firefighting skills. According to their website, the goal of the Ansonia Fire Department is to protect the life and property of Ansonia residents. The five firehouses that comprise the Ansonia Fire Department are Fountain Hose Company No. 1 located at 191 Howard Avenue, Webster Hose Company No. 3 at 67 Platt Street, Charters Hose Company No. 4 at 4 Murray Street, Hilltop Hose Company No. 5 at 80 Pulaski Highway, and Eagle Hose Company No. 6 at 1 Main Street. The Hilltop Hose Company No. 5 has radio communication technologies and is the city's backup EOC. None of the firehouses are located in a flood zone.

The Ansonia Police Department is located at 2 Elm Street and is the city's EOC. According to the city's website, it is the mission of the Ansonia Police Department to protect and preserve life and property, to reduce the incidence of fear of crime, and to improve the quality of life by maintaining order and apprehending criminals. [The Police Department's] mandate is to do so with honor, integrity, and with the highest ethical standards while dealing with the public at all times with courtesy, professionalism, and respect. The Police Department is not located in a flood zone.

Derby

The Derby Fire Department consists of four firehouses located through the city. The department consists of Hotchkiss Hose Company No. 1 at 200 David Humphrey Road, Storm Engine Company No. 2 at 151 Olivia Street, East End Hose Company No. 3 on Derby-Milford Road, and Paugassett Hook and Ladder Company No. 4 at 57 Derby Avenue. In addition to serving the city, the Fire Department is often called into neighboring municipalities for mutual aid. All of the firehouses are located outside of the flood zones in the city.

The Derby Police Department is located at 125 Water Street. The parking lot of the Police Department is located in the X Protected by Levee flood zone (protected by the Derby/Ansonia Levee System). The Police Department provides service, protection, and assistance to the city's residents.

Seymour

The Seymour Fire Department is a volunteer fire department and consists of two firehouses: Citizens Engine Company No. 2 located at 26 DeForest Street and Great Hill Hose Company located at 140 Botsford Road. Neither location has generators, and the Citizens Engine Company No. 2 is located in the FEMA 500-year flood zone. The Fire Department provides fire and rescue protection for residents and consists of approximately 150 volunteers. The Fire Department is managed by a Fire Chief and three Assistant Chiefs. The Fire Chief reports to the Board of Fire Commissioners whose members are appointed by the First Selectman.

The Seymour Police Department is located at 11 Franklin Street and is located in the 500-year flood zone. The Police Department employs a full-time force of 34 officers augmented by five part-time officers. There are two full-time civilians and five part-time civilians that provide ancillary services for the department. The department is overseen by a Board of Police Commissioners that are responsible for establishing policies and procedures.

Shelton

The Shelton Fire Department is comprised of four fire stations that are located throughout the city: Echo Hose Hook and Ladder Company located at 379 Coram Street, Huntington Fire Company at 44 Church Street, Pine Rock Park Fire Company at 722 Long Hill Avenue, and White Hills Fire Company at 2 School Street. None of the fire stations are located within a flood zone. According to the Shelton Fire Prevention Bureau's website, the Shelton Fire Department's mission is to ensure that all persons and property within the city of Shelton remain safe from the perils of fire. To accomplish this [the department engages] in various public education campaigns and programs that focus on the strategies of preventing fire and also preparing for emergencies. Programs not only involve traditional year-round interaction with school age children but also include consultation with businesses, organizations, and community associations. [The department encourages] "one-on-one" interaction and any unique efforts that will help achieve [the department's] mission and goals.

The Shelton Police Department is located at 85 Wheeler Street and is not located in a flood zone. According to the Police Department's website, its mission is to enhance the quality of life within the community by providing services with professionalism and a commitment to excellence. The Police Department consists of 55 officers and 19 civilian members that are dedicated to enhancing the quality of life in Shelton to those that live or work in the city.

Relocation of fire stations from flood zones is not necessarily the best use of municipal resources as long as other fire stations and critical facilities such as the Public Works facilities (described below) are safe during disasters. However, the Derby Police Department, Seymour Police Department, and Citizens Engine No. 2 in Seymour, which are all located in flood zones, may be upgraded via floodproofing methods to ensure that damage is limited if these facilities should be flooded.

Public Works Facilities

The only VCOG municipal Public Works facility that is in a FEMA flood zone is the Seymour Public Works facility located at 721 Derby Avenue. Seymour is aware of this.

The town needs to implement different flood mitigation techniques on the site to prevent future damages associated with flooding.

The remaining VCOG municipalities believe that, located outside of FEMA flood zones, their Public Works facilities are situated in appropriate locations relative to hazard mitigation and disaster resiliency.

<u>Shelters</u>

Emergency shelters are considered to be an important subset of critical facilities as they are needed in emergency situations. These critical facilities are briefly described below by town.

<u>Ansonia</u>

The Ansonia High School located at 20 Pulaski Highway is the primary shelter while the John C. Meade School located at 75 Ford Street is the secondary shelter facility. Both facilities are recognized as ARC shelter facilities. In addition, Ansonia is in the process of approving the Ansonia Middle School at 115 Howard Avenue as the city's third shelter. This location is needed per the chance that the Naugatuck River were to divide the city removing the possibility of transit across the Naugatuck River from one side of the city to the other. The John C. Meade School shelter facility is also animal compatible so long as owners remain with their animals. Both existing and future shelter facilities have or will have a generator on site.

<u>Derby</u>

Derby has two shelters that are designated by the EMD. The shelters are the Derby Middle School at 10 Nutmeg Avenue and the Bradley School at 155 David Humphrey Road. Neither facility has a generator. The EMD also designates the four fire stations as temporary shelters. According to Derby officials, people may congregate at any of the four fire stations while waiting for transpiration to the two designated shelters. None of the fire stations have a generator, and none are located in a flood zone.

<u>Seymour</u>

Seymour currently has one ARC-recognized shelter. This facility is the Seymour Middle School, which is located at 211 Mountain Road. Paul E. Chatfield Elementary School at 51 Skokorat Street will become the town's second shelter when renovations are completed and a full-capacity generator is installed by September 2012. At that point, both locations will have generators. Neither location is located in a flood zone.

<u>Shelton</u>

Shelton has two shelters: Shelton High School at 120 Meadow Street and the Community Center at 41 Church Street, which is a secondary (backup) shelter. Both locations are ARC-recognized, and the Animal Shelter at 20 Riverdale Avenue houses pets during emergencies. The owners of the pets must remain with their pets throughout the duration of the pets' stay during an emergency. None of the three locations are located in a flood zone. Shelton desires a new generator for the high school that can power freezers, restrooms, the gym, and heating and cooling systems.

The VCOG municipalities plan to continue working with other municipal departments and officials to provide upgrades to the designated shelters.

The ARC has published a guidebook entitled *Standards for Hurricane Evacuation Shelter Selection* (American Red Cross Publication #4496). The publication provides guidelines for selecting shelters relative to resilience from storm surges, flooding, and hurricane winds. While the publication recognizes that not all communities are able to identify an ideal shelter, it urges communities to consider as many of the criteria as possible. The ARC also has formal standards for shelters regarding space and internal facilities, but these standards are unrelated to structural resilience.

Several FEMA publications provide design criteria for shelters, including *Design and Construction Guidance for Community Shelters* (FEMA Publication #361). A reference by the International Code Council (ICC) and the National Storm Shelter Association, *Standard on the Design and Construction of Storm Shelters* (ICC-500), also provides design criteria. In general, recommended design wind speeds range from 160 to 250 miles per hour (mph) in these publications. In contrast, Connecticut's building code for shoreline municipalities requires a resistance to wind speeds up to 110 mph. Thus, a critical facility may be code compliant but unable to withstand the highest hurricane wind speeds, making it an inferior choice as primary shelter if another option can withstand higher wind speeds.

The FEMA PDM program is the current FEMA mitigation grant program best suited to funding wind mitigation projects. The PDM program recognizes four categories of projects for wind damage mitigation in critical facilities as follows:

- "Shutter mitigation" projects protect all windows and doors of a structure with shutters or other systems that meet debris impact and wind pressure design requirements. All openings of a building are to be protected.
- "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 event.
- "Code plus" projects are those designed to exceed the local building codes and standards to achieve a greater level of protection.

Aside from any structural issues, a primary shelter should have the ability to operate with a standby source of power such as an emergency generator. While FEMA's mitigation programs are not able to fund generators, other funding programs are available for purchase of generators. The most notable example is the "Emergency Operations Center and Emergency Shelter Generator Grant Program" administered by the Connecticut DESPP. This program specifically targets emergency operations centers and shelters, and awards can only be made for municipal facilities. Derby could pursue this source of funding.

Other Municipal Facilities

Ansonia

Ansonia has two municipally owned facilities that are in FEMA flood zones: the Ansonia Rescue Medical Services (ARMS) facility at 22 West Main Street and the Water Pollution Control Authority (WPCA) Sewage Pump Stations, which are located throughout the city. The ARMS facility is located in the flood zone labeled as Zone X Protected by Levee while the WPCA Sewage Pump Stations are located in Zone AE of the Naugatuck River.

Derby

As is the case in Ansonia, Derby has two municipally owned facilities that are in FEMA flood zones: the Derby Wastewater Treatment Plant (WTP) at the south end of Factory Street and the Derby WPCA Stormwater Pump Stations at various locations throughout the city. The Derby WTP is located in the flood zone labeled as Zone X Protected by Levee associated with the confluence of the Naugatuck and Housatonic Rivers while the WPCA Stormwater Pump Stations are located in Zone AE of the Naugatuck and Housatonic Rivers.

Seymour

Like Ansonia and Derby, Seymour has two municipally owned facilities that are located in FEMA flood zones. These facilities are the Water Pollution Control facility at 723 Derby Avenue and the Public Works facility at 721 Derby Avenue. Both facilities are in the 500-year flood zone of the Naugatuck River.

All these municipally owned facilities would benefit from flood mitigation strategies such as elevation, berming, and other floodproofing procedures.

Health Care, Assisted Living, Daycare, and Special Needs Populations

Ansonia is the only VCOG municipality that has any critical facilities of these types located within a flood zone. These facilities are as follows:

- Julia Day Nursery and Kindergarten (Daycare) at 76 Central Street is in the 500-year flood zone associated with the Naugatuck River and Beaver Brook.
- John J. Stevens Apartments (Elderly) at 75 Central Street is in the same flood zone as the Julia Day Nursery and Kindergarten facility described above.
- Riverside Housing Complex (Multi-Lingual/Limited Transportation) at 36 Olsen Drive is located in the 500-year flood zone of the Naugatuck River.
- Riverview Apartments at 15 West Main Street
- Capital Plaza at 290 Main Street is located at the intersection of the 500-year flood zone and the Zone X Protected by Levee associated with the Naugatuck River.

Evacuation Routes and Preparedness

Evacuation routes for the VCOG municipalities are maintained and understood by the EMDs in each community. Evacuation routes are dependent on local conditions, and the communities must maintain flexibility in designating these routes. Therefore, this HMP is not an appropriate vehicle for modifying them. However, there are certain neighborhoods that are known to be at risk for impaired access during floods. These areas should be targeted for development of specific evacuation protocols. Examples include the residents at the end of Indian Well Road in Shelton that can be cut off by floodwaters from the Housatonic River and residents in northern Shelton that can be cut off by floodwaters from the Housatonic River.

Certain critical facilities – those that house vulnerable populations and have a higher disaster risk than comparable facilities elsewhere – should also be targeted for development of site-specific evacuation plans or protocols.

FEMA and CitizenCorps have published disaster planning guides known as the "Are You Ready?" series (http://www.ready.gov/are-you-ready-guide). These are considered among the best of the planning guides that are available from disaster-related planning and response organizations. Key publications from the series should be available to all Valley residents.

Recommendations for Critical Facilities and Evacuation

The following recommendations are suggested:

- Obtain copies of the disaster planning guides and manuals from the "Are You Ready?" series (http://www.ready.gov/are-you-ready-guide) and make them available at the City and Town Halls and Community Centers.
- Review and update the evacuation route maps for the VCOG municipalities at least once annually and consider posting them to the VCOG municipalities' websites.

- Acquire and install evacuation signs in SFHAs throughout the VCOG municipalities.
- Pursue funding and install generators at both Derby shelters (Derby Middle School and the Bradley School) and at the three fire stations that are currently designated by the city as temporary shelters.
- Following the installation of generators at the Derby shelters, certify them with the ARC.
- Pursue funding and install a generator at Shelton High School.
- Consider floodproofing measures for critical facilities located in designated flood zones:
  - Derby Police Station
  - Seymour Police Station
  - Citizens Engine No. 2 Fire House in Seymour
  - ARMS facility at 22 West Main Street
  - Ansonia WPCA Sewage Pump Stations throughout Ansonia
  - Derby WTP at the south end of Factory Street
  - Derby WPCA Stormwater Pump Stations throughout Derby
  - Seymour Water Pollution Control facility at 723 Derby Avenue
  - Seymour Public Works facility at 721 Derby Avenue
- Develop site-specific evacuation plans for various critical facilities in designated flood zones that house vulnerable populations:
  - Julia Day Nursery and Kindergarten (Daycare) at 76 Central Street in Ansonia
  - John J. Stevens Apartments (Elderly) at 75 Central Street in Ansonia
  - Riverside Housing Complex (Multi-Lingual/Limited Transportation) at 36 Olsen Drive
  - Riverview Apartments (Disabled and Elderly) at 15 West Main Street
  - Capital Plaza (Disabled and Elderly) at 290 Main Street
- Develop an evacuation plan for residents at the end of Indian Well Road in Shelton that can be cut off by floodwaters from the Housatonic River.
- Develop an evacuation plan for residents in northern Shelton that can be cut off by floodwaters from the Housatonic River.

Refer to Appendix A for STAPLEE scores associated with these recommendations.

3.0 FLOODING

3.1 Setting

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

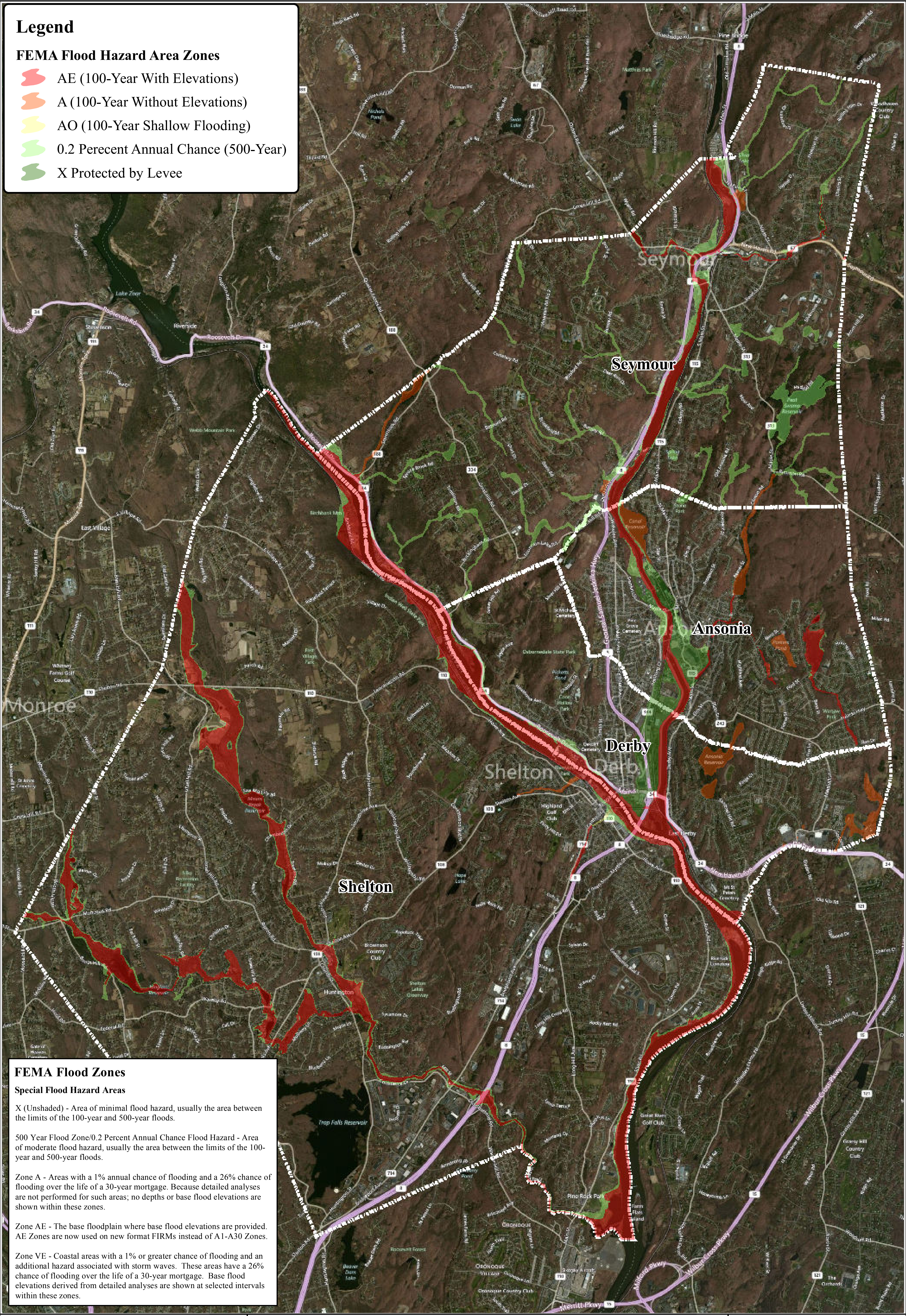
Many communities also have localized flooding areas outside the SFHA. These floods tend to be shallower and chronically reoccur in the same area due to a combination of factors. Such factors can include ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed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

In general, the potential for flooding is widespread across the VCOG municipalities, with the majority of major flooding occurring along established SFHAs. The areas impacted by overflow of river systems are generally limited to river corridors and floodplains. Indirect flooding that occurs outside floodplains and localized nuisance flooding along tributaries are also common problems in different areas of member municipalities. The frequency of flooding in VCOG municipalities is considered highly likely for any given year, with flood damage potentially having significant effects during extreme events (refer to Tables 1-2 and 1-3).

This section addresses riverine flooding as well as nuisance flooding. Refer to Figure 3-1 for the areas of VCOG municipalities susceptible to riverine flooding based on FEMA flood zones.

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 and may also cause landslides and slumps in affected areas.



FEMA Flood Zones

Special Flood Hazard Areas

X (Unshaded) - Area of minimal flood hazard, usually the area between the limits of the 100-year and 500-year floods.

500 Year Flood Zone/0.2 Percent Annual Chance Flood Hazard - Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods.

Zone A - Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.

Zone AE - The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.

Zone VE - Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

SOURCE(S):

Base Map:
"Bing Maps Hybrid" Datalayer
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"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

Figure 3-1: FEMA Flood Hazard Areas

Location: **Ansonia, Derby, Seymour & Shelton, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-1_FEMAVCOG.mxd
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Types of Flooding – According to FEMA, there are several different types of 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
  - **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.

Flood Frequencies – In order to provide a national standard without regional discrimination, the "100-year flood" has been adopted by FEMA as the base flood for purposes of floodplain management and to determine the need for insurance. This flood has a 1% chance of being equaled or exceeded each year. The risk of having a flood of this magnitude or greater increases when periods longer than one year are

> *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.*

considered. For example, FEMA notes that a structure located within a 100-year flood zone has a 26% chance of suffering flood damage during the term of a 30-year mortgage. Similarly, a 500-year flood has a 0.2% chance of occurring in a given year. The 500-year floodplain indicates areas of moderate flood hazard.

NFIP Participation – Ansonia has participated in the NFIP since 1981, Derby since 1977, while Seymour and Shelton have been participating since 1978.

- The original FIS and FIRM for flooding sources in Ansonia are based on work completed on May 3, 1974 (publication of the initial flood hazard boundary) and published on September 2, 1981 (the date of the initial FIRM), with revisions in 1992.

- Derby's original FIS and FIRMs are based on work completed on June 28, 1974 (publication of the initial flood hazard boundary) and published on September 15, 1977 (the date of the initial FIRM), with revisions in 1991.

- Seymour had its original FIS and FIRMs based on work completed on July 26, 1974 (publication of the initial flood hazard boundary) and published on July 3, 1978 (the date of the initial FIRM), with revisions in 1991.

- The original FIS and FIRMs for flooding sources in Shelton are based on work completed on May 24, 1974 (publication of the initial flood hazard boundary) and published on September 29, 1978 (the date of the initial FIRM), with revisions in 1991 and 2000.

Current SFHAs in the VCOG municipalities are delineated on DFIRMs and described in updated FISs. The FIRM delineating areas within Ansonia, Derby, and Seymour that are vulnerable to flooding was most recently published on December 17, 2010 combined with the remainder of New Haven County. Shelton had its most recently published FIRM published on June 18, 2010 along with the remainder of Fairfield County. The current FIS for each county was published on the same dates as the FIRM panels.

Mapping – Refer to Figure 3-1 for the areas of the VCOG municipalities susceptible to flooding based on FEMA mapping. Table 3-1 describes the various zones depicted on the FIRM panel for the VCOG municipalities.

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. This area may include a mapped floodway.
AO	An area subject to inundation by 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet.
0.2% Annual Chance Flood Hazard	An area inundated by 500-year flooding, for which no BFEs have been determined.
X Protected by Levees	An area protected by levees from 100-year flooding.
X (unshaded)	An area that is determined to be outside the 100- and 500-year floodplains.

In Ansonia, the Naugatuck River, Twomile Brook, Beaver Brook, and a tributary to Beaver Brook are all mapped as Zone AE while Parkers Pond, the Ansonia Reservoir, Quillinan Reservoir and upper Beaver Brook, and Canal Reservoir are all mapped as Zone A. A majority of the area surrounding the Naugatuck River in central Ansonia is mapped as "Zone X Protected by Levee." Colony Pond, a tributary of Fountain Lake, and areas surrounding the Zone AE-mapped areas of the Naugatuck River are all zoned as 500-year flood zones.

In Derby, the areas surrounding the Naugatuck and Housatonic Rivers are mapped as Zone AE while the area surrounding the Ansonia Reservoirs, Twomile Brook, and small sections of a tributary to Twomile Brook near Sodom Lane are mapped as Zone A. Most of central Derby surrounding Route 8 east to the Naugatuck River and south to the Housatonic River is mapped as "Zone X Protected by Levee." Some areas to the north of the Housatonic River are mapped as 500-year flood zones.

In Seymour, the Bladens River, Little River, the Housatonic River, and the Naugatuck River are all mapped as Zone AE while Fourmile Brook, the lower section of Kinneytown Brook, the stretch of Rimmon Brook just prior to its confluence with the Naugatuck River, and Beaver Brook just prior to entering Ansonia are all mapped as Zone A. The remaining mapped floodplains in Seymour are all the 500-year flood zone.

Zone AO in downtown Shelton

In Shelton, Means Brook, the Farmill River, and the Housatonic River are all mapped as Zone AE while the lower reach of Curtiss Brook is mapped as Zone A, and the lower reach of Burying Ground Brook (in the urban downtown area) is mapped as Zone AO.

Other areas surrounding Means Brook, the Farmill River, and the Housatonic River are all mapped as the 500-year flood zone.

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

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 throughout large watersheds during storms and the greater hydraulic capacity of the downstream channel to convey floodwaters. Dams and other flood control structures can also reduce the magnitude of peak flood flows. 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.

The recurrence interval level of a precipitation event often differs from the recurrence interval level of the associated flood. With the many dams along the Housatonic and Naugatuck Rivers and the position of the region at the ends of these long rivers, the VCOG communities are accustomed to experiencing riverine floods that are not "matched" to storm frequencies. For example, Tropical Storm Floyd in 1999 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 nearby in Beacon Falls, Connecticut.

3.3 Historic Record

The region has experienced various degrees of flooding in every season of the year throughout its recorded history. Similar to other communities in the northeast, melting snow combined with early spring rains has 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.

Historical Incidents – According to the 2010 FEMA FIS, at least 26 "major" storms occurred in Connecticut since 1693. The notable historical floods in the first half of the 20th century occurred in March 1936, September 1938, January 1949, August 1955, October 1955, and September 1960.

The year 1955 was a devastating year for flooding in Connecticut, but impacts were especially severe in the VCOG region. Connie was a declining tropical storm (described in Section 4.0) when it hit Connecticut in August 1955, producing heavy rainfall of four to six inches across the state. The saturated soil conditions exacerbated the flooding caused by Tropical Storm Diane five days later, the wettest tropical cyclone on record for the northeast. The storm produced 14 inches of rain in a 30-hour period, causing destructive flooding conditions along nearly every major river system in the state. Flooding of the Mad and Still Rivers in Winsted and the Naugatuck River, the Farmington River, and the Quinebaug River caused the most damage.

When heavy rains caused the floods of October 1955, damage was generally lower since there was limited time to rebuild following the August storms. The August and October floodwaters resulted in over 100 deaths, left 86,000 unemployed, and caused an estimated $500 million in damages (1955 United States Dollars, or USD) in Connecticut. To put this damage value in perspective, consider that the total property taxes levied by all Connecticut municipalities in 1954 amounted to $194.1 million.

Recent Incidents – The following are descriptions of more recent examples of floods in and near the VCOG region as described in the National Climatic Data Center (NCDC) Storm Events Database based on correspondence with municipal officials and news and press archives.

- May 31, 1998: Severe thunderstorms formed over southwest Connecticut producing heavy rain, hail, frequent lightning and gusty winds.

- August 18, 1998: Severe thunderstorms moved southeast across the area and produced high winds, heavy rain, and hail.

- August 26, 1998: Thunderstorms moved east to northeast across the region producing high winds, frequent lightning, and heavy rain.

- January 3, 1999: Two low-pressure systems produced rain, freezing rain, and sleet. Rain fell on frozen ground surfaces at rates as high as three inches per hour, and rapid runoff caused serious widespread flooding of low-lying and poor-drainage areas. The rainfall total in Ansonia was 4.30 inches.

- February 2, 1999: A warm front and a low-pressure system combined to produce heavy rain that caused flash flooding and isolated flooding of low-lying and poor-drainage areas across southern Connecticut. In Seymour, a reported 3.07 inches of rain fell.

- July 15, 2000: Bands of heavy rain moved southeast to northwest across the region. Heavy rainfall caused serious and widespread flooding of low-lying and poor-drainage areas. In Shelton, a reported 4.65 inches of rain fell.

- August 16, 2003: A cluster of thunderstorms and heavy showers moved slowly southeast while torrential rain caused flash flooding along parts of Route 8 in Seymour, which was reported by broadcast media.

- August 21, 2004: Showers moved east across the area during the afternoon and evening hours and brought about the development of numerous severe thunderstorms across the region.

- March 7, 2011: Following generally wet conditions in the Housatonic River watershed and coinciding with a melting snowpack, several inches of rain fell in the region – and upstream – on March 6, 2011. Moderate to major flooding occurred across portions of southern Connecticut. The Housatonic River went into flood stage, and severe flooding was experienced below the Stevenson Dam in Oxford, Shelton, and Derby. Three vehicles and two structures were observed floating down the Housatonic River in Oxford. Evacuations were ordered in the Maples section of Shelton (41 homes) and the McConney Grove section of Derby (a partial evacuation of the 25 homes). O'Sullivan's Island in downtown Derby was inundated.

Maples Neighborhood, 9/8/11

- August 15, 2011: A steady and heavy rainfall across the region caused significant drainage-related and nuisance flooding. Numerous basements were flooded in Derby, and the Gilbert Street area was especially hard hit.

- September 8, 2011: The remnants of Tropical Storm Lee combined with a frontal system caused rain from September 6 through the morning of September 8, 2011. In particular, heavy rain fell overnight from September 7 through 8. The Naugatuck River crested midday on September 8 just below flood stage at the Beacon Falls gauging station, just upstream of Seymour. The Housatonic River was in flood stage and expected to crest on the afternoon of September 8, exceeding the stage of the 10-year storm at the Stevenson

McConney Grove Neighborhood, 9/8/11

gauging station. Moderate flooding occurred in the Maples section of Shelton and the McConney Grove section of Derby.

- July 8, 2011: Three to five inches of rain fell within two hours in Seymour, flooding a mile of Route 8 up to several feet deep. A portion of Route 67 was closed due to debris in the roadway.

Refer to Appendix E for copies of newspaper articles about the three floods described above in the year 2011.

3.4 Existing Programs, Policies, Capabilities, and Mitigation

The VCOG communities have in place a number of measures to mitigate for flood damage. These include regulations, codes, and ordinances preventing encroachment and development near floodways; dams and levees; acquisitions and elevations of structures; and monitoring efforts and emergency services.

Regulations, Codes, and Ordinances

The municipal codes, Zoning Regulations, Subdivision Regulations, and Inland Wetland and Watercourses Regulations were described in detail in Section 2.10. The Planning and Zoning Commissions, Inland Wetlands and Watercourses Commissions, and the Building Officials are all charged with reviewing projects and developments in SFHAs as well as projects not located in SFHAs that will alter hydrology and runoff.

All four communities have regulations that are at least as stringent as the NFIP regulations. A few of the provisions of these codes and regulations are especially notable relative to preventing flood damage:

- The City of Ansonia has adopted a more stringent standard than the NFIP regulations. In Ansonia, structures must be elevated more than one foot above the base flood elevation.

- The City of Shelton requires that, in the Zone A, base flood elevation data shall be provided for subdivision proposals and other proposed development which are five acres or 50 lots. This is consistent with FEMA's recommended regulations and will require, in some instances, that detailed flood studies accompany development proposals. In addition, the Planning and Zoning Commission may prohibit the subdivision of any portion of a property lying in a flood zone.

- The City of Ansonia requires that the applicant provide base flood elevations for all subdivision proposals in A zones without available base flood elevations.

- The Cities of Derby and Shelton require a roadway of suitable elevation to access subdivisions in SFHAs. This is consistent with FEMA's recommendation for dry land access to residential populations.

- The Town of Seymour and the City of Ansonia have set 100-foot review areas for projects reviewed by the Inland Wetlands and Watercourses Commissions.

Flood Control Structural Projects

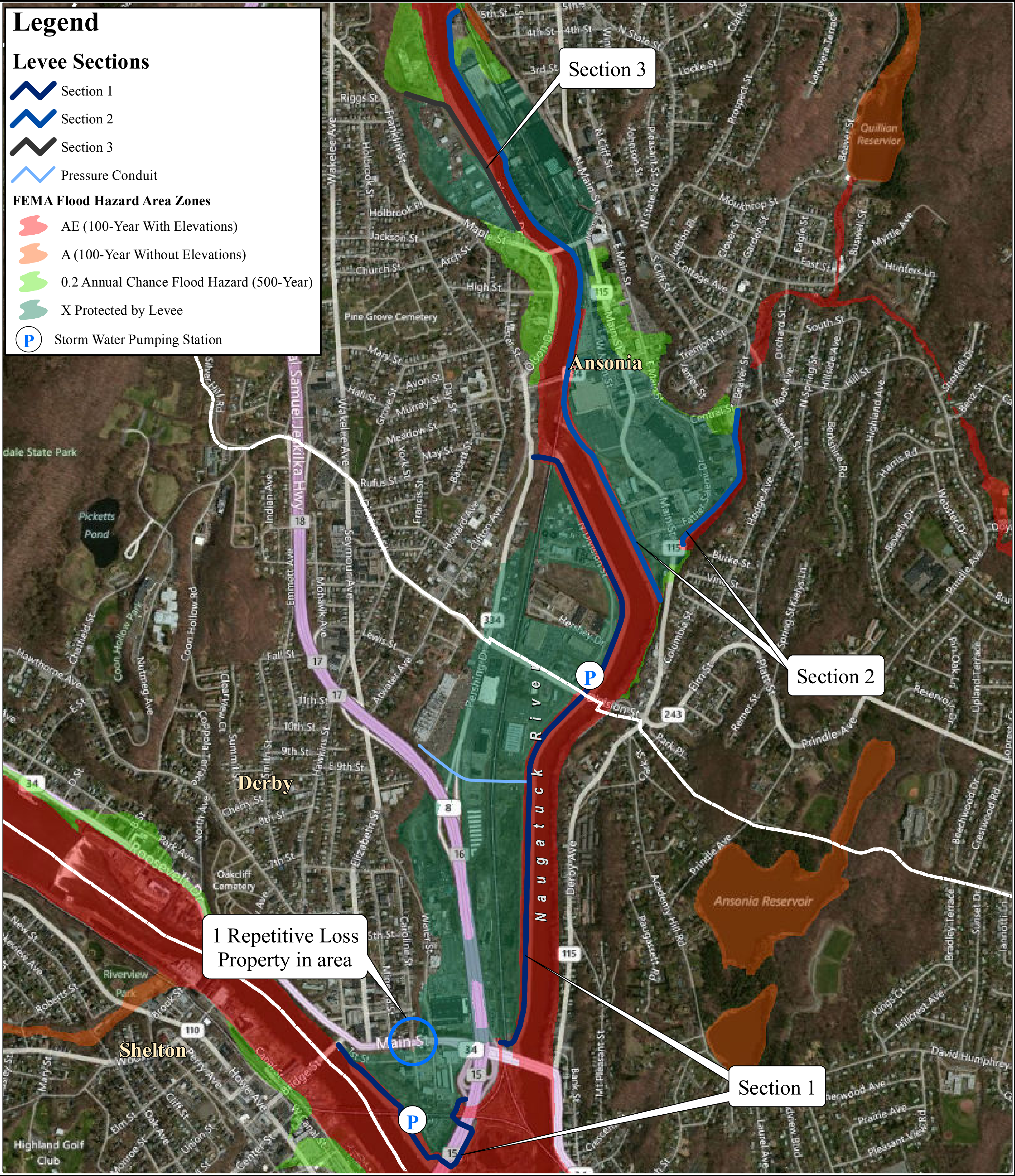
One difference between the Naugatuck River communities and many other Connecticut municipalities is that structural flood control projects such as flood control dams and levees have been heavily utilized for flood control. Several notable flood control dams are located on the Naugatuck River main stem (Thomaston Dam) and along several tributaries, all upstream of the VCOG communities. These dams have prevented severe flooding of the Naugatuck River.

Thomason Dam on Naugatuck River

A system of levees and floodwalls lies along a portion of the Housatonic River and along the entire west bank of the Naugatuck River within the city of Derby, extending north into Ansonia. Refer to Figure 3-2. The Ansonia and Derby flood control projects were constructed by the U.S. Army Corps of Engineers in the late 1960s and early 1970s.

Section of flood control system in Ansonia

The flood control systems in Ansonia and Derby provide protections that are *additional* to the protection from the upstream dams. They are necessary because Ansonia and Derby are located at the end of the Naugatuck River, far from the flood control dams located upstream, and because the Naugatuck River can experience backwater conditions in Derby and Ansonia due to tidal flooding of the Housatonic River downstream of the point that the two rivers conjoin. During Tropical Storm Irene in 2011, the floodgates in the levee system in Ansonia were closed for the first time in 47 years as backwater conditions occurred in the Naugatuck River.



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer (c) 2010 Microsoft Corporation and its data suppliers

"FEMA Flood Hazard Area Zones" Datalayer December, 2010 FEMA

"Levee Sections" Datalayer
Digitized by MMI Staff from City mapping

Figure 3-2: FEMA Flood Hazard Area - Flood Protection System

LOCATION:
Derby & Ansonia, CT

N

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-2_FEMALevees.mxd
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Derby's flood control system provides protection from the base flood for approximately 80 private and municipally owned properties with an assessed value of approximately $40,000,000.

On May 9, 2008, FEMA notified the cities of Derby and Ansonia that FEMA would be providing updated flood maps for New Haven County and that the land behind the levees would be remapped as areas protected by "Provisionally Accredited Levees" (PALs). In response to this notification, the cities executed a Letter of Agreement and Request for PAL designation and an agreement to provide adequate compliance with 44 CFR 65.10. Under the terms of this agreement, the municipalities were to provide FEMA with the supporting documentation to show that the levees comply with the regulations. If documentation was not provided, FEMA indicated that they will initiate a task order with their mapping consultant to revise the FIRM to redesignate the areas behind the levees as prone to flooding. Certification for the Derby levee system has been achieved.

Located along the Naugatuck River and Beaver Brook tributary, the Ansonia portions of the flood control system extend 9,260 feet along both sides of the Naugatuck River beginning at the Division Street bridge and terminating upstream near the Ansonia Copper & Brass Company hydroelectric plant. The system also extends along Beaver Brook from the confluence with the Naugatuck River to 400 feet above Central Street. The flood control system in Ansonia provides protection from the base flood for approximately 120 private and municipally owned properties with an assessed value of approximately $80,000,000.

As noted above, FEMA notified the cities of Derby and Ansonia that FEMA would be providing updated flood maps for New Haven County and that the land behind the levees would be remapped as areas protected by PALs. Certification for the Ansonia levee system is underway and anticipated to be completed in the near future.

The VCOG communities recognize that small flood control structures such as walls and berms on private properties may exist throughout the region.

Bridge Replacements, Drainage, and Maintenance

The Public Works Departments are in charge of the maintenance of drainage systems and perform clearing of catch basins, bridges, and culverts and other maintenance as needed. Drainage complaints are routed to the departments and recorded. The communities use these reports to identify potential problems and plan for maintenance and upgrades.

The Gilbert Street area in Derby suffers flooding from a stream that flows from two reservoirs at Witek Park. The city has a policy of drawing down the two dams to provide some flood abatement and reduce flows in the outlet stream. However, high flows sometimes occur, which jump the culverts and cause flooding downstream in the Gilbert Street area. Additional mitigation is desired in this area.

Acquisitions, Elevations, and Demolitions

As noted below in Section 3.5.1, two repetitive loss properties in the region have been vacated and demolished (one each in Seymour and Derby). These were both commercial/ industrial use properties located in SFHAs. Both properties may be redeveloped in accordance with municipal codes and Zoning Regulations, which will require elevation and/or floodproofing depending on the intended use of the properties.

Shelton possesses a single-jurisdiction HMP that was developed by the Office of Emergency Management and adopted by the Board of Aldermen in February 2010. The presence of this plan has facilitated Shelton's efforts toward hazard mitigation. The city has previously sought grants for mitigation in the Maples neighborhood. A grant under the HMGP was applied for three years ago (after the April 2007 nor'easter and its federal disaster declaration). The application was made available to almost all households on Indian Wells Road, but only seven households participated. Of these, four applied for an elevation and the remainder for acquisitions; however, only the four elevations were approved. Privately funded home elevations are also believed to have occurred over the years. Additional mitigation in this neighborhood is desired.

Flood Watches and Warnings

The Emergency Management Agency and the Fire Department are responsible for monitoring local flood warnings. The town can access the National Weather Service website at http://www.weather.gov/ to obtain the latest flood watches and warnings before and during precipitation events.

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

The region receives regular weather updates through DEMHS Region 3 email alerts and can also access the Automated Flood Warning System to monitor precipitation totals and river stage changes. The Connecticut DEEP installed the Automated Flood Warning System in 1982 to monitor rainfall totals as a mitigation effort for flooding throughout the state.

Warnings are particularly necessary for the Housatonic River below the Stevenson Dam as the flooding in this area can rapidly catch the riverfront neighborhoods off guard in Shelton, Seymour, and Derby. While these warnings have not always prevented a loss of property, they have prevented loss of life.

Summary

In summary, the region has primarily attempted to mitigate flood damage and flood hazards by restricting activities in floodprone areas and relying on existing flood control structures such as dams and levees. The former is primarily carried out through the Planning and Zoning Commissions working with the Building Officials. The communities anticipate that a wider range of mitigation efforts will be utilized in the future, including additional elevations and acquisitions of floodprone structures.

3.5 Vulnerabilities and Risk Assessment

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

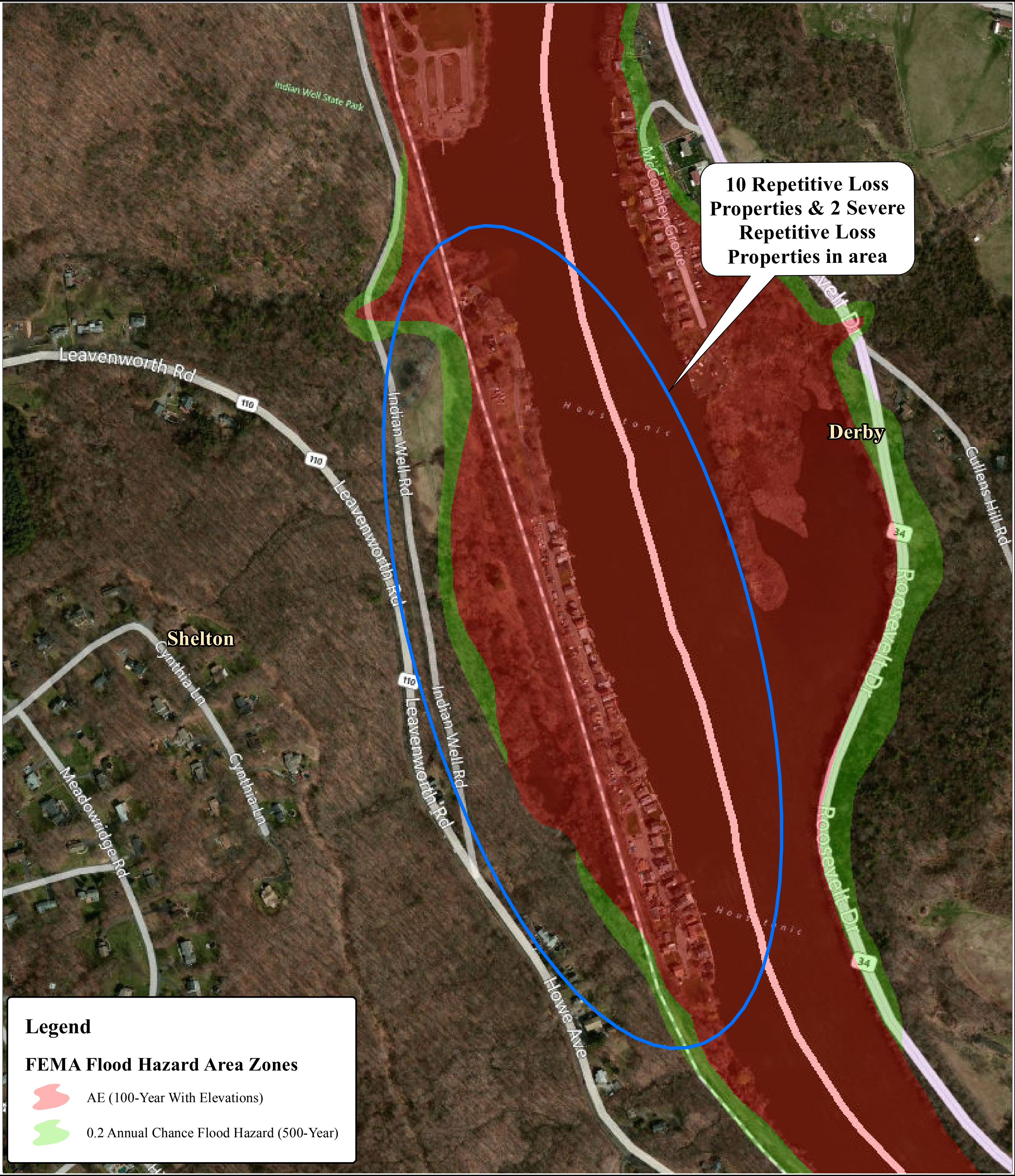
3.5.1 Vulnerability Analysis of Specific Areas

Flooding is known to occur along numerous watercourses in the VCOG municipalities. These areas are described below, grouped by municipality or drainage basin.

Housatonic River – Riverine flooding occurs downstream of the Stevenson Dam along the Housatonic River in Shelton, Seymour, and Derby. The floodprone section is from the Stevenson Dam (upstream of Shelton) to the Derby Dam, which spans the river at downtown Shelton and Derby.

Maples Neighborhood, 9/8/11

Severe flooding of the Maples area of Shelton (Figure 3-3) is well documented. Flooding in March 2011 caused extreme damage, and coverage in the press was thorough. All 41 homes were evacuated as extremely high flows passed over the Stevenson Dam. The website www.sheltonemergency.com includes a survey for Maples residents and an example of a recent emergency warning statement. Some of the homes in the neighborhood have been elevated as noted in Section 3.4, but many have not. Many homes remain on the list of repetitive loss properties (RLP) (discussed in Section 3.5.3).



SOURCE(S):
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"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

Figure 3-3: FEMA Flood Hazard Area - Maples Neighborhood

LOCATION:
Shelton, CT

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-3_FEMAIWRd.mxd
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The Maples neighborhood was studied in 1985 with financial support provided by FEMA and the Connecticut DEEP. The summary of findings and recommendations found that there is no economically justifiable structural flood mitigation measure that would have the effect of eliminating future flooding of the neighborhood. Additionally, the findings stated that Shelton, the Bridgeport Hydraulic Company (currently Aquarion Water Company), and the State of Connecticut should join forces to purchase the residential structures in the neighborhood and relocate residents.

Indian Well Road, 9/8/11

Another problem experienced in Shelton is that Indian Well Road will sometimes be impassable during flooding of the river. This affects the group of homes located north (upstream) of the Maples neighborhood. Some sections of the road become impassable due to the rising river water, and some become impassable from high flows of small streams that cross under the road. Even if residents are not required to evacuate due to a threat of their homes flooding, they may find that access to their homes is cut off during floods.

Like Shelton, residential properties along the Housatonic River in Derby are floodprone. Approximately 25 homes in the McConney Grove neighborhood (Figure 3-4) off Roosevelt Drive are at risk for flooding, and several residents were evacuated during the March 2011 flood event described above. The McConney Grove neighborhood has one RLP. This neighborhood is located across the river from the Maples neighborhood of Shelton.

McConney Grove, 9/8/11

Riverdale Avenue in downtown Shelton also experiences flooding when water levels in the Housatonic River are very high.

O'Sullivan's Island in downtown Derby was completely submerged during the March 2011 flood. A web page was developed on the electronic valley website to describe the flooding in Derby and demonstrate that local officials were evaluating the related issues (www.electronicvalley.org/derby/2011/flooding.htm). One RLP was located on the island, but the structure has been removed.

SOURCE(S): Base Map: "Bing Maps Hybrid" Datalayer (c) 2010 Microsoft Corporation and its data suppliers "FEMA Flood Hazard Area Zones" Datalayer December, 2010 FEMA	**Figure 3-4: FEMA Flood Hazard Area - McConney Grove**	**LOCATION:** **Derby, CT**
	VCOG Hazard Mitigation Plan	**Map By:** SMG **MMI#:** 3211-04 **MXD:** H:\3211-04\GIS\VCOG-wide\Maps\Fig3-4_FEMAMcGr.mxd **1st Version:** 3/1/2012 **Revision:** 6/27/2012 **Scale:** 1 inch = 200 feet

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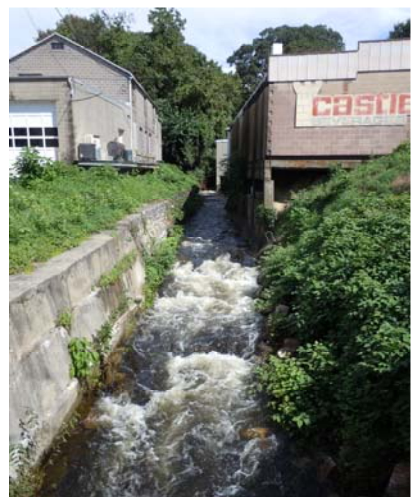
The Maples and McConney Grove neighborhoods were flooded most recently in September 2011 after the remnants of Tropical Storm Lee passed over Connecticut.

Seymour's section of riverbank is also at risk of flooding, but water levels must typically be very high for structures and roads to experience flooding. Refer to Figure 3-5.

Naugatuck River – The Naugatuck River is largely controlled by upstream flood control dams and the flood control system of levees and floodwalls in Ansonia and Derby. Areas behind the levees are designated as "Zone X Protected by Levee," but they can be flooded.

During Tropical Storm Irene, the floodgates on the Naugatuck River were reportedly closed for the first time in 47 years. The Housatonic River experienced backwater conditions in this area as a result of the incoming storm surge, which led to water moving northward up the Naugatuck River. The Olsen Drive area in Ansonia was nearly flooded, which would have forced the city to evacuate the many apartments on this road. This area is shown on Figure 3-6. The river also overflowed its banks in Seymour, leading to evacuations.

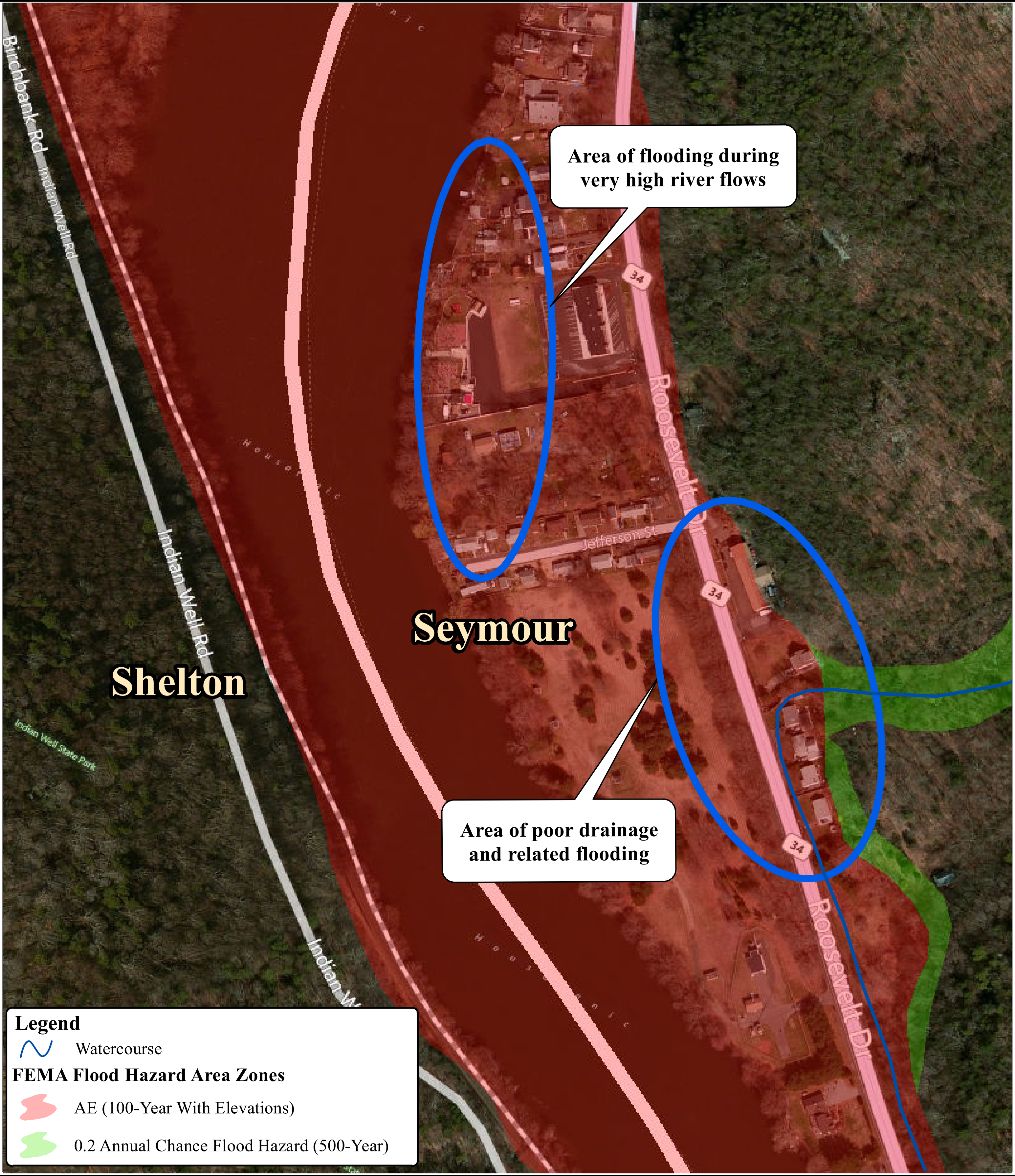
Unnamed Tributary to Beaver Brook, Ansonia – An unnamed tributary to Beaver Brook flows northward through culverts of insufficient capacity and sections of open air in the Prindle Avenue area of Ansonia. This area is shown in Figure 3-7. The watercourse extends from Fairview Street to the east of Upland Terrace to just north of Shortell Drive. The watercourse flows through Nelligen Park in this area of the city. The yards and basements of some homes along Prindle Avenue become inundated following a significant rainfall event or a succession of rainfall events, which exhausts the drainage network in this area.



View of Beaver Brook

Unnamed Drainage Course at Kielys Lane, Ansonia – An unnamed drainage course originating near Prindle Avenue flows to the northwest and past the north end of Kielys Lane. Four residential properties are flooded by this watercourse. This area is shown in Figure 3-7.

Unnamed Drainage Course Along Ells Street, Ansonia – An unnamed drainage course along Ells Street runs under two to three homes and through back yards in this area. A home has experienced significant flooding along the headwall. This area is shown in Figure 3-8.



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"FEMA Flood Hazard Area Zones" Datalayer December, 2010 FEMA

"Watercourse" Datalayer; CT Hydrography Datalayer; 2005 Edition CT DEEP & USGS National Mapping Program

Figure 3-5: FEMA Flood Hazard Area - Seymour

LOCATION: **Seymour, CT**

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-5_FEMARoDr.mxd
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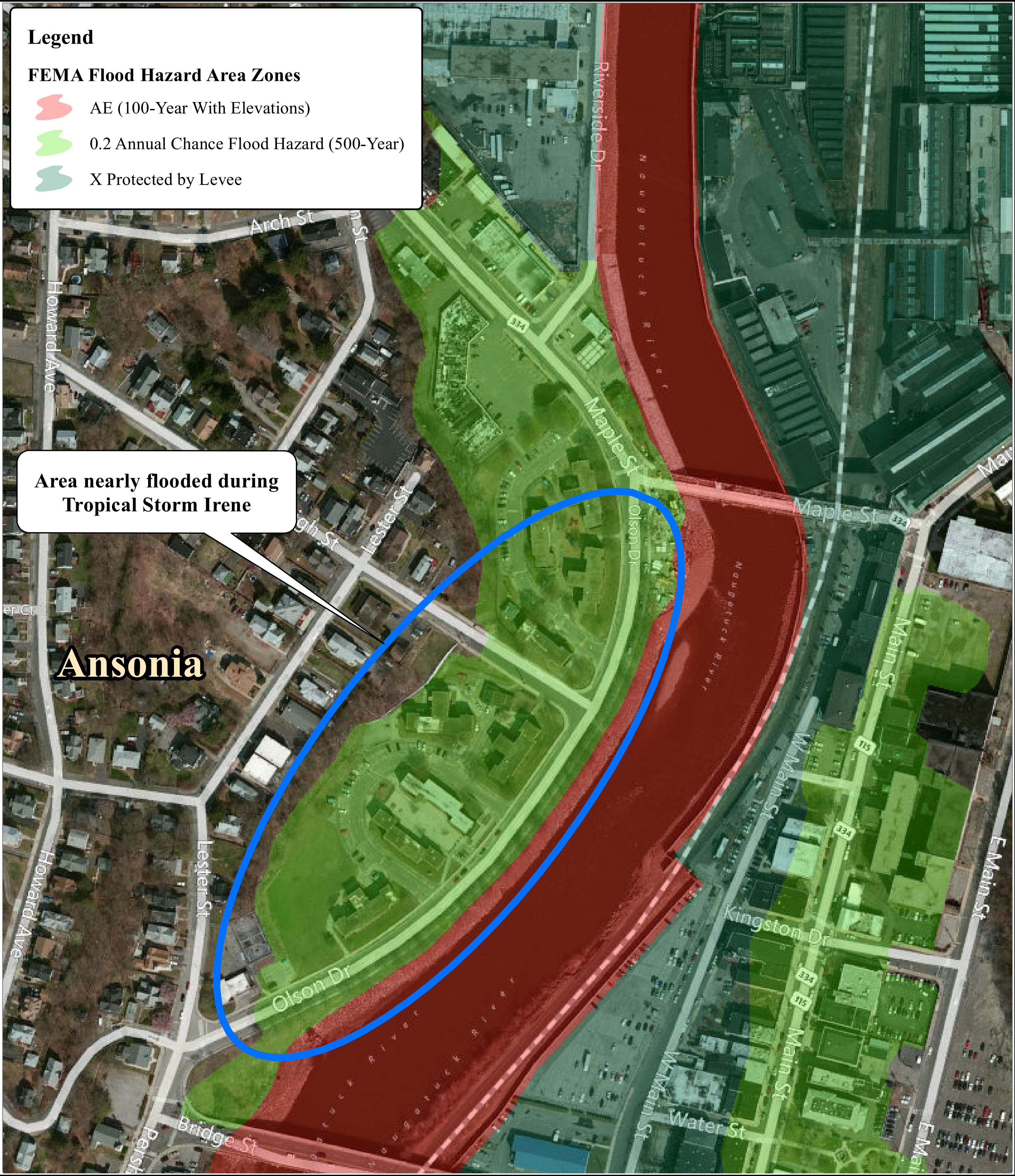

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"FEMA Flood Hazard Area Zones"
Datalayer December, 2010 FEMA

Figure 3-6: FEMA Flood Hazard Area - Olson Drive

LOCATION:
Ansonia, CT

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-6_FEMAOlsonDr.mxd
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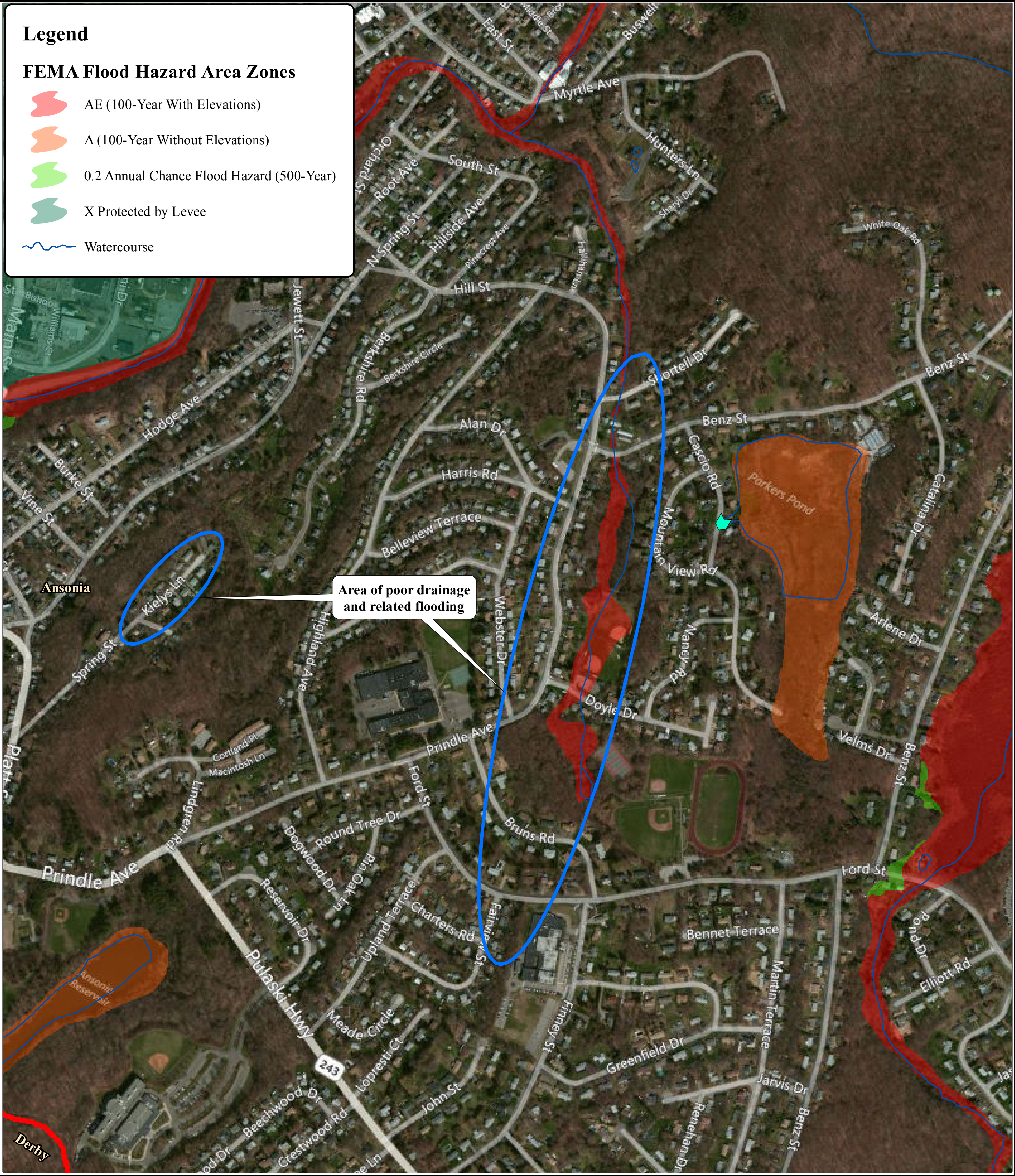

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"FEMA Flood Hazard Area Zones" Datalayer December, 2010 FEMA

"Watercourse" Datalayer; CT Hydrography Datalayer; 2005 Edition CT DEEP & USGS National Mapping Program

Figure 3-7: FEMA Flood Hazard Area - Streams that are Tributary to Beaver Brook

LOCATION:
Ansonia, CT

VCOG Hazard Mitigation Plan

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MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-7_FEMATribBeaverBk.mxd
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"Watercourse" Datalayer
Drawn by MMI Staff by
sight from "Bing Maps Hybrid"
aerial photography

Figure 3-8: FEMA Flood Hazard Area - Ells Street

LOCATION: **Ansonia, CT**

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-8_FEMAElls.mxd
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Unnamed Watercourse Along Wakelee Avenue (Route 334), Ansonia – An unnamed watercourse along Wakelee Avenue inundates the roadway during large-scale rain events. This occurs just to the north of the Wakelee Avenue (Route 334)-Franklin Street intersection and in conjunction with potential Connecticut Department of Transportation (CT DOT) drainage issues along this stretch of the roadway. This is shown in Figure 3-9.

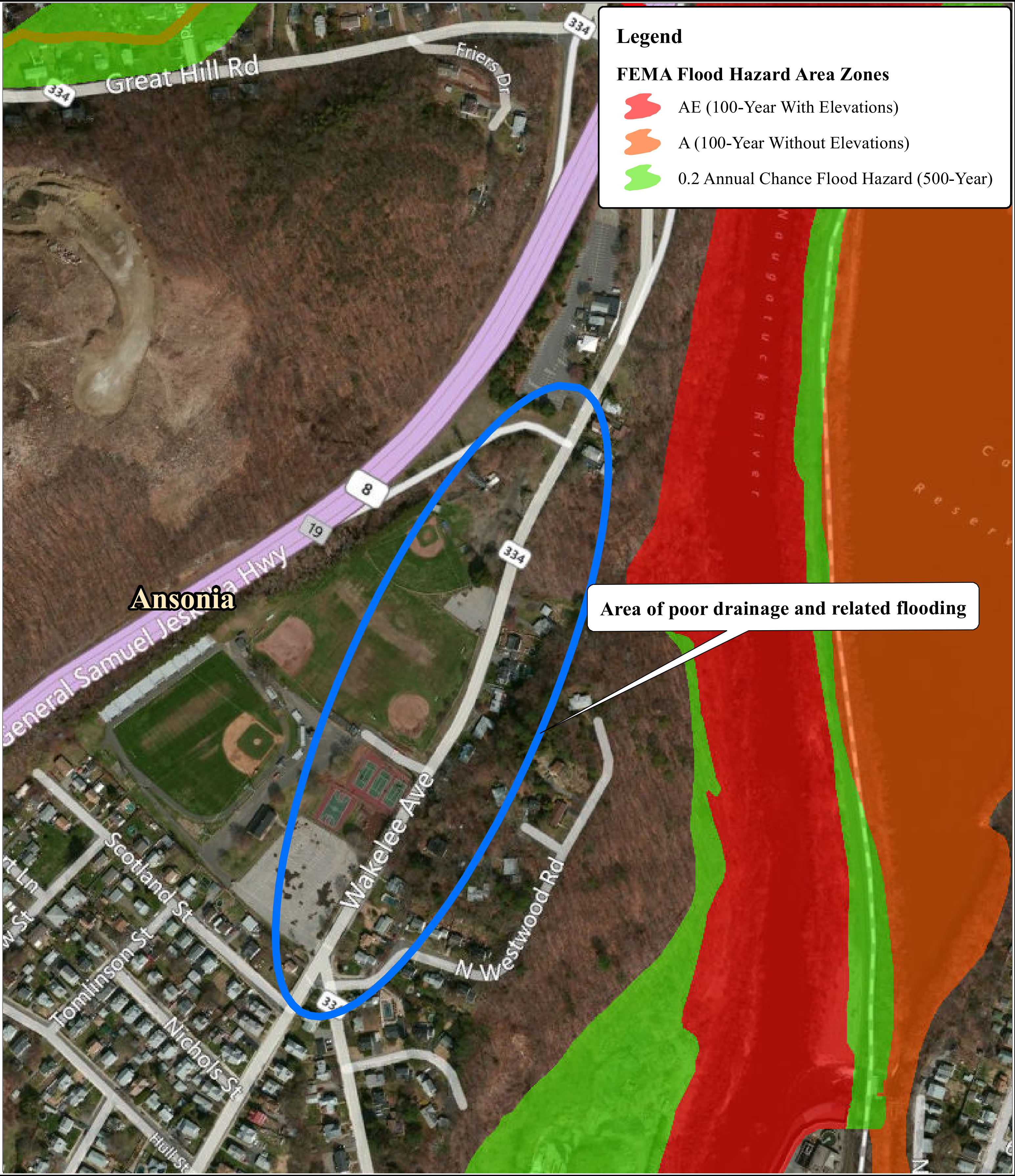
Wetland Area East of Route 8, Ansonia – A wetland area located to the east of Route 8 at the western end of side streets off Wakelee Avenue receives a significant amount of ponding during large-scale rain events. Residents in the area have expressed concern with drainage piping from Route 8 in the past. This area is shown in Figure 3-10.

Gilbert Street Area, Derby – According to Derby officials, the most pressing flooding issue in the city after McConney's Grove is the Gilbert Street area. This is a densely developed residential neighborhood on a steep slope. Flooding is associated with an unnamed tributary to the Housatonic River that flows from the two former Ansonia Reservoirs located in Witek Park. Refer to Figure 3-11.

The stream flowing from the reservoirs is flashy, and its flow can overflow culverts, leading to water flowing down Crescent Street and Gilbert Street as well as through residential properties and structures. When large-scale rain events take place, homes and properties experience damage to basements and driveways. To date, hundreds of thousands of dollars in claims have been made against the city, of which the city has paid a portion. The city implements a policy of drawing down the two dams at Witek Park to provide flood abatement and reduce flows in the stream whenever large-scale rain events are forecast. This is written in the Public Works policy. Flood mitigation is needed in this area. One home in particular should be acquired for implementation of the current mitigation plan.

Downstream, the watercourse flows under Route 34 in a culvert toward the Housatonic River. During high flows, the stream overtops Route 34 with up to a foot of water causing the major arterial roadway to be closed. Additionally, overtopping reportedly occurs when the Housatonic River is high and backwater conditions inhibit the stream from flowing freely through the culvert.

The city has commissioned design of improvements to alleviate flooding in the Gilbert Street area. The preferred design will replace the headwall on the south side of Crescent Street with a new culvert/headwall combination that will allow capture of a higher flow, which will reduce flooding where the stream jumps the culvert, and will replace sections of the culvert beneath outbuildings, homes, and Gilbert Street with upsized sections that avoid buildings and convey greater flow rates. The new sections of the system will join the existing 48-inch by 76-inch culvert at the intersection of Bank Street, Gilbert Street, and Route 34. The system has been designed to convey the 50-year design flow. At the present time, upstream components cannot convey the 10-year storm.



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"FEMA Flood Hazard Area Zones"
Datalayer December, 2010 FEMA

Figure 3-9: FEMA Flood Hazard Area - Wakelee Avenue

LOCATION: **Ansonia, CT**

VCOG Hazard Mitigation Plan

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MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-9_FEMAWakelee.mxd
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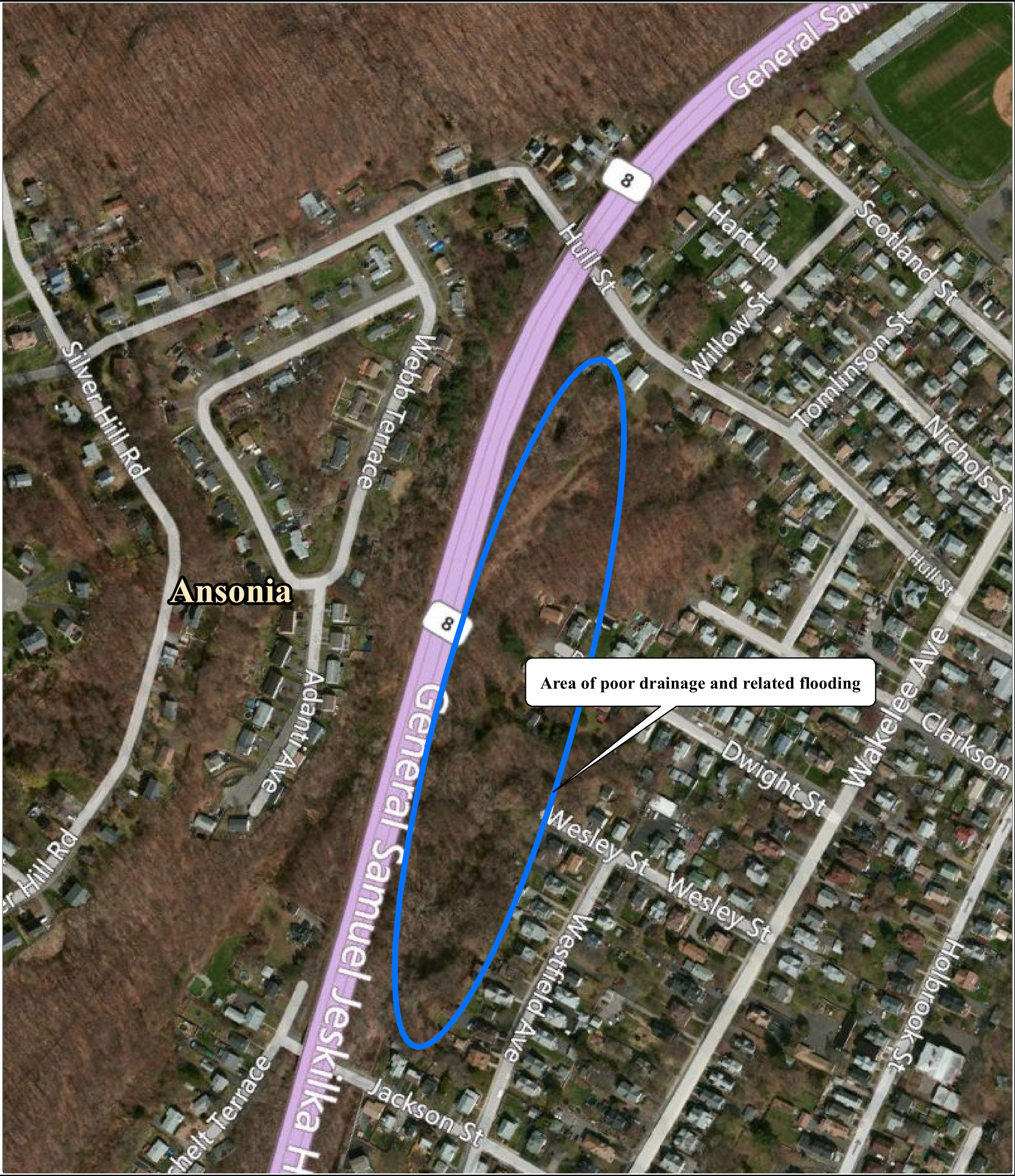

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Figure 3-10: FEMA Flood Hazard Area - Route 8

LOCATION:
Ansonia, CT

VCOG Hazard Mitigation Plan

Map By: SMG
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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-10_FEMARoute8Marsh.mx
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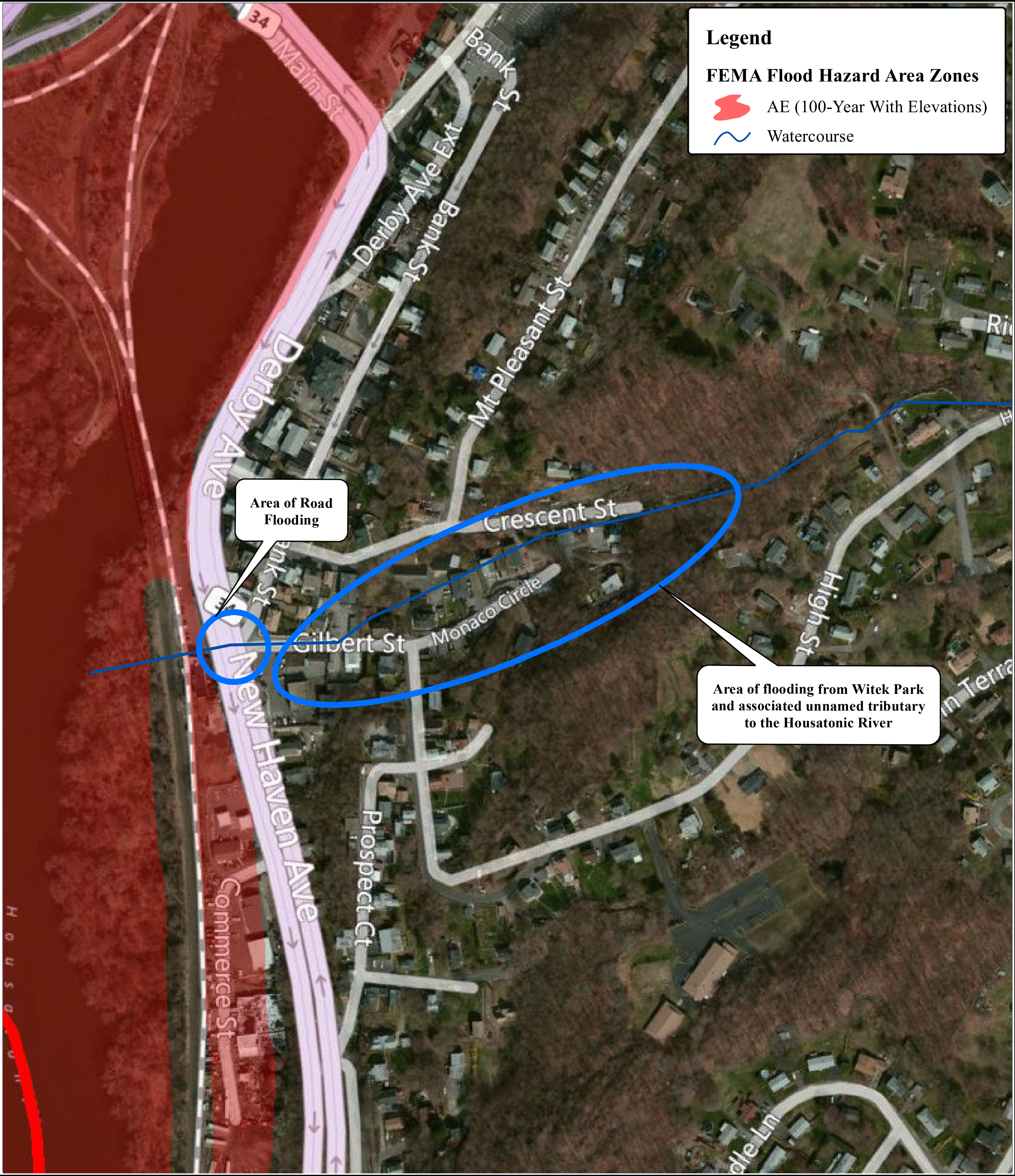

SOURCE(S):
Base Map:
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Figure 3-11: FEMA Flood Hazard Area - Gilbert Street Area

LOCATION: **Derby, CT**

VCOG Hazard Mitigation Plan

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-11_FEMAGilSt.mxd
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Twomile Brook Near Sodom Lane, Derby – Minor flooding occurs downstream of O'Sullivan Road near Sodom Lane in Derby. The detention ponds in this area require routine maintenance, which is not occurring as needed. As a result, flooding is exacerbated downstream. Commercial buildings and parking lots on the south side of Sodom Lane experience flooding. Twomile Brook flows beneath some of the buildings and parking lots in culverts. This area is shown in Figure 3-12.

Beach Street/Bladens River, Seymour – Two ponds at and upstream of the Kerite Dam are reportedly nearly full of silt and fine sediments and have little to no storage capacity. During large-scale rain events, when the water level rises above the Bladens River Dam upstream of the Kerite Dam, the water flows down Beach Street, sometimes flowing down Pearl and Day Streets. This water overtops the roads and some properties in the area. This area is shown in Figure 3-13.

Area where Bladens River can flood roadways; note high flow of 9/8/12

Bank Street/Little River, Seymour – Properties along Bank Street in the area of Wire Company Dam #3 and Wire Company Dam #2 are reportedly subject to flooding as a result of high flows along Little River and poor drainage along Route 67. This area is shown in Figure 3-14. One RLP is listed at the end of the Little River, but this building has been demolished, and the site is unoccupied.

Area where Little River can flood commercial property; note high flow of 9/8/12

Unnamed Watercourse at Walnut Street, Seymour – A residence on Walnut Street has been repeatedly subject to flooding during large-scale rain events. According to town officials, Seymour has funded the replacement of a portion of property damage; however, the storm drainage in this area is in need of upgrading. This area is shown in Figure 3-15.

Unnamed Drainage Along Roosevelt Drive (Route 34), Seymour – Multiple homes are subject to flooding from hillside drainage during large-scale rain events in this area of town. Refer to Figure 3-5.

SOURCE(S):	Figure 3-12: FEMA Flood Hazard Area - Twomile Brook near Sodom Lane	LOCATION: Derby, CT

SOURCE(S):
Base Map:
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"FEMA Flood Hazard Area Zones" Datalayer December, 2010 FEMA

"Watercourse" Datalayer; CT Hydrography Datalayer; 2005 Edition CT DEEP & USGS National Mapping Program

VCOG Hazard Mitigation Plan

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Figure 3-13: FEMA Flood Hazard Area - Bladens River

VCOG Hazard Mitigation Plan

LOCATION: Seymour, CT

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-13_FEMABeSt.mxd
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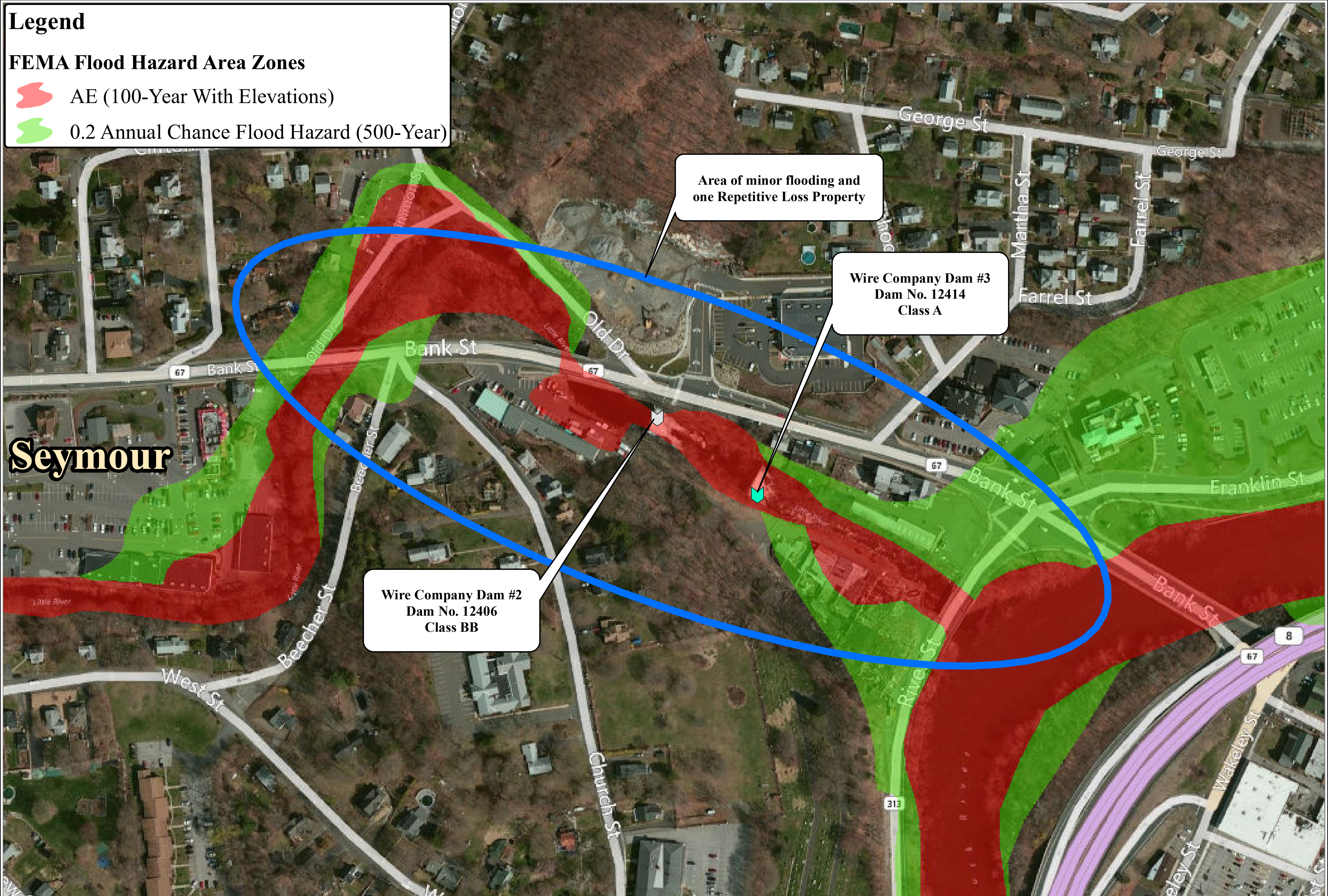

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"FEMA Flood Hazard Area Zones"
Datalayer December, 2010 FEMA

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Figure 3-14: FEMA Flood Hazard Area - Little River

VCOG Hazard Mitigation Plan

LOCATION: Seymour, CT

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-14_FEMALittleRvr.mxd
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"Watercourse" Datalayer; CT Hydrography Datalayer; 2005 Edition CT DEEP & USGS National Mapping Program

Figure 3-15: FEMA Flood Hazard Area - Walnut Street

LOCATION:
Seymour, CT

VCOG Hazard Mitigation Plan

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Means Brook Watershed, Shelton – Means Brook is a major tributary to the Farmill River. Shelton's Huntington Village is located along Means Brook. An unnamed tributary to Means Brook is conveyed under Brookwood Lane in a small culvert, near the intersection with Walnut Tree Hill Road (Figure 3-16). The culvert is in need of upgrading and replacement. The neighborhood located upstream had three culverts replaced along the same small watercourse due to neighborhood flooding in 2002.

Elsewhere, a different unnamed tributary of Means Brook runs beneath Beardsley Road and alongside Jonathan Lane. Although major flooding is not suspected in this area, the stream appears to be associated with a RLP. The area is shown in Figure 3-17.

Huntington Center is densely developed with commercial and residential properties. The Shelton Avenue (Route 108) bridge over Means Brook is a DOT-owned structure that was constructed in the 1920s. It is reported to be hydraulically inadequate and has caused flooding in Huntington Center. The adjacent DOT culvert that conveys Pole Brook under Route 108 is also in need of being evaluated for hydraulic capacity. The area is shown in Figure 3-18. One RLP is located in Huntington Center near Means Brook.

Farmill River, Shelton – Figure 3-19, Figure 3-20, and Figure 3-21 depict three locations in Shelton along the Farmill River where flooding has occurred. The culvert at Walnut Hill Road is reportedly undercapacity, leading to roadway flooding. Following large-scale rain events, which typically occur one to two times per year, closure of the roadway is necessary. Twin boiler sections currently serve as culverts. An engineering study conducted in 1989 recommended their replacement with twin 15-foot by six-foot precast concrete culverts.

Slightly downstream, a RLP is located in the Walnut Hill Road/Waverly Road area. It is believed that culverts in this area may be undersized as well, possibly leading to the flooding.

Finally, one more RLP is located in the most downstream reach of the river in Shelton (where the river forms the municipal border with the town of Stratford). The road known as Yatuka Trail follows the river corridor and is generally at a high elevation above the SFHA, but there are several low sections.

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"Watercourse" Datalayer; CT Hydrography Datalayer; 2005 Edition CT DEEP & USGS National Mapping Program

Figure 3-16: FEMA Flood Hazard Area - Tributary of Means Brook

LOCATION: **Shelton, CT**

VCOG Hazard Mitigation Plan

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-16_FEMABrLn.mxd
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"Watercourse" Datalayer
Drawn by MMI Staff by
sight from "Bing Maps Hybrid"
aerial photography

Figure 3-17: FEMA Flood Hazard Area - Tributary of Means Brook

LOCATION: **Shelton, CT**

VCOG Hazard Mitigation Plan

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"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

Figure 3-18: FEMA Flood Hazard Area - Huntington Center

LOCATION:
Shelton, CT

VCOG Hazard Mitigation Plan

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-18_FEMASheltonAve.mxd
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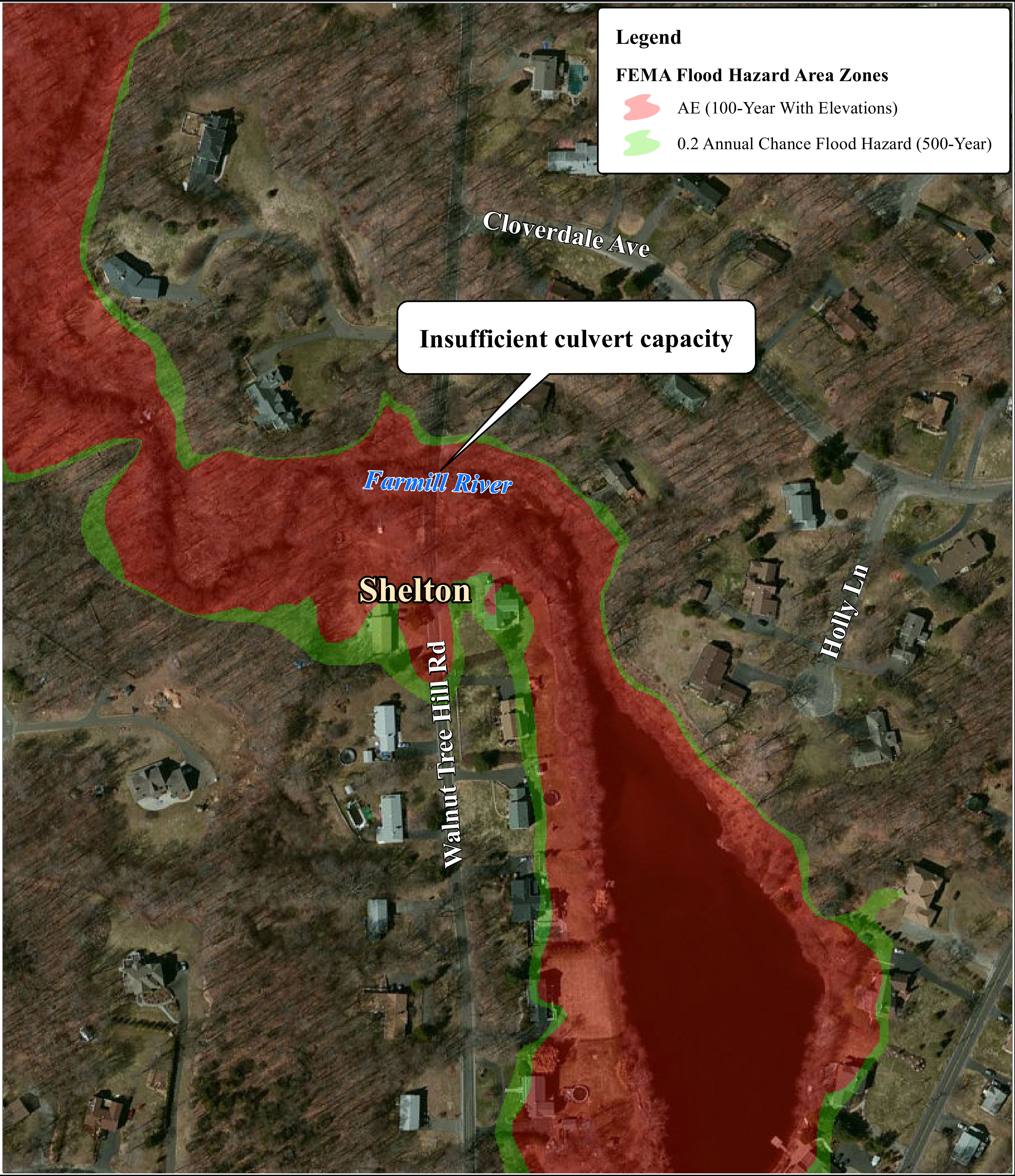

SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer (c) 2010
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"FEMA Flood Hazard Area Zones" Datalayer
June, 2010 FEMA

Figure 3-19: FEMA Flood Hazard Area - Farmill River at Walnut Hill Road

LOCATION:
Shelton, CT

VCOG Hazard Mitigation Plan

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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-19_FEMAWTHRd.mxd
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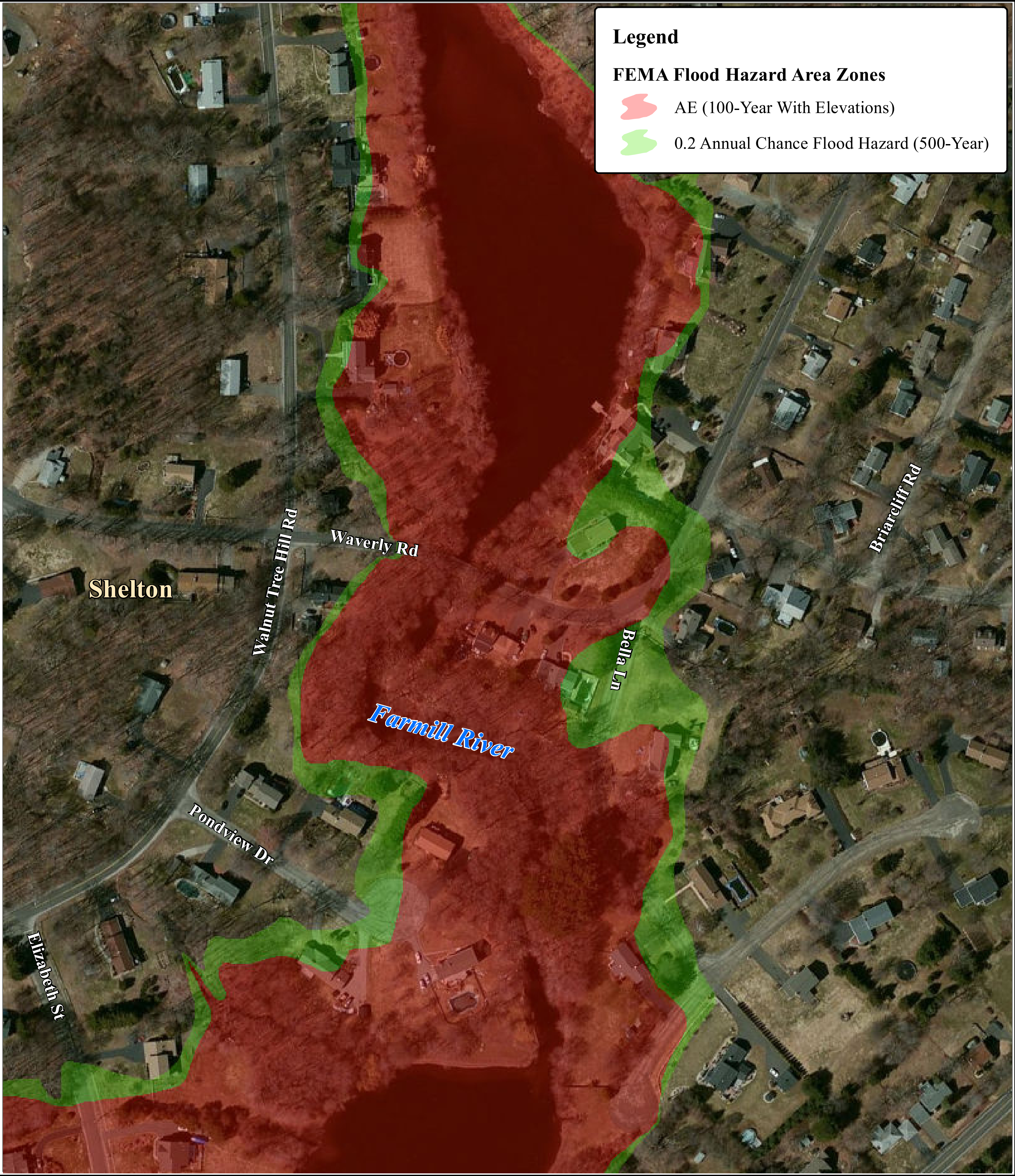

SOURCE(S):
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"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

Figure 3-20: FEMA Flood Hazard Area - Farmill River at Waverly Road

LOCATION:
Shelton, CT

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VCOG Hazard Mitigation Plan

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MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-20_FEMAWaverlyRd.mxd
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Figure 3-21: FEMA Flood Hazard Area - Farmill River at Yatuka Trail

LOCATION: Shelton, CT

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VCOG Hazard Mitigation Plan

Map By: SMG
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MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig3-21_FEMAYutaka.mxd
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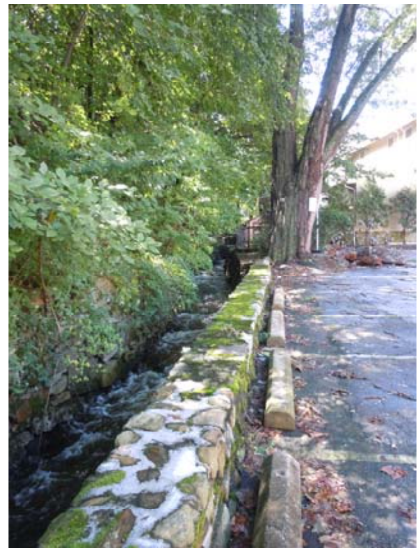
Burying Ground Brook, Shelton – FEMA has mapped an area of shallow flooding (zone AO) in downtown Shelton along the historical channel of Burying Ground Brook, which is one of the only areas in the state mapped with the AO designation. It is indicative of potential sheet-flow flood damage with a depth of three feet. A stone masonry arch structure near Long Hill Avenue is eight feet in height and partially collapsed in 2011 after a moderate rainfall event, requiring emergency repairs. Flooding occurs in this area following significant rainfall events that lead to road closures. This area is shown in Figure 3-22.



Burying Ground Brook in Shelton

Unnamed Watercourse Along Wooster Street, Shelton – An Oak Avenue stone masonry culvert conveys a small watercourse that parallels Wooster Street from the area of Jefferson Street under Oak Avenue and through private properties to the Wooster Street-Brook Street intersection. The culvert is approaching 100 years of age and requires relocation to the public right-of-way as well as an increased conveyance capacity to eliminate flooding conditions. There are sections of the watercourse upstream of Jefferson Street that have been placed in conduits on private property that are in need of being upgraded and relocated to the public right-of-way for proper maintenance. The area is shown in Figure 3-23.

Nearby, the Congress Avenue/Oak Avenue storm sewer conduit conveys a significant drainage area of approximately 125 acres through private properties and under Oak Avenue. The various conduits consist of 30" reinforced concrete pipe (RCP), 42" RCP, and both 40" × 41" and 36" × 42" stone masonry structures. Various sections of this conduit have been repaired since 1983 as they fail.

In summary, flooding problems are widespread throughout the VCOG municipalities. Flooding events along watercourses with or without SFHAs often result in damage to insured and uninsured structures, roads, and other drainage systems. Priority flooding areas to address are the McConney Grove neighborhood in Derby and Maples neighborhood in Shelton on either side of the Housatonic River, the tributary of Beaver Brook in Ansonia, Gilbert Street in Derby, and the Bladens River corridor in Seymour.

3.5.2 Vulnerability Analysis of Private Properties

The software platform *ArcGIS* was utilized along with 2010 *Microsoft Virtual Earth* aerial photography to determine the number of structures located within the various floodplains within the VCOG municipalities.

SOURCE(S):	Figure 3-22: FEMA Flood Hazard Area - Burying Ground Brook	LOCATION: Shelton, CT

SOURCE(S):
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"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

Figure 3-22: FEMA Flood Hazard Area - Burying Ground Brook

LOCATION: **Shelton, CT**

VCOG Hazard Mitigation Plan

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SOURCE(S):	Figure 3-23: FEMA Flood Hazard Area - Wooster Street		LOCATION: Shelton, CT
Base Map: "Bing Maps Hybrid" Datalayer (c) 2010 Microsoft Corporation and its data suppliers "Watercourse" Datalayer Drawn by MMI Staff by sight from USGS Topographic mapping	VCOG Hazard Mitigation Plan	**Map By:** SMG **MMI#:** 3211-04 **MXD:** H:\3211-04\GIS\VCOG-wide\Maps\Fig3-23_FEMAOakAve.mxd **1st Version:** 3/1/2012 **Revision:** 6/27/2012 **Scale:** 1 inch = 150 feet	Engineering, Landscape Architecture and Environmental Science MILONE & MACBROOM® 99 Realty Drive Cheshire, CT 06410 (203) 271-1773 Fax: (203) 272-9733 www.miloneandmacbroom.com

Ansonia has 107 structures within the 100-year floodplain or floodway while Derby has 96 structures, Seymour 118, and Shelton 365; these numbers are proportional to the geographic areas of the communities. In all, the VCOG municipalities have 686 structures in the 100-year floodplain or floodway. According to the 2010 FEMA FIRM GIS data layers, a total of 2,578 acres of land in the VCOG municipalities is located within the 100-year flood boundary, and an additional 1,090 acres of land are located within the 500-year flood boundary.

Based on correspondence with the State of Connecticut NFIP Coordinator, a total of 20 RLPs are listed in Derby, Seymour, and Shelton while Ansonia does not contain any. Three of the RLPs in Shelton are listed as severe repetitive loss properties (SRLPs). It was reported by Derby city officials that the RLP on O'Sullivan Island is a demolished building, so there are no longer any flood losses. Likewise, the industrial property on River Street in Seymour is demolished, and there are no longer flood losses. The other listed properties are assumed to experience flood losses or may experience them in the future. The RLPs and SRLPs related to flooding in the VCOG municipalities are listed below in Table 3-2.

TABLE 3-2
Repetitive Loss Properties

Municipality	RLP/SRLP	Type	Street	Flooding Source
Derby	RLP	Single-Family Home	McConney Grove	Housatonic River
	RLP	Single-Family Home	Roosevelt Drive (Rt. 34)	Housatonic River
	RLP	Commercial*	O'Sullivan's Island	Housatonic River
Seymour	RLP	Commercial*	River Street	Little River
Shelton	RLP	Single-Family Home	Beardsley Road	Means Brook Tributary
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	SRLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	SRLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Indian Well Road	Housatonic River
	RLP	Single-Family Home	Lane Street	Means Brook
	RLP	Single-Family Home	Waverly Road	Farmill River
	SRLP	Single-Family Home	Yutaka Trail	Farmill River

*These structures are demolished, and the properties are vacant.

These properties are located along or near the Housatonic River in Derby and Shelton and an unnamed watercourse, Means Brook, and the Farmill River in Shelton. Each of the structures is located within the 100-year floodplain except for the structure on Beardsley Road in Shelton, which is not located in a SFHA. Several of the residential structures appear to have walk-out basements or garages that may be damaged by flooding whereas the living areas appear to be higher. However, the exact nature of flood damage at each property is not reported.

The VCOG municipalities recognize that many private properties may suffer flood damage that is not reported because the structures are not insured under the NFIP. These residents and business owners are likely repairing structures on their own. Flood mitigation as recommended in this plan will likely help many of these property owners.

3.5.3 Vulnerability Analysis of Critical Facilities

The list of critical facilities provided by the VCOG municipalities (Section 2.9) was used with *Microsoft Virtual Earth* aerial photography to locate each critical facility within the municipalities. A total of eight critical facilities in Ansonia, three in Derby, three in Seymour, and one in Shelton are found to be associated with either a SFHA or 500-year inland floodplain. Table 3-3 lists these critical facilities.

TABLE 3-3
Critical Facilities Located Within or Adjacent to Floodplains

Municipality	Name or Type	Address	Flooding Source
Ansonia	Ansonia Rescue Medical Services (ARMS)	West Main Street	Naugatuck River
	WPCA Sewage Pump Stations	Multiple Locations	Naugatuck River
	Julia Day Nursery and Kindergarten	Central Street	Naugatuck River
	John J. Stevens Apartments	Central Street	Naugatuck River
	Riverside Housing Complex	Olsen Drive	Naugatuck River
	Riverview Apartments	West Main Street	Naugatuck River
	Capital Plaza	Main Street	Naugatuck River
	United Illuminating Company Substation	Riverside Drive	Naugatuck River
Derby	Police Department	Water Street	Naugatuck River
	WPCA Stormwater Pump Stations	Multiple Locations	Naugatuck/Housatonic Rivers
	Derby Dam	Housatonic River	Housatonic River
Seymour	Police Department	Franklin Street	Naugatuck River
	Citizens Engine No. 2	DeForest Street	Naugatuck River
	Regional Water Authority Wellfield	Route 34	Housatonic River
Shelton	Water Pollution Control Facility	Riverdale Avenue	Housatonic River

Although some of these facilities are protected by the Derby and Ansonia flood control systems, the potential exists that these critical facilities can become flooded any year as was evident with the Riverside Housing Complex on Olsen Drive in 2011 when it was almost evacuated because of a significantly high water level in the Housatonic and Naugatuck Rivers caused by Tropical Storm Irene.

3.5.4 *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 USD) to a user-defined region. The software was utilized to perform a basic analysis to generate potential damages in the VCOG municipalities along the various watercourses from 100-year riverine flood events, yielding probabilistic results.

Hydrology and hydraulics for the streams and rivers were generated utilizing the United States Geological Survey's (USGS) 10-meter National Elevation Dataset. The summary is included in Appendix F. The following paragraphs discuss the *HAZUS-MH* analysis.

The FEMA default values were used for each of the VCOG municipalities' 17 census tracts in the *HAZUS* simulation. A summary of the default building counts and values is shown in Table 3-4. Approximately 7.6 million dollars of building value were estimated to exist within the VCOG municipalities.

TABLE 3-4
***HAZUS-MH* Flood Scenario**
Basic Information

Occupancy	Building Count	Dollar Exposure (x 1,000) (2006 USD)
Residential	28,765	$5,540,090
Commercial	1,687	$1,104,703
Other	1,046	$993,999
Total	**31,498**	**$7,638,792**

The *HAZUS-MH* simulation estimates that during a 100-year flood event 158 residential buildings will be at least moderately damaged in the VCOG municipalities from flooding. A total of five of these buildings will be substantially damaged and uninhabitable. Table 3-5 presents the expected damages based on building type.

TABLE 3-5
***HAZUS-MH* Flood Scenario**
Building Stock Damages

Occupancy	None	Minor	Moderate	Severe	Destruction
Residential	27,003	1,598	158	5	1
Commercial	1,606	71	9	0	0
Other	995	45	5	2	0
Total	**29,604**	**1,714**	**172**	**7**	**1**

Based on the actual damages that have occurred recently in the Maples neighborhood, it is possible that *HAZUS-MH* undercounts the damage that could occur during a 100-year flood event.

HAZUS-MH utilizes a *subset* of critical facilities known as "essential facilities" that are important following natural hazard events. These include fire stations, hospitals, police stations, and schools. The software noted that under the 100-year flood event that the lone hospital in the region would be at 0% functionality until day three following the event.

The *HAZUS-MH* simulation estimated that a total of 25,195 tons of debris would be generated by flood damage for the 100-year flood scenario. It is estimated that 1,008 truckloads (at approximately 25 tons per truck) would be required to remove the debris. The breakdown of debris is as follows:

- Structural material (wood, brick, etc.) comprises 6,370 tons.
- Eligible tree debris comprises 9,612 tons.
- Other tree debris comprises 9,213 tons.

HAZUS-MH calculated the potential sheltering requirement for the 100-year flood event. The model estimates that zero households will be displaced due to flooding. Displacement includes households evacuated from within or very near to the inundated areas. Again, this result is suspect because more frequent flood events have caused evacuations of the Maples and McConney Grove neighborhoods along the Housatonic River.

HAZUS-MH also calculated the predicted economic losses due to the 100-year flood event. Economic losses are categorized between building-related losses and business interruption losses. Building-related losses (damages to building, content, and inventory) are the estimated costs to repair or replace the damage caused to the building and its contents. 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 42.13 million dollars of building-related losses are expected. Building damages cost 37.6 million dollars, contents damages total 4.44 million dollars while inventory loss costs a total of 83 thousand dollars.

- A total of nearly 3.51 million dollars of business interruption losses is expected. Relocation loss is expected to total 1.60 million dollars, capital-related losses are expected to cost 210 thousand dollars, wages losses are expected to cost 225 thousand dollars, and rental income loss is expected to total 1.47 million dollars.

Given the above commentary about *HAZUS-MH* undercounting building damages and sheltering needs, it is likely that the simulated economic losses are unrealistically low.

Summary

In summary, flooding is the most persistent hazard to affect the VCOG municipalities. Based on the historic record, information from municipal officials, and *HAZUS-MH* simulations of the 100-year flood events, areas within SFHAs and other areas adjacent to SFHAs are vulnerable to flooding damages. These can include direct structural damages, interruptions to business and commerce, emotional impacts, and injury or death.

3.6 Potential Mitigation Measures, Strategies, and Alternatives

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

3.6.1 Prevention

Prevention of damage from flood losses 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. Prevention may also include maintenance of existing mitigation systems such as drainage systems.

Open Space Preservation: Municipal departments should identify areas for acquisition to remove the potential for flood damage. Open space acquisition should become a high priority in the VCOG municipalities wherever applicable. Acquisition of heavily damaged structures (particularly SRLPs and RLPs) after a flood may be an economical and practical means to accomplish this.

Planning and Zoning: Zoning and Subdivision ordinances should regulate development in flood hazard areas. Flood hazard areas should reflect a balance of development and natural areas although ideally they will be free from development. Policies can also require the design and location of utilities to areas outside of flood hazard areas and the placement of utilities underground. In the VCOG municipalities, the Planning and Zoning Commissions must take an active role in prevention of flood damage.

> *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.*

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

- ❑ Requirements that every lot have a buildable area above the flood level
- ❑ Construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, and drainageways
- ❑ A requirement that developers dedicate open space and flood flow, drainage, and maintenance easements

Building codes should ensure that the foundations of structures will withstand flood forces and that all portions of buildings subject to damage are above or otherwise protected from flooding. Floodplain ordinances should at a minimum follow the requirements of the NFIP for subdivision and building codes. These could be included in the ordinances and regulations for subdivisions and building codes or could be addressed in a separate ordinance. All of the above are enforced to varying degrees within the VCOG municipalities by the Planning and Zoning Commissions and the Building and Engineering staff. It is instrumental to the success of hazard mitigation to strictly enforce these requirements and others similar to them.

FEMA Mapping: One recommendation that municipalities could consider is using more detailed town topographic maps (if available) to develop a more accurate regulatory flood hazard map using the published FEMA flood elevations. FEMA encourages communities to use more accurate topographic maps to expand upon the FIRMs published by FEMA. This is because many FIRMs were originally created using USGS quadrangle maps with 10-foot contour intervals, but many municipalities today have contour maps of one- or two-foot intervals that show more recently constructed roads, bridges, and other anthropologic features. Even in New Haven and Fairfield Counties where map modernization has occurred, there is room for improvement. 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.

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.

Reductions in floodplain area or revisions of a mapped floodplain can only be accomplished through revised FEMA-sponsored engineering studies or Letters of Map Change (LOMC).

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

Standard engineering practice is to avoid the use of detention measures if the project site is located in the lower one-third of the overall watershed. This is recognized in Seymour's regulations, for example. 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 to the stream in the lower reaches of the overall watershed, the peak discharge from the site will occur later in the storm event, which will more closely coincide with the peak discharge of the stream, thus adding more flow to the peak discharge during any given storm event. On the other hand, retention will hold stormwater and promote infiltration. Developers should be required to demonstrate whether detention or retention will be the best management practice for stormwater at specific sites regarding the position of each project site in the surrounding watershed.

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

Wetlands: The Inland Wetlands Commissions administer the Wetland Regulations in the VCOG municipalities. The regulations simultaneously restrict development in floodplains, wetlands, and other floodprone areas.

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

Because a variety of regulations are related to flood damage prevention, the municipalities should consider developing a checklist that cross references the regulations and codes related to flood damage prevention that may be applicable to a proposed project and make this list available to potential applicants. This would be helpful for developers working in two or more of the VCOG communities because, for example, Ansonia's flood damage prevention standards are not in the same document as Derby's.

3.6.2 Property Protection

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

General Improvements: FEMA offers suggestions to homeowners regarding potential home improvements that can mitigate flooding:

- 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 noncorrosive 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.

Standard Flood Protection Techniques: Techniques applicable to property protection include home elevation, construction of barriers, dry floodproofing, and wet floodproofing techniques.

- Home elevation involves the removal of the building structure from the basement and elevating it on piers to a height such that the first floor is located above the 100-year flood level. The basement area is abandoned and filled to be no higher than the existing grade. All utilities and appliances located within the basement must be relocated to the first floor level.

- Barriers include levees, floodwalls, and berms that are useful in protecting areas subject to shallow flooding. Such structural projects are discussed in Section 3.6.6.

- For dry floodproofing, walls may be coated with compound or plastic sheathing. Openings such as windows and vents should be either permanently closed or covered with removable shields. Flood protection should extend only two to three feet above the top of the concrete foundation because building walls and floors cannot withstand the pressure of deeper water.

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

> *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.*

All of the above property protection mitigation measures may be useful for VCOG municipalities' residents to prevent damage from flooding. Building Officials should consider outreach and education in these areas where appropriate.

The RLPs located in the areas subject to flooding in the VCOG municipalities may wish to consider any or all of the possible methods of property protection. For some of the structures, elevation may be cost prohibitive, such that floodproofing may be more advisable. For some, the best option may be to move important equipment from walk-out basements and garages to higher levels of the structures. In cases such as raised ranches, it may not be possible to floodproof the lower level or move equipment given the type of home. For such properties, frequent and repeated flood events may prove too costly, and property acquisitions by either Derby or Shelton may be the best option.

3.6.3 Emergency Services

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

- Forecasting systems to provide information on the time of occurrence and magnitude of flooding.
- A system to issue flood warnings to the community and responsible officials.
- Emergency protective measures, such as an Office of Emergency Management or EMD 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.

Each of these mitigation measures are already in place in the VCOG municipalities. Additional proposals common to all hazards in this plan for improving emergency services are recommended in Section 11.1.

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 11.1.

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 to 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. 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 natural resource protection mitigation measures are recommended to help prevent damage from flooding:

- Pursue additional open space properties in floodplains by purchasing

SRLPs, RLPs, and other floodprone structures and converting the parcels to open space.

- Pursue the acquisition of additional municipal open space properties to the greatest extent possible.
- Selectively pursue conservation objectives listed in the Plans of Conservation and Development and other more recent planning studies and documents.
- Continue to regulate or prohibit development in protected and sensitive areas, including steep slopes, wetlands, and floodplains.

3.6.6 Structural Projects

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

Given the many culverts and bridges in the VCOG municipalities and the increasing rainfall rates in Connecticut, a long-term recommendation of this HMP is for the VCOG municipalities to evaluate the most floodprone river systems using modeling techniques to compare various types of mitigation such as upgrades of bridges and culverts; use of diversions, detention, and retention; and property acquisitions and structure elevations.

The rivers that would benefit most from such studies include the Farmill River/Means Brook system in Shelton, the Little River in Seymour, and Bladens River in Seymour. The Housatonic River and Naugatuck River are not ideal candidates for flood mitigation studies because they are influenced so heavily by dams and, in the case of the Naugatuck River, local flood protection systems are in place.

Additional channelization of rivers, construction of flood control dams, and other large-scale projects for inland flood mitigation would be inappropriate for the VCOG municipalities and are not recommended. However, a number of areas would benefit from improved drainage and flood conveyance, including the many areas discussed in Section 3.5.

3.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives

While many potential mitigation activities are addressed above in Section 3.6, the recommended mitigation strategies for addressing flooding problems in all VCOG municipalities are listed below.

Prevention

- Continue to regulate activities within SFHAs to the greatest extent possible using the municipal codes, Zoning Regulations, and Subdivision Regulations.

- Consider requiring new buildings in floodprone areas to be protected to the highest recorded flood level regardless of SFHA status.

- Ensure that new buildings be designed and graded to shunt drainage away from the building.

- Require developers to demonstrate whether detention or retention of stormwater is the best option for reducing peak flows downstream.

- Consider revising Section 195-112(C) of the Derby Zoning Regulations as this section explains that an applicant must be notified that flood insurance premiums will be higher than typical if permission is granted for construction of a structure below the base flood elevation. This implies that the Planning and Zoning Commission has the authority to permit such construction below the base flood elevation. Such actions are not advisable in the community.

- Ensure that redevelopment of O'Sullivan's Island in Derby is flood damage resistant.

- Ensure that redevelopment of the vacant RLP on River Road in Seymour is flood damage resistant.

Property Protection

- Provide technical assistance to owners of nonresidential structures that suffer flood damage regarding floodproofing measures such as wet and dry floodproofing.

- Pursue elevation of residential properties that suffer flood damage. Properties may be classified as repetitive loss or not classified as repetitive loss, but RLPs should be prioritized. The Maples and McConney Grove neighborhoods are a high priority for home elevations.

Natural Resource Protection

- Pursue acquisition/demolition of floodprone residential properties for open space. Properties may be classified as repetitive loss or not classified as repetitive loss, but RLPs should be prioritized.

- Pursue the acquisition of additional municipal open space in SFHAs.

- Selectively pursue conservation recommendations listed in the Plans of Conservation and Developments and other studies and documents.

- Strictly regulate or prohibit development in protected and sensitive areas, including steep slopes, wetlands, SFHAs, and other floodprone areas.

<u>Public Education</u>

- Consider enrolling each municipality in the CRS.

- Develop an annual outreach program to floodprone residential and commercial property owners. Provide technical information regarding structure elevation, dry and wet floodproofing, and other improvement techniques. Insurance information should also be provided.

- Ensure that EMDs, Building, Engineering, or Public Works personnel attend DEEP and other training workshops annually. FEMA-sponsored training seminars at the Emergency Management Institute (EMI) in Emmitsburg, Maryland should be considered as well. All of these workshops are free of charge. Annual training sessions include emergency management, environmental reviews, the FEMA grant programs, the NFIP and CRS, and sessions related to the other hazards.

<u>Structural Projects</u>

- Develop a hydrologic and hydraulic model of the river systems in the VCOG region that have been subject to repeated flooding as a way to prioritize mitigation activities such as culvert and bridge upgrades, property acquisitions and elevations, and retention/detention. Examples include Means Brook/Farmill River and the Bladens River.

- Upgrade the drainage network including piping and culverts along the unnamed tributary to Beaver Brook in the Prindle Avenue area of Ansonia to reduce flooding that has occurred.

- Upgrade the Wakelee Avenue (Route 334) drainage network in Ansonia as needed to reduce nuisance flooding.

- Review and upgrade/replace the drainage network associated with the unnamed stream in the Ells Street section of Ansonia to reduce flooding.

- Work with the Connecticut DOT to review the drainage network associated with Route 8 in the area to the east of Route 8 that becomes inundated after large-scale rain events in Ansonia and upgrade as needed to reduce the potential for private property damage.

- Consider using localized floodwalls or berms for the area of Olsen Drive in Ansonia that was almost flooded following Tropical Storm Irene in 2011. As an alternative, ensure that structures are flood damage resistant and that dry land access is made available if this area is redeveloped.

- Implement the drainage improvements for the Gilbert Street area in Derby to reduce the incidence and severity of flooding in the neighborhood. Acquire properties as needed to make these improvements.

- Work with the owners of detention basins along the tributary of Twomile Brook upstream of Sodom Lane to ensure that they are maintained for continued functionality.

- Upgrade and replace the culvert for the watercourse at Walnut Street in Seymour to the extent needed to reduce flooding.

- Consider drainage improvements or installation of a new drainage network to reduce flooding from the hillside along Roosevelt Drive (Route 34) in Seymour.

- Replace and upgrade, as needed, the drainage network associated with Bladens River in the Beach Street section of Seymour. Investigate opportunities to reduce the overbank conditions that also lead to flooding in this neighborhood.

- Replace and upgrade, as needed, the drainage network associated with Little River in the Bank Street section of Seymour. Investigate opportunities to reduce the overbank conditions that may also lead to flooding in this area.

- Upgrade or replace the Walnut Tree Hill Road culvert that conveys the Farmill River in Shelton to reduce flooding.

- Upgrade or replace the Long Hill Avenue stone masonry culvert in Shelton that conveys Burying Ground Brook to reduce flooding.

- Upgrade or replace the Brookwood Lane culvert in Shelton that conveys an unnamed watercourse to reduce flooding.

- Upgrade or replace the Oak Avenue drainage network that conveys unnamed watercourses to reduce nuisance flooding in Shelton.

- The culverts along Shelton Avenue (Route 108) in Shelton conveying Means Brook and Pole Brook are in need of hydraulic analyses, and the city should work with the Connecticut DOT to analyze and replace/upgrade these culverts as needed.

Recommendations for critical facilities, emergency operations, and evacuation were previously listed in Section 2.11. In addition, mitigation strategies important to all hazards are included in Section 11.1.

4.0 HURRICANES AND TROPICAL STORMS

4.1 Setting

Several types of hazards may be associated with tropical storms and hurricanes including heavy winds, heavy rains, tornadoes, and flooding. Hurricanes and tropical storms have the potential to affect any portion of the region with their wind. A hurricane striking the VCOG municipalities is considered a possible event each year and could cause moderate damage to the VCOG municipalities and their infrastructure (refer to Tables 1-2 and 1-3). Tropical Storm Irene in 2011 was a reminder that the region is at risk for hurricanes.

4.2 Hazard Assessment

General

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

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

Inland Connecticut is vulnerable to hurricanes despite moderate hurricane occurrences when compared with other areas within the Atlantic Tropical Cyclone Basin. Since hurricanes tend to weaken within 12 hours of landfall, far inland areas are relatively less susceptible to hurricane wind damages than coastal areas in Connecticut. However, the heaviest rainfall often occurs inland. A recent example is Tropical Storm Irene (described in Section 4.3). Tropical Storm Irene caused wind damage in southern Connecticut and extensive precipitation within inland Connecticut and northern New England.

The VCOG municipalities cover an area of 58.5 square miles that stretch approximately 12.6 miles from northeast to southwest and approximately 7.4 miles from northwest to southeast. By virtue of its location within 10 to 15 miles of the shoreline and its position at the ends of two rivers that have watersheds extending to northern Connecticut and beyond, the VCOG region is susceptible to high winds *and* flooding from heavy inland hurricane precipitation. Furthermore, low areas and areas with poor drainage are vulnerable to drainage-induced flooding during a hurricane. Finally, the tidal portion of the Housatonic River below the Derby Dam is susceptible to storm surge. In summary, there are many ways that the effects of a tropical system can cause damage in the VCOG region.

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. Storm surge is no longer part of the scale. The National Hurricane Center is considering offering specific warnings regarding storm surge based on Sea, Lake, and Overland Surges from Hurricanes (SLOSH) mapping for areas that could be impacted by a hurricane.

The following descriptions are from the 2010 *Connecticut Natural Hazard Mitigation Plan Update*.

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

- **Category Two Hurricane:** Sustained winds 96-110 mph (83-95 kt or 154-177 km/hr). *Very strong winds will produce widespread damage*. Some roofing material, door, and window damage of buildings will occur. Considerable damage to mobile homes (mainly pre-1994 construction) and poorly constructed signs is likely. A number of glass windows in high-rise buildings will be dislodged and become airborne. Loose outdoor items will become projectiles, causing additional damage. Persons struck by windborne debris risk injury and possibly death. Numerous large branches will break. Many trees will be uprooted or snapped. Extensive damage to power lines and poles will likely result in widespread power outages that could last a few to several days.

- **Category Three Hurricane:** Sustained winds 111-130 mph (96-113 kt or 178-209 km/hr). *Dangerous winds will cause extensive damage.* Some structural damage to houses and buildings will occur with a minor amount of wall failures. Mobile homes (mainly pre-1994 construction) and poorly constructed signs are destroyed. Many windows in high-rise buildings will be dislodged and become airborne. Persons struck by windborne debris risk injury and possibly death. Many trees will be snapped or uprooted and will block numerous roads. Near total power loss is expected with outages that could last from several days to weeks.

- **Category Four Hurricane:** Sustained winds 131-155 mph (114-135 kt or 210-249 km/hr). *Extremely dangerous winds causing devastating damage are expected.* Some wall failures with some complete roof structure failures on houses will occur. All signs are blown down. Complete destruction of mobile homes (primarily pre-1994 construction). Extensive damage to doors and windows likely. Numerous windows in high-rise buildings will be dislodged and become airborne. Windborne debris will cause extensive damage, and persons struck by the wind-blown debris will be injured or killed. Most trees will be snapped or uprooted. Fallen trees could cut off residential areas for days to weeks. Electricity will be unavailable for weeks after the hurricane passes.

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

4.3 Historic Record

Through research efforts by the National Oceanic and Atmospheric Administration's (NOAA) 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 the 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), two Category Three hurricanes, 11 Category Two hurricanes, 10 Category One hurricanes, and 37 tropical storms have tracked within a 150-nautical-mile radius of the VCOG municipalities. The representative storm strengths were measured as the peak intensities for each individual storm passing within the 150-mile radius. The 23 hurricanes noted above occurred in July through October as noted in Table 4-1.

TABLE 4-1
Tropical Cyclones by Month Within 150 Miles of the VCOG Municipalities, 1851-2012

Category	July	August	September	October
Tropical Storm[1]	4	11	14	5
One	1	3	4	2
Two	0	4	6	1
Three	0	0	2	0
Total	**5**	**18**	**26**	**8**

[1]One tropical storm occurred in May, one occurred in June, and one occurred in November. Hurricane Irene is counted as a Tropical Storm in this table although it had characteristics of a Category One storm upon landfall.

A description of the historic record of tropical cyclones near the VCOG municipalities follows:

1. An unnamed hurricane in September 1858 was a Category One hurricane when its center made landfall in southeastern Connecticut.

2. An unnamed hurricane in September 1859 strengthened to a Category One hurricane when its center passed southeast of Long Island, New York.

3. An unnamed hurricane in September 1869 was a Category Three hurricane when its center made landfall in Rhode Island.

4. An unnamed hurricane in October 1869 was a Category Two hurricane when its center passed over western Cape Cod, Massachusetts.

5. An unnamed hurricane in October 1878 was a Category One hurricane when its center passed over eastern Pennsylvania toward Albany, New York.

6. An unnamed hurricane in August 1879 was a Category One hurricane when its center made landfall in East Falmouth, Massachusetts.

7. An unnamed hurricane in September 1888 was a Category One hurricane when its center made landfall in Nantucket, Massachusetts.

8. An unnamed hurricane in August1893 was a Category One hurricane when its center made landfall near New York City and traveled north over western Connecticut.

9. An unnamed hurricane in October 1894 was a Category One hurricane when its center made landfall near Clinton, Connecticut.

10. An unnamed hurricane in September 1896 was a Category One hurricane when its center passed over southeastern Massachusetts.

11. An unnamed hurricane in July 1916 was a Category One hurricane when its center passed near Block Island, Rhode Island.

12. An unnamed hurricane in August 1924 was a Category Two hurricane when its center passed southeast of Nantucket, Massachusetts.

13. An unnamed hurricane in September 1936 was a Category Two hurricane when its center passed southeast of Long Island, New York.

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

    The majority of damage was caused from storm surge and wind damage. Surges up to 18 feet were recorded along portions of the Connecticut coast, and 130-mile-per-hour gusts flattened forests, destroyed nearly 5,000 cottages, farms, and homes, and damaged an estimated 15,000 more throughout New York and southern New England. The storm resulted in catastrophic fires in New London and Mystic, Connecticut. Fourteen to 17 inches of rain were reported in central Connecticut, causing severe flooding. Overall, the storm left an estimated 564 dead, 1,700 injured, and caused physical damages in excess of $38 million (1938 USD).

15. The "Great Atlantic Hurricane" hit the Connecticut coast in September 1944. This storm was a Category Four hurricane at its peak intensity but was a Category One hurricane when its center passed over eastern Long Island and made landfall in Connecticut near New London. The storm brought rainfall in excess of six inches to most of the state and rainfall in excess of eight to 10 inches in Fairfield County. Most of the wind damage from this storm occurred in southeastern Connecticut although wind gusts of 109 mph were reported in Hartford, Connecticut. Injuries and storm damage were lower in this hurricane than in 1938 because of increased warning time and the fewer structures located in vulnerable areas due to the lack of rebuilding after the 1938 storm.

16. Hurricane Barbara (naming of hurricanes began in 1950) was a Category One hurricane when its center passed southeast of Long Island, New York in August 1953.

17. Hurricane Carol was a Category Two hurricane when it made landfall in Connecticut near Clinton in late August 1954. The storm arrived 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 in the northeast were estimated at one billion dollars (1954 USD), and 48 people died as a direct result of the hurricane. Western Connecticut was largely unaffected by Hurricane Carol due to the compact nature of the storm.

18. A second Category Two hurricane, Hurricane Edna, passed over southeastern Massachusetts in September 1954. It was a Category Three hurricane at peak intensity.

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

20. Hurricane Donna of 1960 was a Category Four hurricane when it made landfall in southwestern Florida and weakened to a Category Two hurricane when it made landfall in September near Old Lyme, Connecticut.

21. Hurricane Esther was a Category Three hurricane when its center passed south of Nantucket, Massachusetts in September 1960.

22. Hurricane Belle of August 1976 was a Category One hurricane as it passed over Long Island but was downgraded to a tropical storm before its center made landfall near Stratford, Connecticut. Belle caused five fatalities and minor shoreline damage.

23. Hurricane Gloria of September 1985 was a Category Three hurricane when it made landfall in North Carolina and weakened to a Category Two hurricane before its center passed over Long Island, New York, making landfall in Connecticut near Bridgeport. The hurricane struck at low tide, resulting in low to moderate storm surges along the coast. The storm produced up to six inches of rain in some areas and heavy winds that damaged structures and uprooted thousands of trees. The volume and spread of debris and loss of power were the major impacts from this storm, with over 500,000 people suffering significant power outages.

24. Hurricane Bob was a Category Two hurricane when its center made landfall in Rhode Island in August 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 and light to moderate tree damage. The storm was responsible for six deaths in the state. Total damage in southern New England was approximately $680 million (1991 USD).

25. Prior to Hurricane Irene in 2011, the most recent tropical cyclone to seriously impact Connecticut was Tropical Storm Floyd in 1999. Floyd is the storm of record in the Connecticut Natural Hazard Mitigation Plan due to heavy rainfall that caused widespread flood damage throughout the state. The winds associated with Tropical Storm Floyd also caused power outages throughout New England and at least one death in Connecticut.

26. Hurricane Earl of early September 2010 was a long-lived, powerful tropical cyclone that became the first major hurricane to threaten New England since Hurricane Bob. Hurricane Earl was a Category One hurricane when it passed within 90 miles of New England. Prior to this, many forecasts predicted that a New England landfall was possible, and the storm provided an exercise in emergency preparations for the state.

Only one year after Hurricane Earl, Hurricane Irene provided another exercise in emergency management for the VCOG municipalities as well as the entire eastern seaboard of the United States. The hurricane peaked as a Category Three storm before it made landfall in North Carolina and tracked northward along the Delmarva Peninsula and New Jersey before the remnants of the eye crossed over New York City on Sunday, August 28, 2011. Anticipating storm surges along the Atlantic coastline, many states and municipalities issued mandatory evacuations on August 26 and 27, 2011. In addition to high winds, heavy precipitation was a huge issue in New England states.

Tropical Storm Irene struck at high tide during a perigee (full moon) tide resulting in an abnormally high storm surge causing serious coastal damage in Connecticut. The storm surge from Irene destroyed many structures and flooded many coastal roads along the shoreline. Although it did not cause damage in southeastern Shelton, the surge caused backwater conditions in the tidal portions of the Housatonic River and thus generated water levels along the lower Naugatuck River that were higher than would have occurred from high flows acting alone.

Only a week after Tropical Storm Irene, the remnants of Tropical Storm Lee combined with a frontal system caused rain from September 6 through the morning of September 8, 2011. In particular, heavy rain fell overnight from September 7 through September 8. The Naugatuck River crested midday on September 8 just below flood stage at the Beacon Falls gauging station just upstream of Seymour. The Housatonic River was in flood stage and expected to crest on the afternoon of September 8, exceeding the stage of the 10-year storm at the Stevenson gauging station. Flooding occurred in the Maples section of Shelton and the McConney Grove section of Derby.

4.4 Existing Programs, Policies, Capabilities, and Mitigation

Flooding

Existing mitigation measures appropriate for flooding have been discussed in Section 3.0. These include the ordinances, codes, and regulations that have been enacted to minimize flood damage.

Wind

Wind loading requirements are addressed through the state building code. The 2005 Connecticut State Building Code was amended in 2009 and adopted with an effective date of August 1, 2009. The code specifies the design wind speed for construction in all 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 Ansonia, Derby, and Seymour is 100 mph while the design wind speed for Shelton is 110 mph for areas east of Route 8 and 100 mph for areas west of Route 8. The VCOG municipalities have adopted the Connecticut Building Code as their building code.

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

Parts of trees (limbs) or entire trees may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. United Illuminating (UI), the local electric utility for Ansonia, Derby, and Shelton and Connecticut Light & Power (CL&P), the local electric utility in Seymour, provide tree maintenance near their power lines. Each VCOG municipality has a Tree Warden that performs tasks with variable responsibilities and resources as noted below:

Ansonia

- The Public Works Director holds the position of Tree Warden in the city.
- A budget is in place for tree maintenance, and the city performs regular visual inspections.
- UI performs a limited amount of tree trimming, which typically includes branches within five feet of its wires.
- The city has the right to remove entire trees that pose threat to human life and property and does so as necessary.
- The city often identifies problematic instances on private lands so that home/facility owners can take the time to remove these threats.
- Wherever a private home/facility owner does not heed the city's warning, the Tree Warden may step in when the threat becomes serious.

Derby

- The Public Works Director holds the position of Tree Warden in the city.
- The old and threatening trees in the city's rights-of-way and on city property are maintained and removed as needed.
- Trees on private properties are not handled by the program.
- UI performs a limited amount of tree trimming, which typically includes branches within five feet of its wires.

The City of Derby believes that its tree maintenance program has helped during events like Tropical Storm Irene and Winter Storm Alfred (discussed in Section 6.0). Only 125 properties lost power during Tropical Storm Irene, and only 42 lost power as a result of Winter Storm Alfred, in comparison to hundreds to thousands of properties losing power in other Connecticut municipalities during both disasters.

Seymour

- The Public Works Director holds the position of Tree Warden in the town.
- The town has a boom truck and a chipper that is employed when performing tree maintenance.
- CL&P performs a limited amount of tree trimming, which typically includes branches within five feet of its wires.

Shelton

- The "Tree Engineer" or Tree Warden in the city operates out of the Parks and Recreation Department on a part-time basis.
- The Tree Warden often fields calls from businesses and homeowners regarding the ownership of trees that lie at or near business or residential properties.
- The Public Works Department often works closely with the Tree Warden to address the needs of home and business owners with issues.

Shelters were discussed in Section 2.11. During emergencies, Ansonia uses Ansonia High School as the primary shelter and the John C. Meade School as the secondary shelter while the Ansonia Middle School is in the process of being approved as the city's third shelter. In Derby, the two shelters are the Derby Middle School and the Bradley School while each of the four fire stations are temporary shelters. The two main shelters and the four temporary shelters lack generators.

In Seymour, the Seymour Middle School and, upon coming online in September 2012, the Paul E. Chatfield Elementary School will both be ARC shelters. In Shelton, the primary shelter is Shelton High School while the secondary shelter is the Community Center. The Animal Shelter houses pets during emergencies. Both main shelters are recognized as ARC shelters.

Although hurricanes that have impacted the VCOG municipalities have historically passed in a day's time, additional shelters could be outfitted following a storm on an as-need basis for long-term evacuees. In Ansonia, additional locations that could be used as shelters, if needed, include the ARMS building, which was formerly the city's EOC and is outfitted with a generator and radio tower. However, the ARMS facility is within the *Zone X Protected by Levee* flood zone, so the EOC was moved to the Police Station, which could also be used as a shelter if needed. In Derby, a generator is located in the basement of City Hall (the EOC), which could be used as a shelter.

In Shelton, additional possible shelter locations include City Hall (the EOC), the Shelton Police Department (the backup EOC), and all four fire locations, all of which are outfitted with generators.

Prior to severe storm events, the VCOG municipalities ensure that warning/notification systems and communication equipment are working properly and prepare for the possible evacuation of impacted areas. Ansonia, Derby, and Shelton all rely on Reverse 911 while Seymour relies on CodeRed and the Facebook and Twitter social networks for communicating emergency alerts to citizens. In addition, all municipalities rely on radio, cable television, area newspapers, and the internet to spread information on the location and availability of shelters. Text messaging, another powerful tool, should be explored by each municipality as an option of relaying emergency-related messages to citizens. It is understood that several of these information sources can be cut off due to power failure, so emergency personnel should also pass this information on manually.

4.5 Vulnerabilities and Risk Assessment

Hurricane Risk

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

NOAA has utilized the National Hurricane Center Risk Analysis Program (HURISK) to determine return periods for various hurricane categories at locations throughout the United States. As noted on the NOAA website, hurricane return periods are the frequency at which a certain intensity or category of hurricane can be expected within 75 nautical miles of a given location. For example, a return period of 20 years for a particular category storm means that on average during the previous 100 years a storm of that category passed within 75 nautical miles of that location five times. Thus, it is expected that similar category storms would pass within that radius an additional five times during the next 100 years.

Table 4-2 presents return periods for various category hurricanes to impact Connecticut. The nearest two HURISK analysis points were New York City and Block Island, Rhode 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 (Western Connecticut)	Block Island, RI (Eastern Connecticut)
One	17	17
Two	39	39
Three	68	70
Four	150	160
Five	370	430

According to the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, hurricanes have the greatest destructive potential of all natural disasters in Connecticut due to the potential combination of high winds, storm surge and coastal erosion, heavy rain, and flooding that can accompany the hazard. Tropical Storm Irene notwithstanding, it is generally believed that New England is long overdue for another major hurricane strike. As shown in Table 5-2, NOAA estimates that the return period for a Category Two or Category Three storm to strike eastern New Haven County to be 39 years and 70 years, respectively. The last major hurricane to impact Connecticut was Hurricane Bob in 1991. The heavy-rain-impacting remnants of Hurricane Irene was a reminder that both hurricanes and their remnants impact Connecticut.

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

<u>General Vulnerabilities</u>

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. Recently, the remnants of Hurricane Irene proved to cause complete disruption of power and communications nearly statewide in Connecticut on the order of a week. In addition to falling limbs, trees, and other materials, which took out power, telephone, cable, and cellular service statewide, flooding proved a threat to human life and property in many Connecticut communities including the VCOG towns.

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

Specific Regionwide Vulnerabilities

As noted above, the VCOG region is susceptible to high winds *and* flooding from heavy inland hurricane precipitation by virtue of its location within 10 to 15 miles of the shoreline and its position at the ends of two rivers. The communities are vulnerable to wind damage throughout their boundaries and to flooding along the rivers as well as in areas with poor drainage. Structures along the tidal portion of the Housatonic River below the Derby Dam are vulnerable to storm surge. Factors that influence relative vulnerability to tropical cyclones in the VCOG municipalities include building codes currently in place, local zoning and development patterns, and the age and number of structures located in highly vulnerable areas of the community.

Based on the population projections in Section 2.6, the population of the VCOG member municipalities is estimated to increase only moderately through 2020. All areas of growth and development increase the municipalities' 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 and flood damage prevention codes.

Of particular concern to the VCOG region are the blockage of roads and the damage to the electrical power supply from falling trees and tree limbs. According to municipal officials, most areas within the VCOG municipalities are vulnerable to falling trees and limbs with the exception of each city or town center where the number of trees is significantly lower.

The VCOG municipalities' housing stock consists of many historic buildings and homes greater than 50 and sometimes 100 years old, relatively younger buildings built before the 1990s when the building codes changed to mitigate for wind damage, and relatively recent buildings that utilize the new code changes. Since most of the existing housing stock in the municipalities predates recent code changes, many structures are highly susceptible to roof and window damage from high winds.

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

According to municipal officials, municipally owned critical facilities do not have wind-mitigation measures installed to specifically reduce the effects of wind. Thus, it is possible that many of the critical facilities in the VCOG municipalities are as vulnerable to damage from hurricane-force winds as other noncritical structures. Note that many critical facilities in the VCOG municipalities are not specifically designed to withstand hurricane-force winds. Newer critical facilities, such as Griffin Hospital and the Cancer Center in Derby, the Seymour Police Department, and the Shelton Police Department are considered to be the most resistant to wind damage even if they are not specifically wind resistant for hurricane gusts.

Also of particular concern to the VCOG region are the conditions of levees and dams such as the Witek Park dams in Derby, the Derby Dam on the Housatonic River, and others that necessitate emergency planning during a high-precipitation hurricane event. Levees were discussed in Section 3.0, and dams are discussed in Section 8.0.

Sheltering Vulnerabilities

The VCOG municipalities currently determine sheltering need based upon areas damaged or needing to be evacuated 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. In general, during extended power outages, it is believed that only 10% to 20% of the affected population of the VCOG municipalities will relocate while most will stay in their homes until power is restored. In the case of a major (Category Three or above) hurricane, it is likely that the VCOG municipalities will depend on state and federal aid to assist in sheltering displaced populations until normalcy is restored.

As previously described, between Ansonia High School (primary), the John C. Meade School, and, once approved, Ansonia Middle School, Ansonia will be well prepared for meeting the demands of sheltering when an emergency situation takes place. Derby's sheltering resources have not been approved by the ARC process, and both main locations and the four temporary locations lack a generator. In Seymour, once the Paul E. Chatfield Elementary School comes online, it will bring the town to its current population needs. The primary and secondary shelters in Shelton (Shelton High School and the Shelton Community Center) are both ARC recognized and meet current demands of the city along with the Animal Shelter. This was further discussed in Section 2.11 of this plan.

HAZUS-MH Analysis for Wind

In order to quantify potential hurricane damage, *HAZUS-MH* simulations were run for probabilistic storms that could theoretically affect the VCOG municipalities. 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 nonwind effects. Thus, the damage and displacement estimates presented below are likely *lower* than would occur during a hurricane associated with severe rainfall and storm surge. Results are presented in Appendix G and summarized below.

The FEMA default values were used for each census tract in the *HAZUS* simulations. A summary of the default building counts and values is shown in Table 4-3. Approximately 7.6 billion dollars of building value was estimated to exist in the VCOG municipalities.

TABLE 4-3
***HAZUS* Hurricane Scenarios – Basic Information**

Occupancy	Building Count	Dollar Exposure (x 1,000)
Residential	28,765	$5,540,090
Commercial	1,687	$1,104,703
Other	1,046	$993,999
Total	**31,498**	**$7,638,792**

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 4-4 presents the peak wind speeds during each wind event simulated by *HAZUS* for the VCOG municipalities. The number of expected residential buildings to experience various classifications of damage is presented in Table 4-4, and the total number of buildings expected to experience various classifications of damage is presented in Table 4-5. Minimal damage is expected to buildings for wind speeds less than 65 mph, with overall damages increasing with increasing wind speed.

TABLE 4-4
***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	43-44	0	0	0	0	0
20 Years	58-60	17	1	0	0	18
50 Years	77-78	244	17	1	0	262
100 Years	90-92	1,599	158	5	1	1,763
200 Years	100-102	4,465	704	33	16	5,218
500 Years	113-115	8,797	2,572	294	174	11,836
1,000 Years	121-124	10,666	4,642	911	576	16,796

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

Return Period or Storm	Minor Damage	Moderate Damage	Severe Damage	Total Destruction	Total
10 Years	0	0	0	0	0
20 Years	23	1	0	0	24
50 Years	271	19	1	0	291
100 Years	1,714	172	7	1	1,894
200 Years	4,792	787	46	16	5,642
500 Years	9,440	2,930	382	177	12,929
1,000 Years	11,398	5,258	1,169	585	18,410

The *HAZUS* simulations consider a subset of critical facilities termed "essential facilities" that 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 4-6, minimal damage to essential facilities is expected for wind speeds less than 78 mph. The only significant damage to an essential facility for the return periods used in the modeling occurs to the hospital, which experiences moderate damage with an increasing length of loss of use from the 100-year return period to the 500-year return period. Minor damage to the remaining essential facilities is likely to occur for all greater wind events. The 1,000-year probabilistic event (wind speeds of 121-124 mph) has a greater than 50% chance of moderate loss of use to the hospital for a period of greater than one month.

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

Return Period or Storm	Fire Station (11)	Hospital (1)	Police Station (6)	Schools (26)	Emergency Operations Center (2)
10 Years	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
20 Years	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
50 Years	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
100 Years	None or minor damage, no loss of use	Chance of moderate damage >50%, loss of use < 1 week	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
200 Years	None or minor damage, no loss of use	Chance of moderate damage >50%, loss of use < 1 week	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
500 Years	None or minor damage, no loss of use	Chance of moderate damage >50%, loss of use > 1 week < 1 month	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use
1,000 Years	None or minor damage, no loss of use	Chance of moderate damage >50%, loss of use > 1 month	None or minor damage, no loss of use	None or minor damage, no loss of use	None or minor damage, no loss of use

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

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

Return Period or Storm	Brick / Wood	Reinforced Concrete / Steel	Tree Debris	Total	Estimated Truckloads (25 Tons Per Truck)
10 Years	None	None	None	None	None
20 Years	12	None	225	237	10
50 Years	1,444	None	1,876	3,320	133
100 Years	6,393	None	18,802	25,195	1,008
200 Years	15,832	None	32,377	48,209	1,929
500 Years	45,383	None	82,033	127,416	5,097
1,000 Years	86,108	None	125,614	211,722	8,469

Table 4-8 presents the potential sheltering requirements based on the various wind events simulated by *HAZUS*. The predicted sheltering requirements for <u>wind damage</u> are relatively minimal except for the two largest wind events and are expected to be able to be met through the use of the existing municipal shelters.

TABLE 4-8
***HAZUS* Hurricane Scenarios – Shelter Requirements**

Return Period or Storm	Number of Displaced Households	Short-Term Sheltering Need (Number of People)
10 Years	None	None
20 Years	None	None
50 Years	None	None
100 Years	None	None
200 Years	21	3
500 Years	300	63
1,000 Years	1,231	271

Table 4-9 presents the predicted economic losses due to the various simulated wind events. Property damage loss estimates include the subcategories of building, contents, and inventory damages. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building or its contents.

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

Return Period or Storm	Residential Property Damage Losses	Commercial, Industrial & Others Property Damage	Business Interruption (Income) Losses	Total Property Damage Losses
10 Years	None	None	None	None
20 Years	405	None	2	407
50 Years	10,666	633	602	11,901
100 Years	38,203	3,931	3,507	45,641
200 Years	97,303	17,118	13,212	127,633
500 Years	303,187	82,192	49,250	434,629
1,000 Years	644,975	197,125	112,899	954,999

Business interruption loss estimates in Table 4-9 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 homes because of the storm.

Losses are minimal for storms with return periods of less than 50 years (78 mph) but increase rapidly as larger storms are considered. 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 the VCOG municipalities. Based on the historic record and *HAZUS-MH* simulations of various wind events, all VCOG municipalities are 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 Measures, Strategies, and Alternatives

Many potential mitigation measures for hurricanes include those appropriate for flooding. These are presented in Section 3.0. However, hurricane mitigation measures must also address the effects of heavy winds that are inherently caused by tropical systems. Mitigation for wind damage is therefore emphasized in the subsections below.

4.6.1 Prevention

Although wind from hurricanes and tropical storms cannot be prevented, a number of methods are available to prevent damage from the storms. To prevent wind damage, the VCOG municipalities should expand the current programs of placing utilities underground and look for opportunities to relocate utilities underground.

Although the Tree Wardens in the VCOG municipalities actively enforce the tree ordinances, time and budgetary constraints reportedly hamper their ability to be as effective as needed to help prevent wind problems. Pruning tree limbs should be considered in addition to removal of older or dying trees. VCOG-wide additional funding could allow for increased tree maintenance and pruning.

4.6.2 Property Protection

Potential mitigation measures for property protection during hurricanes include designs for hazard-resistant construction and retrofitting techniques. These may take the form of increased wind and flood resistance as well as the use of storm shutters over exposed glass and the inclusion of hurricane straps to hold roofs to buildings and transfer loads to foundations.

As noted in Section 2.11, the ARC has published a guidebook entitled *Standards for Hurricane Evacuation Shelter Selection* (American Red Cross Publication #4496). The publication provides guidelines for selecting shelters relative to resilience from flooding and high winds.

Several FEMA publications provide design criteria for shelters, including *Design and Construction Guidance for Community Shelters* (FEMA Publication #361). A reference by the ICC and the National Storm Shelter Association, *Standard on the Design and Construction of Storm Shelters* (ICC-500), also provides design criteria. In general, recommended design wind speeds range from 160 to 250 mph in these publications. The VCOG municipalities use Connecticut's building code, which is 100 mph for Ansonia, Derby, and Seymour; 100/110 for Shelton; 110 mph for areas east of Route 8; and 100 mph for areas west of Route 8.

The PDM program is the current FEMA mitigation grant program best suited to funding hurricane wind mitigation projects. The PDM program recognizes four categories of property protection projects for wind damage mitigation as follows:

- "Shutter mitigation" projects protect all windows and doors of a structure with shutters or other systems that meet debris impact and wind pressure design requirements. All openings of a building are to be protected.
- "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 event.
- "Code plus" projects are those designed to exceed the local building codes and standards to achieve a greater level of protection.

The availability of these potential mitigation projects through FEMA's PDM grant program may be of interest to the VCOG region as there may be an opportunity to obtain incremental funding for shelters to withstand hurricane force winds.

The Building officials should make literature available to developers during the permitting process regarding various design standards.

4.6.3 Public Education and Awareness

The public should be made aware of evacuation routes and available shelters should a hurricane be forecast to impact the VCOG municipalities. The municipalities should continue to use various forms of media to notify the public on any and all updates to natural disaster preparedness and damage prevention from the earliest feasible moment to the storm's arrival. Recommendations regarding public education and awareness are common to all hazards in this plan and are listed in Section 11.1.

4.6.4 Emergency Services

A natural hazard mitigation plan addresses actions that can be taken before a disaster event. In this context, emergency services that would be appropriate mitigation measures for hurricanes include diligent use of forecasting, continuous updates on municipality websites and social media platforms, implementation of Reverse 911 and CodeRed to provide information on the time of occurrence and magnitude of a storm, and early evacuation of neighborhoods and localities. As previously outlined, Ansonia, Derby, and Shelton utilize the services of Reverse 911 while Seymour has made CodeRed available to their residents and businesses. Although evacuation of all VCOG municipalities as a whole may not be feasible, coordination between the three arms of the various municipal Emergency Management Department (Fire, Police, and Emergency Management) representatives and early and frequent broadcasts regarding weather and town updates are crucial. Constant communication in all aspects of emergency preparedness as far in advance as needed depending on the availability of a forecast is instrumental in the end result.

Based on the above guidelines, a number of specific proposals for improved emergency services are recommended to prevent damage from flooding. These are common to all hazards in this plan and are listed in Section 11.1.

4.6.5 Structural Projects

Structural projects for wind damage mitigation are not possible. Note that structural mitigation methods used for *buildings* are classified as *property protection* and were described above.

4.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives

Recommendations for mitigation of hurricane and tropical storm winds within the VCOG municipalities include the following:

- Expand the current programs of placing utilities underground and look for opportunities to relocate utilities underground.
- Continue, improve, and/or implement tree limb inspections, maintenance, and outreach to private property owners regarding branches above power lines.
- Increase funding for the Tree Wardens to address a wide range of tree limb hazards.
- Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards for wind and include such literature on the municipality websites and in posts on the municipalities' social media platforms.
- Encourage the use of wind-mitigation structural techniques in new structures, especially critical facilities, to protect new buildings to a greater level than the required standard.

In addition, many of the recommendations in Section 3.7 for mitigating flooding are suitable for mitigation of flooding caused by hurricanes and tropical storms. Finally, important recommendations that apply to all hazards are listed in Section 11.1.

5.0 SUMMER STORMS AND TORNADOES

5.1 Setting

Like hurricanes and winter storms, summer storms and tornadoes have the potential to affect any area within the VCOG member municipalities. 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 municipalities or an area within an individual municipality without harming another area. All VCOG municipalities are 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 occur 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 New Haven County (Ansonia, Derby, and Seymour) and Fairfield County (Shelton) each year and could cause significant damage to a small area (refer to Tables 1-2 and 1-3).

5.2 Hazard Assessment

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

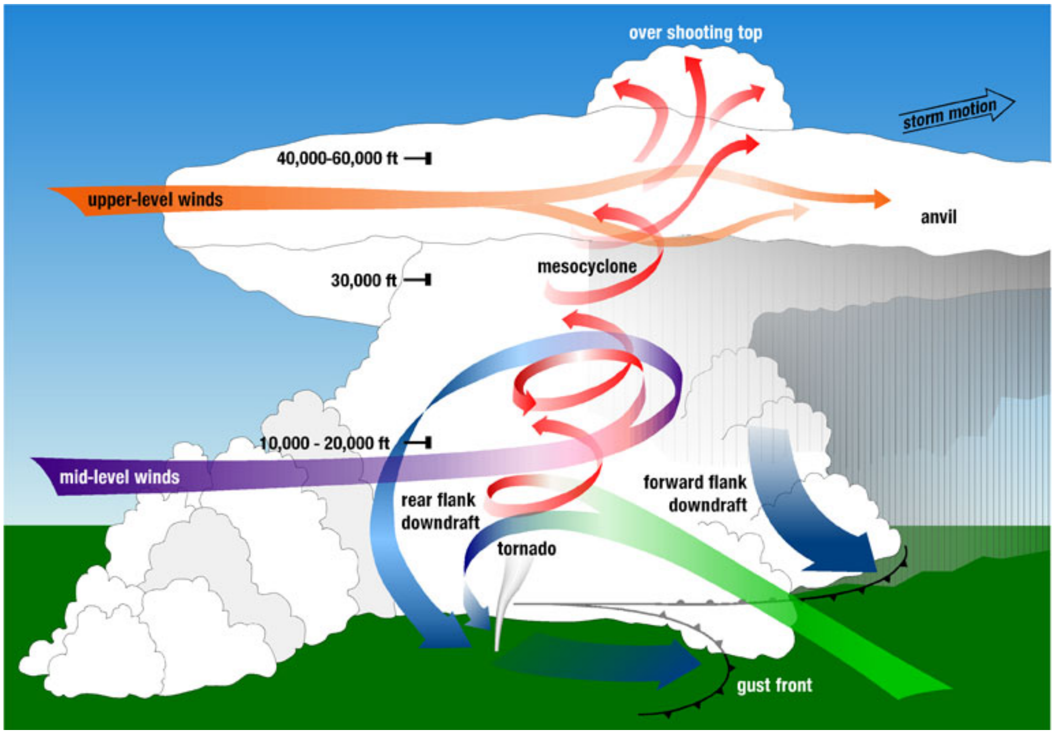


Figure 5-1: Anatomy of a Tornado. Image from NOAA National Severe Storms Laboratory.

Nonsupercell 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 nonsupercell tornadoes are gustnadoes and landspouts:

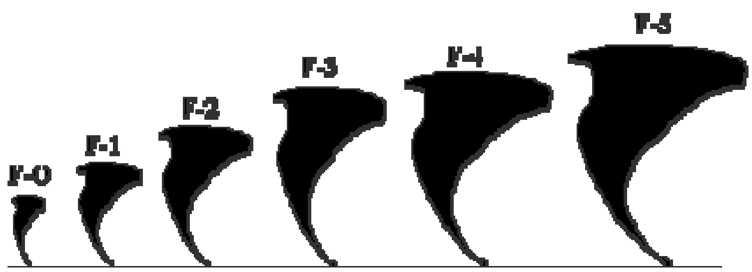
- A gustnado is a whirl of dust or debris at or near the ground with no condensation tunnel that forms along the gust front of a storm.
- A landspout is a narrow, ropelike condensation funnel that forms when the thunderstorm cloud is still growing and there is no rotating updraft. Thus, the spinning motion originates near the ground. Waterspouts are similar to landspouts but occur over water.

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 had 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.

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 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 debarked; 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.



Fujita Tornado Scale. Image courtesy of FEMA.

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. Unfortunately, violent and long-lasting tornadoes have caused severe destruction to the midwest and southern United States in spring 2011 and spring 2012.

The Enhanced Fujita Scale was released by NOAA for implementation on February 1, 2007. According to the NOAA website, the Enhanced Fujita Scale was developed in response to a number of weaknesses in 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 Fujita 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 Enhanced Fujita Scale**		**Operational Enhanced Fujita 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 the VCOG communities is discussed in Section 6.3. Due to historical weather conditions, tornadoes are most likely to occur in Connecticut in June, July, and August of each year.

<u>Lightning</u>

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.


Image courtesy of NOAA.

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 are an average of 100,000 thunderstorms per year in the United States. An average of 41 people per year died, and an average of 262 people were injured from lightning strikes in the United States from 2000 to 2009. Most lightning deaths and injuries occur outdoors, with 45% of lightning casualties occurring in open fields and ballparks, 23% under trees, and 14% involving water activities. The historic record of lightning strikes both in Connecticut and near VCOG municipalities is presented in Section 5.3.

<u>Downbursts</u>

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:

- *<u>Microbursts</u> affect an area less than 2.5 miles in diameter, last five to 15 minutes, and can cause damaging winds up to 168 mph.*
- *<u>Macroburst</u>s affect an area at least 2.5 miles in diameter, last five to 30 minutes, and can cause damaging winds up to 134 mph.*

It is difficult to find statistical data regarding frequency of downburst activity. NOAA reports that there are 10 downburst reports for every tornado report in the United States. This implies that there are approximately 10,000 downbursts reported in the United States each year and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This value suggests that downbursts are a relatively uncommon yet persistent hazard. A few downbursts have occurred in the VCOG municipalities as have been communicated by municipal officials.

<u>Hail</u>

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. Hailstorms have occurred in VCOG municipalities as reported in the historic record in Section 6.3.

5.3 Historic Record

Since 1960, Connecticut has had approximately 50 confirmed tornado events. The most vulnerable area of the state is Litchfield County based on historical accounts. Seven of the 50 confirmed tornadoes since 1960 were in Fairfield County. Of the eight counties in Connecticut, Fairfield has had the fourth highest number of tornadoes since 1960. Inland areas are generally more vulnerable to tornadoes than coastal areas since sea breezes can have the effect of defusing tornadoes.

An extensively researched list of tornado activity in Connecticut is available on Wikipedia. This list extends back to 1648 although it is noted that the historical data prior to 1950 is incomplete due to lack of official records and gaps in populated areas. Based on available information through July 2010, New Haven County has experienced a total of 21 tornado events with reported damages totaling tens of millions of dollars. Of the 21 total tornado events, the two that touched down within the VCOG region were tornadoes in Shelton in 1901 and 2009. Table 5-3 summarizes the tornado events near the VCOG municipalities from 1950 through March 2012 based on the Wikipedia list.

TABLE 5-3
Tornado Events Near the VCOG Municipalities

Date	Location	Scale	Property Damage	Injuries / Deaths
June 20, 1682	Northeastern Fairfield/Southwestern New Haven County	NR	Path cut a half-mile wide	NR
September 15, 1876	Northern Bridgeport, Connecticut	NR	Unroofed several homes	NR
September 15, 1901	Shelton and Monroe	NR	House torn from foundation, barns destroyed, hundreds of trees leveled	1 person killed
July 28, 1982	Central New Haven County	NR	NR	NR
July 10, 1989	New Haven County	F4	Destroyed approximately 400 structures	Injured 40
August 4, 1992	Long Hill section of Trumbull	F1	NR	NR
July 9, 1996	Monroe	F1	Downed trees	NR
July 31, 2009	Shelton	EF1	Tree and minor property damage	NR
June 24, 2010	Bridgeport and Stratford, Connecticut	EF1	Downed trees and damage to several buildings including nine roofs	NR

NR = None Reported
F = Fujita
EF = Enhanced Fujita

Thunderstorms occur on 18 to 35 days each year in Connecticut. Only 17 lightning-related fatalities occurred in Connecticut between 1959 and 2009. Most recently, on May 8, 2010, lightning struck a fishing jetty at Seaside Park in nearby Bridgeport, Connecticut, injuring three and killing one. Hail and high winds are often a part of these powerful thunderstorms as evident in the historic record for the VCOG municipalities (below). A limited selection of summer storm damage in the VCOG municipalities taken from the NCDC Storm Events database is listed below:

- July 7, 1997 – Scattered severe thunderstorms moved east across the area producing high winds that downed trees and power lines in Brookfield to the northwest, and lightning struck the Town Hall in the town of Monroe (adjacent to the VCOG region), which disabled the Police Department's Communications Center and damaged town offices.

- May 31, 1998 – Severe thunderstorms moved across the area producing large hail, frequent lightning, heavy rain, and gusty winds. Trees were downed over power lines and houses, and lightning injured the Communications Officer at the nearby Trumbull Police Department, who was hospitalized. The Trumbull Police Department's primary radio communications system was taken out of line.

- August 26, 1998 – Thunderstorms moved northeast across the region producing high winds, frequent lightning, and heavy rain. High winds downed trees and power lines while lightning struck a structure in a nearby municipality. In Seymour, a house under construction at 84 Great Hill Road was struck by lightning, caught fire, and was completely destroyed.

- September 7, 1998 – A line of severe thunderstorms moved across the area producing high winds and downed tree limbs in Ansonia.

- August 18, 1998 – Severe thunderstorms moved southeast producing high winds, heavy rain, and hail. High winds downed trees and power lines in Ansonia, Derby, and Seymour. Hail was also observed in Derby.

- June 2, 2000 – Severe thunderstorms moved through the region, producing high winds that downed many trees and power lines causing one death and one injury. Downbursts were observed in the adjacent town of Orange, causing damage in four areas of the town, while in Seymour high winds downed a tree, which fell on and crushed a pickup truck on Route 67, resulting in the death of a 35-year-old woman.

- June 30, 2001 – Scattered severe thunderstorms developed across the region moving east, producing high winds that downed numerous tree limbs and whole trees in Ansonia, Seymour, and Shelton. In Shelton, several houses were struck by lightning.

- May 31, 2002 – A funnel cloud was reported in Derby although no tornadoes were confirmed. Additionally, a severe thunderstorm produced high winds that downed three trees on Prospect Street in Derby.

- August 21, 2004 – Trees and power lines were downed when severe thunderstorms moved east across the area during the afternoon and evening hours. Lightning produced by severe thunderstorms struck several houses causing an unknown amount of damage.

- August 1, 2006 – A line of severe thunderstorms moved across the area resulting in high winds and downed trees and power lines. According to media reports, trees were downed on houses and cars in Derby and the adjacent town of Orange.

- July 8, 2011 – As explained in Section 3.3, three to five inches of rain fell within two hours in Seymour, flooding a mile of Route 8 up to several feet deep. Winds of 50 mph were recorded, and lightning knocked out power to residents of Seymour and neighboring Beacon Falls.

5.4 Existing Programs, Policies, Capabilities, and Mitigation

After a series of deadly tornadoes struck Litchfield and New Haven counties on July 10, 1989, killing two persons and causing millions of dollars in damage, Connecticut installed a new type of warning system. The NOAA Weather Radio Specific Area Message Encoder (WRSAME) system allows forecasters at three National Weather Service (NWS) offices to send watches and warnings to specific areas of Connecticut. Warnings can be sent within a few minutes of a Doppler radar indication that a tornado may be trying to form within a severe thunderstorm.

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

TABLE 5-4
NOAA Weather Watches

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

TABLE 5-5
NOAA Weather Warnings

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

Aside from warnings, several other methods of mitigation for wind damage are employed in the VCOG communities as explained in Section 5.4 within the context of hurricanes and tropical storms. In addition, the Connecticut State Building Code includes guidelines for the proper grounding of buildings and electrical boxes.

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

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

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

- Developing and disseminating emergency public information and instructions concerning tornado, thunderstorm wind, lightning, and hail safety, especially guidance regarding in-home protection and evacuation procedures and locations of public shelters.
- Designating appropriate shelter space in the community that could potentially withstand lightning and tornado impact.
- Periodically test and exercise tornado response plans.
- Putting emergency personnel on standby at tornado "watch" stage.
- Providing all summer storm and tornado mitigation procedures and plans to the public in appropriate municipal buildings, on municipal websites, and through municipal social media platforms.

The VCOG communities have Tree Wardens and as-needed programs for tree trimming as explained in Section 4.4. UI and CL&P have limited tree trimming maintenance programs in place. Utilities in new subdivisions must be located underground whenever possible in order to mitigate storm-related wind damage. The Public Works Departments have the necessary equipment to clean up downed tree limbs and brush following major wind events.

5.5 Vulnerabilities and Risk Assessment

According to the *2010 Natural Hazard Mitigation Plan Update*, Litchfield and Hartford Counties have the highest incidences of tornadoes and therefore may be considered to have a high risk for the occurrence of future tornadoes. The second area of moderate to high risk is in Fairfield and New Haven Counties. According to the 2010 Connecticut HMP and by virtue of their locations in Fairfield and New Haven Counties (moderate to high risk), the VCOG municipalities have moderate to high potential to experience tornado damage in the future.

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. This may be evident with northern Tolland and Windham Counties (Connecticut) and western Massachusetts subject to tornado activity in 2011.

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 or safe rooms. Instead, the state has provided NOAA weather radios to all public schools as well as to many local governments for use in public buildings. The general public continues to rely on mass media for knowledge of weather warnings. Warning time for tornadoes is very short due to the nature of these types of events, so pre-disaster response time can be limited. However, the NOAA weather radios provide immediate notification of all types of weather warnings in addition to tornadoes, making them very popular with communities.

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

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

Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Straight-line winds occur as the first gust of a thunderstorm or from a downburst from a thunderstorm and have no associated rotation. The risk of downbursts occurring during such storms and damaging the VCOG municipalities is believed to be moderate for any given year. All areas of the VCGO municipalities are susceptible to damage from high winds although more building damage is expected in the municipal centers and the densely populated neighborhoods surrounding them.

Secondary damage from falling branches and trees is more common than direct wind damage to structures. Heavy winds can take down trees near power lines, leading to the start and spread of fires. Most downed power lines in the VCOG municipalities are detected quickly, and any associated fires are quickly extinguished. Such fires can be extremely dangerous during the summer months during dry and drought conditions.

Derby's two shelters, the Middle School and Bradley School, which both lack generators, are the most vulnerable to summer storm wind damage because of this. However, some critical facilities are more likely to be vulnerable than others to flash flooding damage due to summer storms. Such facilities vulnerable to flooding damage were discussed in Section 3.5.

In summary, all areas of the VCOG municipalities are at relatively equal risk for experiencing damage from summer storms and tornadoes. Based on the historic record, only a few summer storms or tornadoes have resulted in costly damages to the VCOG municipalities. Most damages are relatively site specific and occur to private property (and therefore are paid for by private insurance). For municipal property, the VCOG municipalities' budgets for tree removal and minor repairs are generally limited to handling routine summer storm damage. However, the EF1 tornado that caused minor property damage along a 0.5-mile path through eastern Shelton in 2009 and the EF1 tornado that struck Bridgeport in 2010 have raised awareness regarding the potential catastrophic damage such storms can cause and the possibility of one taking place within the VCOG region.

5.6 Potential Mitigation Measures, Strategies, and Alternatives

Most of the mitigation activities for summer storm and tornado wind damage are similar to those discussed in Section 4.6 and are not reprinted here. Public education is the best way to mitigate damage from hail, lightning, and tornadoes. In addition to other educational documents, the municipalities' Building Official should make literature available regarding appropriate design standards for grounding of structures both in appropriate municipal buildings and on the municipalities' websites.

Both the FEMA and the NOAA websites contain valuable information regarding preparing for and protecting oneself during a tornado as well as information on a number of other natural hazards. Available information from FEMA includes:

- Design and construction guidance for creating and identifying community shelters
- Recommendations to better protect your business, community, and home from tornado damage, including construction and design guidelines for structures

- ❑ Ways to better protect property from wind damage
- ❑ Ways to protect property from flooding damage
- ❑ Construction of safe rooms within homes

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

As was explained earlier, Seymour utilizes CodeRed while all other VCOG municipalities utilize the Reverse 911 emergency notification system to send geographically specific telephone warnings into areas at risk for hazard damage. These programs are extremely useful for natural hazard mitigation compared to a community warning system, which relies on radios and television and is considerably less effective at warning residents during the night when the majority of the community is asleep. This fact was evidenced by a severe storm that struck Lake County, Florida on February 2, 2007 and the recent storms that struck Alabama in spring 2011. These powerful storms, which included several tornadoes, stuck at night. In the case of the Florida storm, local broadcast stations had difficultly warning residents due to the lack of listeners and viewers and encouraged those who were awake to telephone warnings into the affected area.

5.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives

Recommendations for mitigation of summer storms and associated winds include the following, repeated from Section 4.7:

- ❑ Expand the current programs of placing utilities underground and look for opportunities to relocate utilities underground.
- ❑ Continue, improve, and/or implement tree limb inspections, maintenance, and outreach to private property owners regarding branches above power lines.
- ❑ Increase funding for the Tree Wardens to address a wide range of tree limb hazards.
- ❑ Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards for wind and include such literature on the municipality websites and in posts on the municipalities' social media platforms.
- ❑ Encourage the use of wind-mitigation structural techniques in new structures, especially critical facilities, to protect new buildings to a greater level than the required standard.

In addition, many of the recommendations in Section 3.7 for mitigating inland flooding are suitable for mitigation of flash flooding caused by summer storms. Finally, important recommendations that apply to all hazards are listed in Section 11.1.

6.0 WINTER STORMS AND NOR'EASTERS

6.1 Setting

Similar to summer storms and tornadoes, winter storms have the potential to affect any part of the VCOG municipalities. However, unlike summer storms, winter events and the hazards that result (wind, snow, and ice) have more widespread geographic extent. In general, winter storms are considered highly likely to occur each year, and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect across all VCOG municipalities (refer to Tables 1-2 and 1-3). Although major storms are less frequent, the high frequency of winter storms during the 2010-2011 winter season plus Storm Alfred in October 2011 could be signs of things to come in Connecticut.

6.2 Hazard Assessment

According to the NWS, 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.

This section focuses on those effects commonly associated with winter storms, including those from blizzards, ice storms, heavy snow, freezing rain, and extreme cold. Most deaths from winter storms are indirectly related to the storm, such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects include loss of power and heat.

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

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets, flooding, heavy winds, and extreme cold. The NWS defines a blizzard as having winds over 35 mph with blowing snow that reduces visibility to less than one-quarter mile for at least three hours. Along the coast, wind-driven waves can batter the shore, causing flooding and severe beach erosion. Coupled with a high tide, the low pressure of a nor'easter can have an effect similar to a storm surge from a hurricane. This is something that even Shelton and Derby could be concerned with along the tidal portion of the Housatonic River.

Connecticut experiences at least one severe winter storm every five years although a variety of small and medium snow and ice storms occur every winter. The likelihood of a nor'easter occurring in any given winter is therefore considered high, and the likelihood of other winter storms occurring in any given winter is very high. The October 29-30, 2011 Winter Storm Alfred is a reminder that changes in weather patterns may bring changes in the frequency and impact levels of future storms in Connecticut.

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

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

TABLE 6-1
NESIS Categories

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

6.3 Historic Record

A total of 16 extreme, crippling, and major winter storms has 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. Winter Storm Ginger in 1996 caused up to 27 inches of snow in 24 hours and shut down the state of Connecticut for an entire day.

Winter Storm Alfred from October 29-30, 2011 dumped up to 20+ inches in parts of northern Connecticut. The entire state dealt with wet snow and ice and statewide power outages affecting Connecticut for a week or longer. The overall storm impacts and damages resulted in a Presidential Disaster Declaration for Connecticut.

Other storms have been powerful. A 1992 nor'easter, in particular, caused the third-highest tides ever recorded in Long Island Sound and damaged 6,000 coastal homes. Inland areas received up to four feet of snow.

According to the NCDC, there have been 134 snow and ice events in the state of Connecticut between 1993 and April 2010, causing over $18 million in damages. Notably, heavy snow in December 1996 caused $6 million in property damage. Snow removal and power restoration for a winter storm event spanning March 31 and April 1, 1997 cost $1 million. On March 5, 2001, heavy snow caused $5 million in damages, followed by another heavy snow event four days later that caused an additional $2 million in damages. The last documented winter storm event that qualified as a blizzard was Winter Storm Ginger in January 1996. These events were recorded for various counties throughout the state.

Catastrophic ice storms are less frequent in Connecticut than the rest of New England due to the close proximity of the warmer waters of the Atlantic Ocean and Long Island Sound. 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 southwest New Haven County and northeast Fairfield County selected from the NCDC database include:

- East Coast Winter Storm, March 13-14, 1993 – A powerful storm carrying with it record low barometric pressure readings hit the state with blizzard conditions. Gale-force winds accompanied by snowdrifts several feet deep closed businesses, hindered travel, and forced residents to lose power. Federal aid was given to the state for snow removal.

- Heavy Snow, January 21, 2001 – Heavy snow and a period of sleet and freezing rain changing to snow impacted the region. In Seymour, a total of eight inches was reported while nearby Bridgeport received a total of approximately six inches.

- Heavy Snowstorm, March 12, 2005 – Snowfall rates reached in excess of two inches per hour at several locations in the region. Storm snowfall amounts ranged from approximately five to nine inches. In Ansonia, a reported snowfall total of 8.1 inches fell while nearby Derby reported 6.3 inches, and Seymour reported 7.8 inches.

- Blizzard, December 26-27, 2010 – An intense low-pressure system moved across the region with bands of heavy snow with embedded thunderstorms and significant winds. The powerful blizzard brought the area 10 to 18 inches of snow with sustained winds of 25 to 40 mph with gusts in excess of 60 mph. The storm made all forms of travel extremely difficult to nearly impossible, and service on Metro North and Amtrak lines was suspended due to high snowdrift.

- Heavy Snow, January 11-12, 2011 – Very heavy snow developed across the region, producing snowfall rates of three to four inches per hour and snow totals ranging from 15 to 30 inches in southern Connecticut. The highest snowfall totals were seen across northern portions of Fairfield and New Haven counties.

- Heavy Snowstorm, January 26-27, 2011 – A period of moderate to heavy snow moved through the region, producing two to five inches before a second round of precipitation, consisting of very heavy snow, moved across the area. This system boasted snowfall rates of three to four inches per hour over a four- to six-hour period, which raised snow totals to 12 to 20 inches of snow throughout much of the region.

- Heavy Snowstorm (Storm Alfred), October 29-30, 2011 – A powerful east coast early fall/winter storm wreaked havoc on the region dumping up to 32 inches of snow and causing over 600,000 electrical customers in Connecticut to lose power for a significant amount of time. 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 statewide.

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 fell on Connecticut during the 2010-2011 winter season proved to be catastrophic for a number of buildings. Severely low temperatures coupled with the absence of the removal of snow and ice buildup from roofs of buildings in Connecticut caused numerous roofs to collapse 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. Properties in Ansonia and Shelton are included.

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)

TABLE 6-2 (continued)
Reported Roof Collapse Damage, 2011

Address	Municipality	Date	Description
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
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 (three-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
364 High Street	Tolland	2/9/2011	Horse barn
61 Monroe Turnpike	Trumbull	2/1/2011	Trumbull Tennis Center

TABLE 6-2 (continued)
Reported Roof Collapse Damage, 2011

Address	Municipality	Date	Description
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

As a result of the roof and building collapses, injury occurred to humans and animals, and significant and widespread damage to property took place. Just like Winter Storm Alfred, the overall storm impacts and damages of the winter 2010-2011 storms resulted in a Presidential Disaster Declaration for Connecticut.

6.4 Existing Programs, Policies, Capabilities, and Mitigation

Existing programs applicable to winter storm winds are the same as those discussed in Sections 4.0 and 5.0. Programs that are specific to winter storms are generally those related to preparing plows and sand and salt trucks; tree trimming and maintenance to protect utilities, roads, and structures; and other associated snow removal and response preparations.

The Connecticut Building Code specifies that a weight of 30 pounds per square foot be used as the base "ground snow load" for computing snow loading for different types of roofs. As a result of the winter of 2010-2011, it is anticipated that many communities will develop and utilize programs for roof snow removal. The state's request for HMGP applications in spring 2011 included specific line items for snow removal planning and programs.

Likewise, as a result of Winter Storm Alfred in October 2011, it is likely that communities will place a higher priority level on tree trimming and maintenance to protect utilities, roads, persons in transit, and structures. Planning is already underway, from the publication of James Lee Witt's report *Connecticut October 2011 Snowstorm Power Restoration* (December 2011) to meetings that have been ongoing in late 2011 and early 2012 between utility companies and Connecticut municipalities.

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

Collectively, the Connecticut DOT works with Ansonia, Derby, and Seymour's Public Works Departments and Shelton's Highways and Bridges Department (a branch of the Public Works Department) to conduct the majority of plowing within the municipalities. Within the VCOG municipalities, the Connecticut DOT plows Routes 8, 34, 67, 110, 115, 188, 243, 313, and 334. Private developments are responsible for their own plowing while municipal roadways are plowed in the order of primary routes and bus routes to secondary routes as conditions permit.

6.5 Vulnerabilities and Risk Assessment

Many tree limbs on VCOG municipal roadways are not suited to withstand high wind and snow or ice loads. If trees or tree limbs fall on the roadways, the proximity of structures puts them at risk for damage. The VCOG municipalities' Tree Wardens communicate to property owners the need for tree maintenance as necessary. Additionally, UI and CL&P perform tree maintenance on those trees that threaten their power supply infrastructure. In either situation, performing maintenance is the ultimate decision of the property owner or UI/CL&P.

Connecticut's vulnerability is noted by Witt in the report *Connecticut October 2011 Snowstorm Power Restoration* as follows:

> *Connecticut's ample tree canopy, while beautiful, tends to increase the likelihood of power outages, given that electricity transmission and distribution infrastructure is primarily above-ground and frequently close to trees in the right-of-way. Utility companies have responsibility for vegetation management in their utility rights-of-way. However, utility companies must seek permission for tree-trimming on trees that are outside their rights-of-way yet may potentially have impacts on infrastructure. Proximity of heavy vegetation to power transmission and distribution lines can contribute to the likelihood of damage to power lines and resulting power outages in high wind, early snowfall, and ice events. While appropriate vegetation management can reduce outages and increase reliability, it can meet public resistance because of aesthetic, environmental, economic (tourism) and other issues.*

Winter storms present some unique transportation vulnerabilities. There is a high propensity for traffic accidents during heavy snow and even light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots as well as the accessibility to medical and shelter facilities. Stranded motorists, especially senior and/or handicapped citizens, are at a particularly high risk during a blizzard.

6.6 Potential Mitigation Measures, Strategies, and Alternatives

Potential mitigation measures for storm surges and flooding along the tidal portion of the Housatonic River caused by nor'easters include those appropriate for flooding. These were presented in Section 3.6 and are not repeated here. Likewise, wind-related mitigation was covered in Sections 4.6 and 5.6. However, winter storm mitigation measures must also address blizzards, snow, and ice hazards. These are emphasized in the following subsections. Note that natural resource protection and structural projects are generally not applicable categories of mitigation when addressing snow and ice.

6.6.1 Prevention

Cold air, snow, and ice cannot be prevented from impacting any particular area. Thus, mitigation should be focused on property protection, infrastructure protection, emergency services (discussed below), and prevention of damage to structures and utilities as caused by breakage of tree limbs. Previous recommendations for tree limb inspections and maintenance in Section 4.6 are thus applicable to winter storm hazards as well. If tree limbs are cut back or utilities are underground, then heavy snow, ice, and winter winds cannot damage or destroy them.

6.6.2 Property Protection

Property can be protected during winter storms through the use of shutters, storm doors, storm windows, weather stripping, and other means of keeping cold air outdoors and heat indoors.

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. During the winter of 2010-2011, even sloping roofs had trouble with snow loads. Heating coils may be used to melt snow from flat roofs, and rakes can be used to physically remove snow. Pipes should be adequately insulated to protect against freezing and bursting. All of these recommendations apply to new construction although they may also be applied to existing buildings during renovations.

6.6.3 Public Education and Awareness

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

6.6.4 Emergency Services

Plowing the access to and from critical facilities, such as health and medical facilities and the shelters that were listed in Table 2-6, should be prioritized. It is recognized that this may not be a priority to all residents as people typically expect their own roads to be cleared as soon as possible.

6.7 Recommended Actions

The following recommendations are applicable to aspects of winter storms such as winds, snow, and ice; recommendations regarding tree trimming and burying utilities have been listed previously in this HMP:

- Conduct a study to identify municipal buildings, critical facilities, and commercial/industrial buildings that are vulnerable to roof damage or collapse due to heavy snow loads.
- Develop a plan to prioritize snow removal from the roofs of municipal buildings (especially critical facilities) and make funding available for clearing.
- Retrofit or modify critical facilities as needed to strengthen roofs and structures and make them more resilient to snow loading.
- Consider posting the snow plowing routes in municipal buildings, on the municipal websites, and on social media platforms.
- Identify areas that are difficult to access during winter storm events and develop contingency plans.
- Provide information for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings.

In addition, important recommendations that apply to all hazards are listed in Section 11.1.

7.0 EARTHQUAKES

7.1 Setting

All VCOG municipalities are susceptible to earthquake damage. However, even though earthquake damage has the potential to occur anywhere both in the VCOG municipalities and in the northeastern United States, the effects may be felt differently in some areas based on the type of geology. In general, earthquakes are considered a hazard that may occur and would likely cause effects to a large area of the VCOG member towns (refer to Tables 1-2 and 1-3) 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 are determined by the use of the Richter scale and the Mercalli scale, respectively.

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

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

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects. A comparison of Richter magnitude to typical Modified Mercalli intensity is presented in Table 7-1.

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

Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known active faults. Instead, earthquakes with epicenters in Connecticut are referred to as intraplate 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 as a whole, potentially putting a greater number of people at risk.

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. Objects thrown in the air.

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

7.3 Historic Record

According to the 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 are provided below based on information provided in USGS documents, the Weston Observatory, the 2010 *Connecticut Natural Hazard Mitigation Plan Update*, other municipal hazard mitigation plans, and newspaper articles.

- A devastating earthquake near Three Rivers, Quebec on February 5, 1663 caused moderate damage in parts of Connecticut.
- Strong earthquakes in Massachusetts in November 1727 and November 1755 were felt strongly in Connecticut.
- In April 1837, a moderate tremor occurred at Hartford, causing alarm but little damage.
- In August 1840, another moderate tremor with its epicenter 10 to 20 miles north of New Haven shook Hartford buildings but caused little damage.
- In October 1845, an Intensity V earthquake occurred in Bridgeport. An Intensity V earthquake would be approximately 4.3 on the Richter scale.
- On June 30, 1858, New Haven and Derby were shaken by a moderate tremor.
- On July 28, 1875, an early morning tremor caused Intensity V damage throughout Connecticut and Massachusetts.
- The second strongest earthquake to impact Connecticut occurred near Hebron on November 14, 1925. No significant damage was reported.
- The Timiskarning, Ontario earthquake of November 1935 caused minor damage as far south as Cornwall, Connecticut. This earthquake affected one million square miles of Canada and the United States.
- An earthquake near Massena, New York in September 1944 produced mild effects in Hartford, Marion, New Haven, and Meriden, Connecticut.
- An Intensity V earthquake was reported in Stamford in March 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.

Most recently, a magnitude 5.8 earthquake occurred 38 miles from Richmond, Virginia on August 23, 2011. The quake was felt from Georgia to Maine and reportedly as far west as Chicago. Many residents of Connecticut experienced the swaying and shaking of buildings and furniture during the earthquake although widespread damage was constrained to an area from central Virginia to southern Maryland. According to Cornell University, the August 23 quake was the largest event to occur in the east central United States since instrumental recordings have been available to seismologists.

7.4 Existing Programs, Policies, Capabilities, and Mitigation

The Connecticut Building Codes include design criteria for buildings specific to each municipality as adopted by the Building Officials and Code Administrators (BOCA). These include the seismic coefficients for building design in the VCOG community. The VCOG municipalities have adopted these codes for new construction, and they are enforced by the Building Officials.

Due to the infrequent nature of damaging earthquakes, land use policies in the VCOG towns do not directly address earthquake hazards. However, various regulations indirectly address areas susceptible to earthquake damage and regulations that help to minimize potential earthquake damage.

Consider Section 4-19-5 of the Subdivision Regulations of the Town of Shelton. The section discusses steep slopes in the context of open space stating that "not more than 25% of the of the minimum required Open Space area shall consist of designated inland wetlands and/or steep slopes in excess of 30%..." This is an attempt to reduce the tendency for developers to reserve steep slopes for open space, instead requiring that some of the adjacent developable land is set aside for open space as well.

The POCDs for Ansonia, Derby, and Seymour all make reference to steep slopes in their "strategies" lists within the natural resources discussions, indicating that these three communities desire avoiding development on steep slopes. However, much of the available land in the Valley region consists of steep slopes, and the VCOG municipalities will need to be careful in their review of development proposals.

7.5 Vulnerabilities and Risk Assessment

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

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.

Approximately 4,964 of 37,445 acres (approximately 13%) of the VCOG municipalities are underlain by alluvium or sand and gravel. This generally includes centers of Derby, Ansonia, and Seymour as the centers of these municipalities are generally adjacent to the Naugatuck River. Figure 2-4 depicts surficial materials in the VCOG communities. 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 is the application of the most stringent building codes such as those in the Connecticut Building Codes or, wherever each municipality deems necessary, the possible prohibition of new construction. Because many of these areas occur in floodplains associated with the Naugatuck River, Housatonic River, and other smaller water bodies in the four municipalities, most are already regulated. The areas that are not at increased risk during an earthquake due to unstable soils are the areas in Figure 2-4 underlain by glacial till.

Areas of steep slopes can collapse during an earthquake, creating landslides. Seismic activity can also break utility lines, such as water mains and 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 8.0, and landslides have been addressed in Section 10.0.

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

According to the FEMA *HAZUS-HM* Estimated Annualized Earthquake Losses for the United States (2008) document, FEMA used probabilistic curves developed by the USGS for the National Earthquakes Hazards Reduction Program to calculate Annualized Earthquake Losses (AEL) for the United States. Based on the results of this study, FEMA calculated the AEL for Connecticut to be $11,622,000. This value placed Connecticut 30th out of the 50 states in terms of AEL. The magnitude of this value stems from the fact that Connecticut has a large building inventory that would be damaged in a severe earthquake and takes into account the lack of damaging earthquakes in the historical record.

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

A series of earthquake probability maps was generated using the 2009 interactive web-based mapping tools hosted by the USGS. These maps were used to determine the probability of an earthquake of greater than magnitude 5.0 or 6.0 damaging the VCOG municipalities. Results are presented in Table 7-2 below.

TABLE 7-2
Probability of a Damaging Earthquake in VCOG Municipalities

Time Frame (Years)	Probability of the Occurrence of an Earthquake Event > Magnitude 5.0	Probability of the Occurrence of an Earthquake Event > Magnitude 6.0
50	1% to 2%	<1%
100	4% to 6%	<1%
250	8% to 10%	2% to 3%
350	12% to 15%	2% to 3%

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

The 2010 *Connecticut Natural Hazard Mitigation Plan Update* created four "maximum plausible" earthquake scenarios (three historical, one potential) within *HAZUS-MH* to generate potential earthquake risk to the state of Connecticut. The same four scenarios were simulated within *HAZUS-MH* to generate potential damages in each VCOG member municipality 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, Connecticut, based on historic event
- Magnitude 5.7, epicenter in Haddam, Connecticut, based on historic event
- Magnitude 6.4, epicenter in East Haddam, Connecticut, based on historic event
- Magnitude 5.7, epicenter in Stamford, Connecticut, magnitude based on USGS probability mapping

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

Table 7-3 presents the number of residential buildings (homes) damaged by the various earthquake scenarios while Table 7-4 presents the total number of buildings within all municipalities damaged by each earthquake scenario. A significant percentage of building damage is to single-family residential buildings while other building types include agriculture, commercial, education, government, industrial, other residential, and religious buildings. The exact definition of each damage state varies based on building construction. See Chapter 5 of the HAZUS-MH *Earthquake Model Technical Manual*, available on the FEMA website, for the definitions of each building damage state based on building construction.

TABLE 7-3
***HAZUS-MH* Earthquake Scenarios**
Number of Residential Buildings Damaged in VCOG Municipalities

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	1,329	296	38	3	1,666
Portland – 5.7	1,175	257	33	3	1,468
Stamford – 5.7	2,078	508	65	7	2,658
East Haddam – 6.4	2,850	766	107	11	3,734

TABLE 7-4
***HAZUS-MH* Earthquake Scenarios**
Total Number of Buildings Damaged in VCOG Municipalities

Epicenter Location and Magnitude	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage	Total
Haddam – 5.7	1,520	375	50	4	1,949
Portland – 5.7	1,348	326	43	4	1,721
Stamford – 5.7	2,393	676	93	9	3,171
East Haddam – 6.4	3,240	993	152	16	4,401

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

TABLE 7-5
***HAZUS-MH* Earthquake Scenarios**
Essential Facility Damage in VCOG Municipalities

Epicenter Location and Magnitude	Hospitals (1)	Fire Stations (11)	Police Stations (6)	Schools (26)	Emergency Operations Centers (2)
Haddam – 5.7	0	0	0	0	0
Portland – 5.7	0	0	0	0	0
Stamford – 5.7	0	0	0	0	0
East Haddam – 6.4	0	0	0	0	0

Table 7-6 presents potential damage to utilities and infrastructure based on the various earthquake scenarios. The municipal transportation network and utility network were assumed by *HAZUS-MH* to include the following items:

- ❑ Highway: 65 major roadway bridges and 27 important highway segments
- ❑ Railway: 19 important railway segments and two important railway bridges
- ❑ Bus: Two important bus facilities
- ❑ A potable water system consisting of 788 total kilometers of pipelines
- ❑ A sanitary sewer system consisting of 473 total kilometers of pipelines and four treatment facilities
- ❑ A total of 315 kilometers of natural gas lines

TABLE 7-6
***HAZUS-MH* Earthquake Scenarios – Utility, Infrastructure,**
and Fire Damage in VCOG Municipalities

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
Haddam – 5.7	Light highway, railway, and bus damage Total damage: $500,000	Moderate damage consisting of: • Two leaks in the potable water system (no loss of service) causing $10,000 in total damages • One leak in the wastewater system (no loss of service) and moderate damage to wastewater facilities totaling $7.41 million in damages • No leaks in the natural gas system • No homes with a loss of electricity • Light damage to communications facilities totaling $10,000 in damages • Total damage: $7.93 million	No ignitions or fire damage
Portland – 5.7	Light highway, railway, and bus damage Total damage:	Moderate damage consisting of: • Two leaks in the potable water system (no loss of service) resulting in $10,000 in damages	No ignitions or fire damage

Epicenter Location and Magnitude	Transportation Network	Utilities	Fire Damage
	$400,000	• One leak in the wastewater system (no loss of service) and moderate damage to wastewater facilities leading to $6.00 million in damages • No leaks in the natural gas system • No homes with a loss of electricity • Light damage to communications facilities totaling $10,000 in damages Total damage: $6.02 million	
East Haddam – 6.4	Moderate highway damage and light railway and bus damage Total damage: $4.7 million	Moderate damage consisting of: • Nine leaks in the potable water system (no loss of service) resulting in $40,000 in damages • Four leaks in the wastewater system (no loss of service) and significant damage to wastewater facilities leading to $12.47 million in damages • Two leaks in the natural gas system costing $10,000 • No homes with a loss of electricity • Light damage to communications facilities totaling $10,000 in damages Total damage: $12.53 million	No ignitions or fire damage
Stamford – 5.7	Significant highway damage, light railway damage, and moderate bus damage Total damage: $6.90 million	Moderate damage consisting of: • 16 leaks in the potable water system (no loss of service) resulting in $70,000 in damages • Eight leaks in the wastewater system (no loss of service) and moderate damage to wastewater facilities leading to $4.23 million in damages • Three leaks in the natural gas system costing $10,000 • No homes with a loss of electricity • Light damage to communications facilities totaling $10,000 in damages Total damage: $4.32 million	No ignitions or fire damage

As shown in Table 7-6, highways and the rail facilities are predicted to have light damage under the Haddam and Portland 5.7 scenarios, moderate damage under the East Haddam 6.4 scenario, and significant damage under the Stamford 5.7 scenario. In terms of utilities, the East Haddam earthquake scenario will cause the most significant damage. The potable water system, wastewater system, and natural gas network will experience minor damage and leaks that will be able to be isolated with minimal service loss; however, damage to wastewater infrastructure can prove costly. No fires or fire damage are expected under any of the simulations although earthquake-related fires could realistically occur.

Table 7-7 presents the estimated tonnage of debris that would be generated by earthquake damage during each *HAZUS-MH* scenario. Significant debris is expected for the

Stamford and East Haddam earthquake scenarios, with the East Haddam scenario generating the most debris in the VCOG municipalities.

TABLE 7-7
***HAZUS-MH* Earthquake Scenarios**
Debris Generation (Tons) in VCOG Municipalities

Epicenter Location and Magnitude	Brick / Wood	Reinforced Concrete / Steel	Total	Estimated Cleanup Truckloads (25 Tons / Truck)
Haddam – 5.7	13,600	6,400	20,000	600
Portland – 5.7	6,900	3,100	10,000	520
Stamford – 5.7	18,000	12,000	30,000	1,000
East Haddam – 6.4	22,800	17,200	40,000	1,520

Table 7-8 presents the potential sheltering requirements based on the various earthquake events simulated by *HAZUS-MH*.

TABLE 7-8
***HAZUS-MH* Earthquake Scenarios**
Shelter Requirements in VCOG Municipalities

Epicenter Location and Magnitude	Number of Displaced Households	Short-Term Sheltering Need (Number of People)
Haddam – 5.7	43	25
Portland – 5.7	37	22
Stamford – 5.7	65	38
East Haddam – 6.4	120	70

The predicted sheltering requirements for earthquake damage are relatively minimal for the Haddam and Portland scenarios but more significant for the Stamford scenario and most significant for the East Haddam scenario. However, it is possible that an earthquake could also produce dam failure(s), thereby further exacerbating flooding, which could increase the overall sheltering need in the VCOG municipalities. Thus, on the whole, the VCOG shelters may be insufficient during an event such as the East Haddam scenario when one considers damage from the earthquake, fires, and potential dam failures.

Table 7-9 presents the casualty estimates generated by *HAZUS-MH* for the various earthquake scenarios. Casualties are broken down into four severity levels that describe the extent of injuries. The levels are as follows:

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

TABLE 7-9
***HAZUS-MH* Earthquake Scenarios**
Casualty Estimates

Epicenter Location - Magnitude	2 AM Earthquake	2 PM Earthquake	5 PM Earthquake
Haddam – 5.7	9 (Level 1) 1 (Level 2)	10 (Level 1) 1 (Level 2)	9 (Level 1) 1 (Level 2)
Portland – 5.7	8 (Level 1) 1 (Level 2)	8 (Level 1) 1 (Level 2)	8 (Level 1) 1 (Level 2)
Stamford – 5.7	15 (Level 1) 2 (Level 2)	22 (Level 1) 3 (Level 2) 1 (Level 4)	18 (Level 1) 3 (Level 2) 1 (Level 4)
East Haddam – 6.4	23 (Level 1) 3 (Level 2) 1 (Level 4)	28 (Level 1) 4 (Level 2) 1 (Level 4)	25 (Level 1) 4 (Level 2) 1 (Level 4)

Some casualties would be expected from earthquake damage in the VCOG municipalities for the four earthquake scenarios, with the East Haddam scenario producing the highest level of casualties including deaths. The casualty categories include commuters, educational, hotels, industrial, other-residential, and single-family residential and are accounted for during the night, in the early afternoon, and during afternoon rush hour.

Table 7-10 presents the total estimated losses and direct economic impact that may result from the four earthquake scenarios created for the VCOG municipalities 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 homes because of the storm. Note that these damages do not include transportation, utility, or fire damage in Table 7-6.

TABLE 7-10
***HAZUS-MH* Estimated Losses From Earthquake Scenarios (Millions of dollars)**

Epicenter Location and Magnitude	Estimated Capital Damage Losses	Estimated Business Interruption Losses	Estimated Total Losses
Haddam – 5.7	43.85	8.93	52.78
Portland – 5.7	36.85	7.78	44.62
Stamford – 5.7	63.75	18.12	81.87
East Haddam – 6.4	108.20	26.11	134.31

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

Despite the low probability of occurrence, earthquake damage presents a potentially significant hazard to the VCOG municipalities. However, it is very unlikely that the VCOG municipalities would be at the epicenter of a significantly damaging earthquake.

7.6 Potential Mitigation Measures, Strategies, and Alternatives

As earthquakes are relatively infrequent, difficult to predict, and can affect all of the VCOG municipalities, potential mitigation can only include adherence to building codes, education of residents, and adequate planning. The following potential mitigation measures have been identified for all VCOG municipalities:

- ❑ Consider preventing residential development in areas prone to collapse such as below steep slopes or in areas prone to liquefaction.
- ❑ Continue to require adherence to the state building codes.
- ❑ Ensure that municipal departments and critical facilities have adequate backup facilities in case damage occurs to critical facilities.

The following potential mitigation measures have been identified as being municipality-specific within the VCOG member municipalities:

Ansonia

- ❑ Work with the owner of the property with the granite block wall along South Main Street just to the north of Columbia Street to remove the large trees that have grown at the top of the wall and have rooted into the wall.
- ❑ Work with property owners of the Platt Street landslide site from 2011 and conduct maintenance as necessary to limit future landslides.
- ❑ As noted in the POCD, discourage building and road development on steep slopes (15% or greater).

Derby

- Work with the condominium owners at 233 Derby Avenue and the adjacent complex to perform maintenance as necessary to counter future landslides at the rear of the complexes.
- Provide support as necessary to the owners of Commodore Commons, which is reportedly moving downhill toward the Housatonic River.
- Conduct maintenance as necessary to the steep slopes near the base of Gilbert Street.
- As noted in the POCD, consider regulations to protect slopes in excess of 25%.

Seymour

- Conduct maintenance as necessary at the historical site of a landslide event at Cedar and Rose Streets.
- As noted in the POCD, consider regulations to protect slopes in excess of 25%.

Shelton

- Conduct maintenance, where necessary, at the Riverdale Apartments on Shelton Avenue where substantial landslide activity occurred during a heavy rainfall event in 2010 and resulted in the removal of a residence.

In addition, important recommendations that apply to all hazards are listed in Section 11.1.

8.0 DAM FAILURE

8.1 Setting

Dam failures can be triggered suddenly with little or no warning and often in connection with 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 a total of 60 registered dams and potentially several other minor dams scattered throughout the VCOG municipalities, dam failure has the potential to occur throughout all member towns. Shelton, the largest community in land area, has the most registered dams with 33 while Seymour follows with 16, then Ansonia with seven, and Derby with four registered dams.

While flooding from a dam failure generally has a limited geographic extent, the effects are potentially catastrophic depending on the downstream population such as the case of the Stevenson Dam, which is located on the Housatonic River just upstream of the northern boundary of Shelton and Seymour in Monroe. Fortunately, a major dam failure is not considered a likely hazard event in any given year (Table 1-2).

8.2 Hazard Assessment

The Connecticut DEEP administers the Dam Safety Section 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 any of the following: possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, and schools; damage or interruption of the use of service of utilities; damage to primary roadways and railroads; and a 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.

According to the "Connecticut Dams" data file that was published in 1996, there were 60 DEEP-registered dams within VCOG municipalities: 33 in Shelton, 16 in Seymour, seven in Ansonia, and four in Derby. Of the 60 total DEEP-registered dams within VCOG municipalities, 22 were Class A, 13 were Class B, seven were Class BB, 10 were Class C, and eight were unranked. Dams in the VCOG municipalities are listed in Table 8-1, and dam locations are illustrated in Figure 8-1.

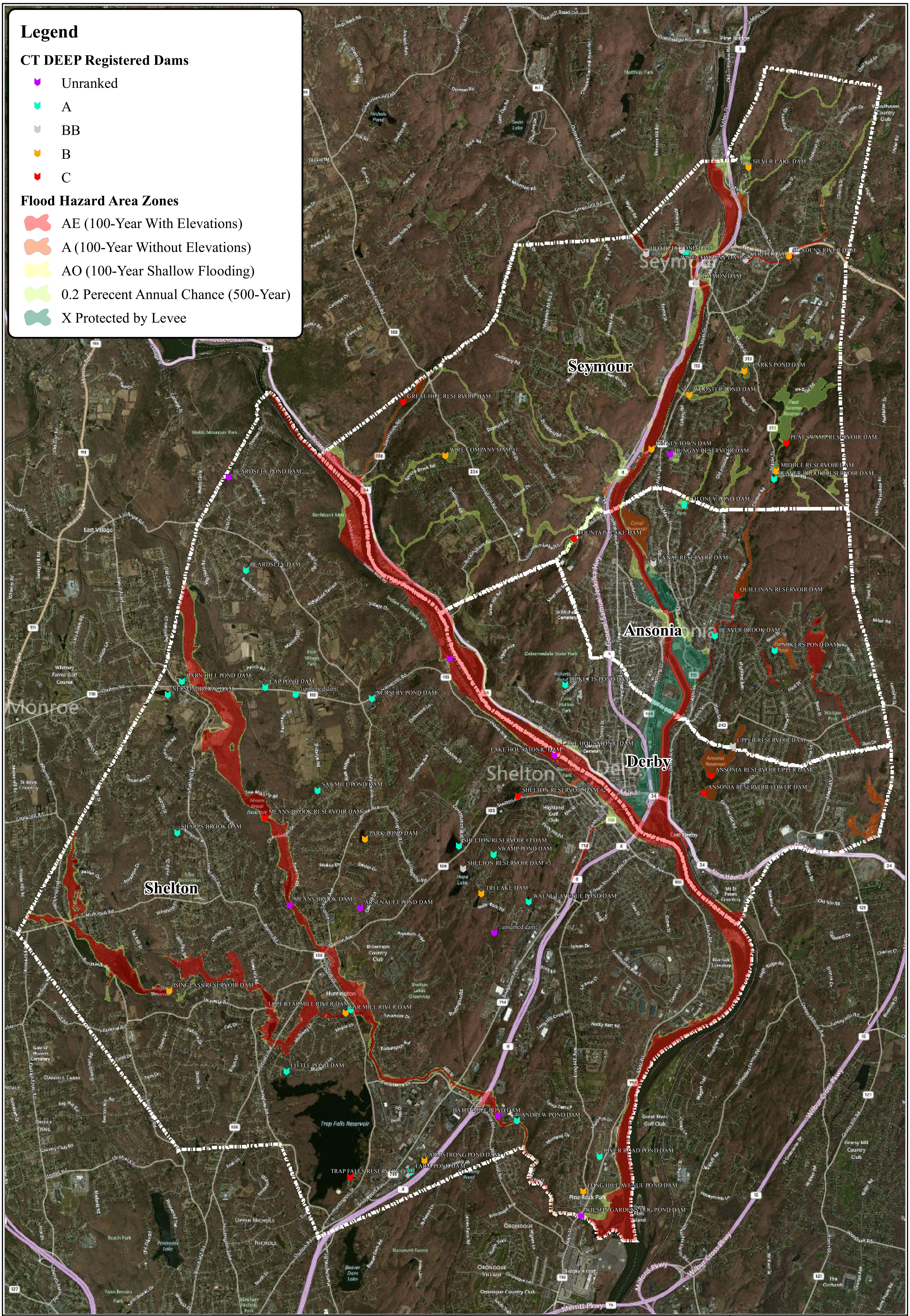
TABLE 8-1
Dams Registered With the DEEP in the VCOG Municipalities

Number	Name	Class
Ansonia		
201	Quillinan Reservoir Dam	C
202	Fountain Lake Dam	C
203	Canal Reservoir Dam	BB
204	Beaver Brook Dam	A
205	Parkers Pond Dam	A
206	Coloney Pond Dam	A
207	Upper Reservoir Dam	BB
Derby		
3701	Lake Housatonic Dam ("Derby Dam")	C
3702	Ansonia Reservoir Lower Dam	C
3703	Picketts Pond Dam	A
3704	Ansonia Reservoir Upper Dam	C
Seymour		
12401	Great Hill Reservoir Dam	C
12402	Peat Swamp Reservoir Dam	C
12403	Middle Reservoir Dam[1]	B
12404	Bladens River Dam	B
12405	Kinneytown Dam	B
12406	Wire Company Dam #2	BB
12407	Kerite Dam	BB
12408	Hoadley Pond Dam	BB
12409	Wooster (Sochrin) Pond Dam	B
12410	Silver Lake Dam	B
12411	Clarks Pond Dam	B
12412	Beaver Brook Reservoir Dam	A
12413	Rimmon Dam	BB
12414	Wire Company Dam #3	A
12415	Wire Company Dam #1[1]	B
12416	Bungay Reservoir Dam	Not Rated
Shelton		
12601	Trap Falls Reservoir Dam	C
12602	Means Brook Reservoir Dam	C

Number	Name	Class
12603	Lake Housatonic Dam	Not Rated
12604	Isinglass Reservoir Dam	B
12605	Shelton Reservoir Dam #2	C
12606	Armstrong Pond Dam[1]	B
12607	Far Mill River Dam	B
12608	Shelton Reservoir Dam #3	BB
12609	Baird Mill Pond Dam	Not Rated
12610	Unnamed Dam	Not Rated
12611	Tri Lake Dam[1]	B
12612	Park Pond Dam[1]	B
12613	Nelson Brook Dam	A
12614	Long Hill Avenue Pond Dam[1]	B
12615	Wilson Gardens Dog Pond Dam	Not Rated
12616	River Road Pond Dam	A
12617	Walnut Avenue Pond Dam	A
12618	Farm Pond Dam	A
12619	Shelton Reservoir #1 Dam	A
12620	Swamp Pond Dam	A
12621	Nursery Pond Dam	A
12622	Unnamed Dam	A
12623	Cap Pond Dam	A
12624	Barn Hill Pond Dam	A
12625	Beardsley Dam	A
12626	Sawmill Pond Dam	A
12627	Sharps Brook Dam	A
12628	Upper Farmill River Dam	A
12629	Little Pond Dam	A
12630	Andrew Pond Dam	A
12631	Means Brook Dam	Not Rated
12632	Beardsley Pond Dam	Not Rated
12633	Arsenault Pond Dam	Not Rated

[1]Listed as Class B dams in 1996 but were not included in the 2007 DEEP list of Class B and C dams

This HMP section primarily discusses the possible effects of failure of both high potential hazard (Class C) dams and significant hazard (Class B) dams. Note that in Seymour the Middle Reservoir Dam (No. 12403) and the Wire Company Dam #1 (No. 12415) were both registered as Class B dams in 1996 but were not included in the 2007 DEEP list of Class B and C dams. Likewise, four dams in Shelton, the Long Hill Avenue Pond Dam (No. 12614), the Armstrong Pond Dam (No. 12606), the Tri Lake Dam (No. 12611), and Park Pond Dam (No. 12612) were also not included in the 2007 list of Class B and C dams but were previously registered as Class B dams in 1996.



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
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and its data suppliers

"FEMA Flood Hazard Area Zones"
Datalayer June, 2010 FEMA

"CT DEEP Registered Dams"
Datalayer 1996, CT DEEP

Figure 8-1: Dams Registered with the CT DEEP

Location: **Ansonia, Derby, Seymour & Shelton, CT**

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig8-1_Dams.mxd
1st Version: 3/1/2012
Revision: 6/27/2012
Scale: 1 in = 4,500 ft

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Four dams that are currently listed as Class B or C dams have dam failure analysis (DFA) mapping on file at CT DEEP. The Isinglass Reservoir Dam, the Trap Falls Reservoir Dam, and the Means Brook Reservoir Dam, all owned by the Aquarion Water Company (Aquarion), have updated EOPs which, according to Aquarion, are on file at Shelton City Hall. These EOPs were originally created in 2002 and have been updated annually.

Letters were sent to the owners of the Bladens River Dam, the Kinneytown Dam, and the Clarks Pond Dam in Seymour and the Far Mill River Dam in Shelton. One reply letter was sent from Beach Properties Ltd., owners of the Bladens River Dam. The letter outlined maintenance procedures and physical characteristics and included a copy of the latest inspection report, which is dated September 18, 2006. Aquarion and John Fanotto, an owner of the Silver Lake Dam in Seymour, were contacted via email regarding EOPs. Aquarion replied with physical characteristics, a summary of inspections, a condition summary, the dates and update procedure for the dams' EOPs, and inundation mapping. A telephone conversation with John Fanotto discussed problems associated with the dam, overtopping occurrences, land use surrounding the dam, and physical characteristics of the dam.

DFA reports are not on file at the CT DEEP for the following Class B and C dams:

- Quillinan Reservoir Dam (No. 201) in Ansonia owned by CT DEEP
- Both the Upper and Lower Ansonia Reservoir Dams (No. 3704 and No. 3702) in Derby owned by the City of Derby
- The Bladens River Dam (No. 12404) in Seymour owned by Beach Properties Ltd.
- The Kinneytown Dam (No. 12405) in Seymour owned by Kinneytown Hydro, Inc.
- The Sochrin Pond Dam (No. 12409) owned by the City of Seymour in Seymour
- The Silver Lake Dam (No 12410) in Seymour owned by John Fanotto et al.
- The Clarks Pond Dam (No. 12411) in Seymour owned by Leonora Geaudreau
- The Isinglass Reservoir Dam (No. 12604) in Shelton owned by Aquarion Water Company
- The Trap Falls Reservoir Dam (No. 12601) in Shelton owned by Aquarion Water Company
- Means Brook Reservoir Dam (No. 12602) in Shelton owned by Aquarion Water Company
- Far Mill River Dam (No. 12607) in Shelton owned by Thomas and Elaine Bombero
- Shelton Reservoir Dam #2 (No. 12605) in Shelton owned by the City of Shelton

8.3 Historic Record

According to the CT DEEP website, approximately 200 notable dam and reservoir failures occurred worldwide in the twentieth century while in excess of 8,000 people died in these disasters. The following is a listing of some of the more catastrophic dam failures in Connecticut's recent history:

- 1938 and 1955: Exact numbers of dam failures caused by these floods are unavailable, but the Connecticut DEEP believes that more dams were damaged in these events than in the 1982 or 2005 flooding events described below.
- 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.
- June 5-6, 1982: Connecticut experienced a severe flood that caused 17 dams to fail and seriously damaged 31 others. Failure of the Bushy Hill Pond Dam in Deep River caused $50 million in damages, and the remaining dam failures caused nearly $20 million in damages.

More recently, the NCDC reports that flash flooding on April 16, 1996 caused three small dams in Middletown and one in Wallingford to breach. In 2005, 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

Dam failures in Connecticut were of primary concern to the well-being of many communities in 2010 according to an American Rivers blog posted on March 31, 2010. As an example, overtopping of the Sylvias Pond Dam in Stonington, Connecticut caused an evacuation of homes downstream in 2009. Additionally, the mayor of the town of Montville evacuated a section of town once it become possible that the Rand-Whitney Dam in town could breach.

Because they are nearing the end of their life expectancies, a significant number of dams in Connecticut, New England, and across the United States are likely to grow as potential threats to life and property. Indeed, the Association of State Dam Safety Officials has indicated that dam failures 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.

8.4 Existing Programs, Policies, Capabilities, and Mitigation

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

Dam Inspection Regulations require that nearly 700 dams in Connecticut be inspected annually. The DEEP currently prioritizes inspections of those dams that pose the greatest potential threat to downstream persons and properties.

Dams regulated 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.

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.

According to Connecticut DEEP Dam Safety files and Aquarion, DFAs were performed on the Fountain Lake Dam (Class C) in Ansonia, the Lake Housatonic Dam (Class C) in Derby, the Great Hill Reservoir (Class C) and the Peat Swamp Reservoir (Class C) in Seymour, and the Isinglass Reservoir (Class B), Trap Falls Reservoir (Class C), and Means Brook Reservoir (Class C) Dams in Shelton. DFAs are the first step in understanding the impacts of a particular dam failure and are therefore necessary for mitigation.

In Connecticut, the owners of Class C dams are required to maintain EOPs. An EOP is often the only documentation for dam-specific protocols that can be followed to prevent failure or lessen the effects of failure on downstream residents.

8.5 Vulnerabilities and Risk Assessment

As previously discussed, failure of a Class C dam could result in any of the following: loss of life; major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways; and a significant economic loss. Failure of a Class B dam could result in any of the following: possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, and schools; damage or interruption of the use of service of utilities; damage to primary roadways and railroads; and a significant economic loss. Both hazard classes of dams are regarded as significant in the state of Connecticut. Additionally, seven dams in the VCOG municipalities were classified as Class BB, representing a moderate hazard potential.

The impacts related to the Class C and B dams in the VCOG municipalities are described below. The descriptions below are based on information available at the Connecticut DEEP Dam Safety Section and information received from dam owners following the initial Dam Safety Section review by MMI employees. It is noted that the failure of any of the 43 other dams in the VCOG municipalities could also have impacts on human life and property within the municipalities although these are not discussed in favor of the B and C classes.

Class C Dams

Ansonia

- Quillinan Reservoir Dam (No. 201) is located at the southern end of the Quillinan Reservoir off Beaver Street to the north of Buswell Street in Ansonia. The dam impounds Beaver Brook. The impoundment was originally created as a water supply source, which was most recently owned by Birmingham Utilities. However, the reservoir no longer serves this purpose and is now owned by the CT DEEP. The dam's length is approximately 300 feet with a spillway length of 25 feet, impounding approximately 11 acres. The dam was extensively reconstructed in 1991 when the spillway was lowered, and an auxiliary spillway was constructed to the left of the original spillway. Additionally, the dam's thickness increased to approximately nine feet at the level of the spillways, and new concrete training walls were constructed along with a new apron for the auxiliary spillway. Other changes included a concrete cap on the stone masonry wall, a concrete gravity wall constructed, a galvanized trash rack installed, and others. A history of maintenance was not available in the Dam Safety Section.

  Although neither dam failure mapping nor a description of dam failure impacts were available, on preliminary topographic mapping review, it is likely that if the dam were to fail it would cause damage to the roads to the north of Myrtle Avenue in the area, south to Beaver Brook, and the tributary to Beaver Brook.

- Fountain Lake Dam (No. 202) is on the north end of Fountain Lake between Fountain Lake Road (Route 334) and Birmingham Boulevard on the municipal line between Ansonia and Seymour near the municipal border with the northeast section of Derby. The dam has a right embankment of 160 feet and a left embankment of 140 feet with a one-foot high concrete wall and a maximum height of 20 feet and a minimum top width of 10 feet. The dam is comprised of concrete and stone and has a 21-foot spillway. The spillway has a nine-foot flow notch that underwent repairs that were completed in 1989, and the spillway was lowered at that time. The intake structure has two valves 20 feet to the right of the spillway in the pond. The lake above the dam covers a surface area of 7.4 acres. The most recent EOP on file at the Dam Safety Section is dated 1983.

  The most recent inspection in the Dam Safety Section is described in a July 7, 2006 letter from the CT DEEP to the City of Ansonia. The most recent inspection on file at the Dam Safety Section was dated June 13, 2006. The inspection stated that the dam was in need of maintenance including the removal of debris, monitoring seepage, an updated EOP, removal of the bridge over the spillway or a hydraulic and hydrologic study on the bridge if it were to remain, the investigation of the operability of the gates and repairs as needed, monitoring of the cracking of the spillway, and other repairs as needed. The inspection stated that the dam has an earthen embankment upstream face and a mortared stone masonry downstream face.

  Failure of the Fountain Lake Dam would likely cause catastrophic damage along the tributary to the Naugatuck River, which runs along the municipal border between Seymour and Ansonia toward the Naugatuck River. Within the files at the Dam Safety Section and within the EOP, it is described that there would be immediate flooding impact on the downstream residential area of Fountain Lake Road (Seymour)/Great Hill Road (Ansonia) (Route 334). Water would likely travel approximately 300 feet downstream before overtopping Route 334 by approximately six feet, and residential homes and roads between the dam and Derby Avenue to the north would flood including the commercial plaza, which currently includes a martial arts and fitness business, a liquor store, a Dunkin' Donuts, and parking lot bordering Derby Avenue to the northeast of the dam. However, flooding of Route 8 would not be anticipated if the dam were to overtop as flood storage available to the west of Derby Avenue and large culverts under Route 8 would be expected to hold water levels low enough. In Ansonia, Great Hill Road (Route 334) between Wakelee Avenue and the dam, and Ansmour Road between Route 334 and the municipal line with Seymour are within the limits of potential flooding. In Seymour, Ansmour Road between the Ansonia municipal boundary and Brookdale Road, Brookdale Road (600 feet south of Ansmour Road to Terrace Road), Derby Avenue (Great Hill Road and 2,000 feet northward), Bungay Road (Derby Avenue and 200 feet northward), and the Tri-Town Plaza are within limits of potential flooding.

Derby

- Lake Housatonic Dam (No. 3701), or "Derby Dam" stretches the width of the Housatonic River just upstream of the confluence of the Housatonic and Naugatuck Rivers from the area of Roosevelt Drive in Derby to the area of Howe Drive (Route 110) in Shelton. The impoundment is owned and operated by McCallum Enterprises I LP with a Federal Energy Regulatory Commission license. The dam's spillway is approximately 675 linear feet in length with flashboards. On the Derby side, the dam features an abutment wall, the Derby Gatehouse located upstream of the abutment wall which controls flow into the Derby Canal, the inlet to the Derby Canal, and the Derby Dike upstream from the Gatehouse extending 400 feet to the Yale Boathouse. On the Shelton side, an old Shelton Gatehouse with five permanently open gates controls the flow to the historical Shelton Canal. The Shelton Gatehouse and Shelton Canal no longer serve as water retention structures for the Housatonic Lake.

  The main spillway has an average crest of 23 feet, is 675 feet in linear length and is comprised of cut stone and concrete arched in plan, and the spillway abutments have vertical stone masonry walls with a left (Derby) abutment top elevation of 30 feet and a right (Shelton) top elevation of 35 feet. The most recent EOP, which includes inundation mapping and an inundation area description, is dated 2009.

  An Inflow Design Flood (IDF) breach of 16,500 cubic feet per second (cfs) antecedent river flow would result in the flooding of Canal Street, Riverdale Avenue, and those intersecting streets in Shelton. The same breach would result in flooding of Roosevelt Drive south of D Street, A Street, B Street, C Street, Park Avenue south of C Street, the low area protected by dikes at the confluence of the Naugatuck and Housatonic Rivers bounded to the north by Division Street, west near Water Street, north of Main Street, and the area south of Main Street.

- Upper and Lower Ansonia Reservoir Dams (No. 3704 and 3702) are located to the north of Academy Hill/Sentinel Hill Road in the northern section of Derby. Both Dams are designated as Class C. The dams are located on a tributary to the Naugatuck River and, according to Dam Safety Section files, were both most recently inspected on June 29, 2011 and found to be in need of maintenance. The dams were originally created for water supply in 1887 but are now both owned by the City of Derby.

  The Upper Ansonia Reservoir Dam is 345 feet in linear length and constructed of masonry materials, with a dam height of 20.8 feet, crest elevation of 307 feet, and a crest width of 4.8 feet. The dam's spillway is weir type with zero feet of freeboard, is 20.5 feet in length, and was deemed inadequate by CT DEEP inspectors. The impounded surface area is 34 acres with a maximum storage of 310 acre-feet and a maximum discharge of 240 cfs.

The most recent inspection report for the Upper Ansonia Reservoir Dam listed the dam's condition as fair. The inspection asked Derby to retain the service of an engineer to evaluate seepage areas, investigate the dam and embankment conditions, supervise the removal of large trees near the dam, design and implement any necessary repairs, obtain a dam permit for any construction or demolition work, and update the EOP and submit. An EOP was not on file at the Dam Safety Section.

The Lower Ansonia Reservoir Dam is 423 feet in linear length and constructed of earthen materials, with a dam height of 17.8 feet, crest elevation of 277 feet, and a crest width of 25 feet. The dam's spillway is comprised of masonry materials, is weir type, and was deemed inadequate by CT DEEP inspectors. The impounded surface area is 9.6 acres with a maximum storage of 90 acre-feet and a maximum discharge of 210 cfs.

The most recent inspection report for the Lower Ansonia Reservoir Dam listed the dam's condition as fair. The inspection stated that any repairs are to be carried out in accordance with plans and specifications prepared by an engineer and that a dam repair permit is needed for any construction or demolition work. The inspection also included a list of maintenance items similar to that provided for the Upper Ansonia Reservoir Dam. The Dam Safety Section requested that the city update the EOP. No EOP was on file at the Dam Safety Section.

The stream flowing from the Upper and Lower Ansonia Reservoir Dams is associated with flooding in Derby, as described in Section 3.0 (refer to Figure 3-7).

Seymour

- Great Hill Reservoir Dam (No. 12401) is located near the municipal border between Oxford and Seymour in northwestern Seymour on the Fourmile Brook. The Great Hill Reservoir Dam was originally created for water supply. The dam is now owned by Seymour, and the water-impounded water body is no longer used for water supply. The dam is 37 feet in height at its centerline and has a total length of 210 feet. The dam is a concrete gravity type dam with a concrete gravity spillway that is set in bedrock 30 feet above the streambed with a length of 40 feet and a freeboard of 6.3 feet. The impoundment created is the Great Hill Reservoir, which extends from northwest Seymour to southern Oxford. The most recent dam failure inundation mapping is dated 1983.

  If the dam were to fail, according to 1983 mapping, flooding would occur approximately 4,500 feet downstream, including four homes and one daycare center along Route 188 and Route 34. Homes and daycare facilities would also be inundated from two to four feet above sill level while the Route 188 and Route 34 roadways would be overtopped approximately three to seven feet. This flooding is according to a discharge of 22,700 cfs.

- <u>Peat Swamp Reservoir Dam (No. 12402)</u> is located in southeast Seymour on Beaver Brook just to the north of Maple Street (Route 313). The dam is owned by the Regional Water Authority (RWA). The dam was installed to create a source of water supply and is still used as such. It was noted in the files at the Dam Safety Section that the EOP is held on file at RWA offices in Volume 2 ECP, Section 4 Flood Response Plan of the Water Supply Plan dated September 2009. The EOP described in the Dam Safety Section files describes that the EOP is dated July 2009.

  The dam's height is 42 feet with a linear length of 318 feet and a maximum discharge of 600 cfs, and the Peat Swamp Reservoir has a surface area of approximately 61 acres. The dam was first completed in 1925. Further information on the dam was not available at the Dam Safety Section.

<u>Shelton</u>

- <u>Trap Falls Reservoir Dam (No. 12601)</u> is located at the southern end of the Trap Falls Reservoir to the north of Route 8 near the municipal intersection of Shelton, Stratford, and Trumbull. The impoundment creates a water supply source, and both the reservoir and the dam are owned by Aquarion Water Company (Aquarion). The dam was originally constructed in 1905 and was raised in 1916. The dam is composed of concrete with buttresses with a height of 48 feet and a length of 1,080 feet. A concrete spillway is located on the right side of the dam and is 138 feet in linear length. The dam spillway is adequate enough to pass the spillway design flood (SDF), which is also the probable maximum flood (PMF). The date of the most recent inspection performed by Aquarion is September 14, 2010 when the condition of the dam was described as "good." Inspections are conducted every two years by Aquarion. The dam's original EOP was created in 2002 and is updated annually.

  Failure of the Trap Falls Reservoir Dam would likely cause catastrophic damage south of the dam, inundating Huntington Street, Bridgeport Avenue, Route 8 into Stratford including the Beaver Dam Access Road, the areas immediately surrounding Beaver Dam Lake and southward including homes and sections of roadways along Beaver Dam Road, Wildwood Road, Pumpkin Ground Road, Cutspring Road, Circle Drive, Route 15, Linton Street, Cheshire Street, Morning Glory Terrace, Morning Dew Lane, Chapel Street, Ross Drive, Butternut Lane, Rosebrook Drive, Whippoorwill Lane, Mill Pond Road, Main Street, Winton Place, and River Road.

- <u>Means Brook Reservoir Dam (No. 12602)</u> is located in central Shelton, was originally created for water supply in 1915, and is currently used for water supply and owned by Aquarion. The dam is located at the southern end of the Means Brook Reservoir along Means Brook. The dam was originally constructed in 1915 and is comprised of concrete. The dam is 50 feet in height with a length of 527 linear feet. The dam's the SDF is the dam's PMF. Based on the dam's size and its hazard class, the spillway is not adequate enough to pass the SDF. The dam has a concrete ogee spillway at the right side of the dam, which is approximately 100 feet in length. The dam was last inspected on September 14, 2010 and is inspected every two years. The most recent inspection described the dam's condition as being fair. The dam's original EOP was created in 2002 and is updated annually. Aquarion updates the EOP annually.

Failure of the Means Brook Reservoir Dam would likely cause catastrophic damage along Means Brook south of the dam including homes and roadway sections on Chamberlain Drive, Cobblestone Drive, Longmeadow Road, Tulip Lane, Treeland Road, Mark Drive, Brownson Drive, Soundview Avenue, Shelton Avenue, Old Shelton Road, Meeting House Lane, Lane Street, Huntington Street, Courtland Drive, Sycamore Drive, Serene Drive, Great Oak Road, Buddington Road, Mill Street, Commerce Drive, Stratford Road, Beard Saw Mill Road, Yutaka Trail, Kanungum Trail, Pine Tree Trail, River Road, and Ojibwa Trail.

- Shelton Reservoir #2 Dam (No. 12605) is located at the east end of Pine Lake to the north of Shelton Avenue (Route 108). The dam is owned by Shelton, and the dam is composed of stone masonry and an earthen embankment. The dam is 150 feet in linear length and 23 feet in height with a spillway at the center of the dam that is 32 feet in linear length. A wooden bridge spans the spillway and is three feet above the spillway crest. The dam impounds Curtiss Brook and has a maximum discharge of 535 cfs with an impoundment surface area of approximately 7.3 acres. The most recent item on file at the Dam Safety Section was a letter from the CT DEEP to Shelton regarding there being no EOP on file at the Dam Safety Section.

Class B Dams

Seymour

- Bladens River Dam (No. 12404) is located in the southwestern corner of Paper Mill Pond between Beach Street and Smith Street just south of Route 67 in Seymour. The dam is currently owned by Beach Properties Limited. The impoundment creates Paper Mill Pond, which has an approximate surface area of 1.31 acres. According to the owner, the pond is approximately 40% water with an average depth of less than two feet with the remaining area an island made of a mix of silt and gravel. The island is covered with trees and brush. The dam is comprised of earthen material with masonry training walls and a concrete spillway. The dam is 330 feet in linear length and has a maximum height of 20 feet. The dam has an earthen embankment section, a concrete buttress spillway section, a rubble concrete gravity spillway section, and an intake structure downstream of the forebay. No EOP or dam failure analysis/inundation mapping was on file at the DEEP.

  After being contacted via mail, the owner sent the most recent inspection dated September 18, 2006, which stated that the dam was covered with brush and trees and that the right embankment had grass covering it. There was an eroded area on the left crest that was said to have been unchanged since inspection of the dam 12 years prior. There was some misalignment to the left training wall and some concrete spalling in the vertical walls of the spillway. The conclusion was that the dam was sound and intact. Although the owner was asked to provide an EOP, one was not sent. The owner stated that the dam is inspected periodically, and debris, usually including large logs or branches, is removed as necessary.

- Kinneytown Dam (No. 12405) is located between Route 8 and South Main Street (Route 115) on the Naugatuck River in southern Seymour near the municipal border with Ansonia. The Kinneytown Dam is currently owned by Kinneytown Hydro, Inc. The dam was originally constructed in 1845 as a log crib dam, which washed out in 1910 when a 245-foot long rubble concrete dam with a full-length ogee spillway was constructed, which remains today. Work completed in 1923 on the dam raised the crest elevation from 51.88 feet to 52.08 feet. The left earthen embankment washed out as a result of the flood of 1955 and, in 1956, an addition of 168 feet of concrete ogee spillway was added to the dam.

  No dam failure inundation figure is included in the Phase II Inspection/EOP Report dated December 1980; however, the flooding areas are described. According to the EOP, if there was a dam failure, only apartment units on the west bank of the Naugatuck River just downstream of Maple Street in Ansonia would likely be susceptible to flooding. No other information was on file at the Dam Safety Section, and the owner was contacted for more information via mail with no reply.

- Sochrin Pond Dam (No. 12409), also known as the Wooster Pond Dam, is located in southeastern Seymour on Wooster Brook. The dam is currently owned by the Town of Seymour. The impoundment creates Wooster/Sochrin Pond, which is approximately 1.5 acres in size. The dam is L shaped and is concrete gravity. There is a partial upstream earthen embankment, and the dam is approximately 265 feet in linear length, which includes the emergency spillway. The dam length is approximately 165 feet with an approximate 100-foot emergency spillway. The dam is approximately 15 feet in height and was most recently inspected in 2004 and reported to be in good/fair condition. The emergency spillway is located on the right of the dam's earthen overflow concrete training walls, which are approximately 100 feet in linear length.

  There was no dam failure analysis/inundation mapping on file at the Dam Safety Section, and Seymour is unaware of the location or existence of an EOP for the dam. However, the files at the Dam Safety Section state that failure could result in the overtopping of Colony Street, located approximately 200 feet downstream, and Route 115 in the area of Colony Street.

- Silver Lake Dam (No. 12410) is located just to the east of Lakeview Avenue and Route 8 and the municipal border between Beacon Falls and Seymour. The dam is owned by John Fanotto et al. The dam is located on Rimmon Brook, and the impoundment forms Silver Lake, which is approximately 5.6 acres in land surface area. No file existed at the CT DEEP Dam Safety Section. The owner (John Fanotto) was contacted via email and responded via telephone.

According to the owner, the dam is comprised of earthen material with a concrete spillway. The dam is approximately eight feet long and eight feet high with a spillway length of eight feet and height of six feet. The dam overtopped three times in 2011 from significant rainfall events. The owner reports that the Class B classification may be too high and that there is no significant amount of industrial or commercial properties downstream aside from a small industrial operation off Rimmondale Road. The are approximately 10 homes and approximately three additional commercial/industrial properties that may be affected if the dam is significantly overtopped. However, the owner stated that the overtopping in 2011 may be compounded with problems from a development upstream in Beacon Falls (Chatfield Farms) which, according to the owner, has caused a major increase in runoff.

- <u>Clarks Pond Dam (No. 12411)</u> is located in eastern Seymour between Maple Street (Route 313) and Hickory Lane. The dam is on the western side of Clarks Pond near Hickory Lane. The dam impounds Mud Brook and forms Clarks Pond, which has a land surface area of approximately 4.8 acres. No file existed at the CT DEEP's Dam Safety Section when MMI personnel conducted a review. As a result, the owner of the dam, Leonora Gaudreau, was contacted via mail, and no response was received.

<u>Shelton</u>

- <u>Isinglass Reservoir Dam (No. 12604)</u> is located just to the west of Far Mill Street in Shelton to the south of the Copper Benny Lane-Far Mill Street intersection. The dam was created as water supply and still serves this purpose, currently owned by the Aquarion Water Company (Aquarion). The Farmill River is impounded creating the Isinglass Reservoir. The concrete dam was originally constructed in 1905 and has a height of 24 feet with a linear length of 114 feet. According to Aquarion, based on the size and hazard class of the dam, the spillway design flood is one-half PMF, and the dam spillway is not adequate enough to pass the SDF. The dam is inspected every five years and was most recently inspected on September 16, 2011. The most recent inspection deemed the dam's condition as fair, and the EOP was originally created in 2002 and is updated every other year.

  Overtopping of the dam would include the inundation of roadways and homes south of the Isinglass Reservoir and along the Farmill River through sections of Far Mill Street, Corn Hill Road, Horse Stable Circle, Laurel Glen Drive, Misty Lane, Brentley Drive, Walnut Tree Hill Road, Earl Street, Waverly Road, Willard Road, Pond View Drive, Elizabeth Street, Nicholas Avenue, Bayberry Lane, Mulburry Lane, Courtland Drive, Huntington Street, Lane Street, Great Oak Road, Mill Street, Commerce Drive, Old Stratford Road, Route 8, Beard Sawmill Road, Yutaka Terrace, Kanungum Trail, Maple Trail, River Road, and Pine Tree Trail.

- <u>Far Mill River Dam (No. 12607)</u> is located in south-central Shelton to the west of Huntington Street, north of Courtland Drive, and south of Roaring Brook Lane. The dam is located on the eastern end of what is known as Ross Pond. The dam is currently owned by Thomas and Elaine Bombero. The most recent documentation on file at the CT DEEP Dam Safety Section was a 2006 letter requesting routine maintenance work and an updated EOP from the owners. The letter stemmed from a 2006 inspection that outlined the poor condition of the masonry wall and embankment. No dimensions of the dam were included in the file at the Dam Safety Section.

  The owners were contacted via mail for an EOP, inundation mapping, dimensions, and any other pertinent information. The owners did not return any correspondence.

8.6 <u>Potential Mitigation Measures, Strategies, and Alternatives</u>

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 noncompetitive state funding for repair of municipality-owned dams. Funding is limited by the State Bond Commission. State statute Section 25-84 allows municipalities to form Flood and Erosion Control Boards, but municipalities must take action to create the board within the context of the local government, such as by revising the municipal charter.

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

The VCOG municipalities should work with private property owners, the RWA, Aquarion, and the Connecticut DEEP to stay up to date on the evolution of any EOPs and DFAs for the significant hazard dams in the VCOG municipalities should any be produced. The municipalities' EMDs, Building Officials, and Engineering/Public Works Departments should have copies of all existing EOPs and DFAs for dams within the municipality in their possession. Whenever possible, copies of these documents (or portions of them that do not provide specific dam vulnerabilities) should be made available at the City and Town Halls for reference and public viewing.

The VCOG municipalities should maximize their emergency preparedness for a potential dam failure. The VCOG municipalities should also consider coordinating occasional inspections of Class A, AA, BB, and unranked dams with the assistance of private property owners and inform dam owners of resources available to them through various governmental agencies.

The VCOG municipalties should consider including future dam failure areas into the Reverse 911 and CodeRed emergency notification systems. These technologies should be used to warn residents downstream of a dam of an impending dam failure and facilitate evacuation. In the absence of DFA mapping, the 500-year floodplains downstream of a Class B dam could be used to delineate potential dam failure areas.

The following specific recommendations are offered for dam failure mitigation:

- ❑ Include dam failure areas in the Reverse 911 and CodeRed emergency contact databases.
- ❑ Work with the RWA to develop a specific EOP and maintenance plan for Peat Swamp Reservoir Dam if none exists.
- ❑ Work with CT DEEP to develop a specific EOP for the Quillinan Reservoir Dam.
- ❑ The City of Derby should develop an EOP and maintenance plan for the Upper and Lower Ansonia Reservoirs.
- ❑ Work with Beach Properties Ltd. to develop a specific EOP and maintenance plan for the Bladens River Dam in Seymour.
- ❑ Work with Kinneytown Hydro, Inc. to develop a specific EOP and maintenance plan for the Kinneytown Dam in Seymour.
- ❑ The Town of Seymour should develop a specific EOP and maintenance plan for the Sochrin Pond Dam.
- ❑ The Town of Seymour should develop a specific EOP and maintenance plan for the Great Hill Reservoir Dam.
- ❑ Work with John Fanotto et al. to develop an EOP and maintenance plan for Silver Lake Dam in Seymour and work to address increased runoff issues and any elevated sedimentation in Silver Lake.
- ❑ Locate and work with the owner of the Clarks Pond Dam in Seymour, Leonora Gaudreau, to develop an EOP and maintenance schedule for the dam.
- ❑ Locate and work with Thomas and Elaine Bombero, the owners of the Far Mill River Dam in Shelton, to develop an EOP and maintenance schedule for the dam.
- ❑ The City of Shelton should locate/develop/update an EOP for Shelton Reservoir Dam #2.

9.0 WILDFIRES

9.1 Setting

The ensuing discussion about wildfires is focused on the undeveloped wooded and shrub/grassland areas of the VCOG municipalities, along with the wildland interface, which is low-density suburban-type development found at the margins of these wooded areas. Structural fires in higher density areas of the municipalities are not directly addressed. With the relatively large land area that comprises the VCOG municipalities and the different wildland interfaces within each municipality, wildfires can occur almost anywhere across the VCOG municipalities.

9.2 Hazard Assessment

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

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

Nevertheless, wildfires are also a natural process in many ecosystems, 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 of humans and wildlife in these areas.

9.3 Historic Record

According to the Connecticut Natural Hazards Mitigation Plan, Connecticut enacted its first statewide forest fire control system in 1905 when the state was largely rural with very little secondary growth forest. By 1927, the state had most of the statutory foundations for today's forest fire control programs and policies in place such as the State Forest Fire Warden system, a network of fire lookout towers and patrols, and regulations regarding open burning. The severe fire weather in the 1940s prompted the state legislature to join the Northeastern Interstate Forest Fire Protection Compact in 1949.

Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEEP, forest has reclaimed over 500,000 acres of land that was used for agriculture as of 1914. However, that new forest has been fragmented in the past few decades by residential development. The urban/wildland interface is increasing each year as sprawl extends further out from Connecticut's cities.

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

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

TABLE 9-1
Wildland Fire Statistics for Connecticut

Year	Number of Wildland Fires	Acres Burned	Number of Prescribed Burns	Acres Burned	Total Acres Burned
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	**1,940**	**2,778**	**74**	**830**	**3,608**

Source: National Interagency Fire Center

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

Due to a reduced snowpack and dry conditions, March 2012 was Connecticut's most recent month of high wildfire risk. A forest fire burned about 25 acres at Devil's Hopyard State Park in East Haddam on March 26-27, 2012.

9.4 Existing Programs, Policies, Capabilities, and Mitigation

Existing mitigation for wildland fire control is typically focused on Fire Department training and maintaining an adequate supply of equipment. The VCOG municipalities' Subdivision Regulations require provision of supplemental water supply systems for fire protection and stipulate that the Fire Departments review and approve the location, size, design, construction specifications, and installation of these water supply systems. In addition, new roads, subdivisions, and fire ponds are required to allow for fire truck access.

Unlike wildfires on the west coast of the United States where the fires are allowed to burn toward development and then stopped, the VCOG municipalities' Fire Departments move to the fires whenever possible. This proactive approach is believed to be effective for controlling wildfires. The Fire Departments have some water storage capability but primarily rely on the use of the fire ponds, dry hydrants, water tanks, and the municipalities' public water system (Aquarion Water Company in Shelton and the majority of Seymour, and the RWA in Ansonia, Derby, and a small section of southern Seymour) to fight fires located along major roads throughout the municipalities.

The DEEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system to compile forest fire probability forecasts. This allows the DEEP and the VCOG municipalities the ability to monitor the drier areas of the state to be prepared for forest fire conditions.

Because prevention is still the primary means of reducing wildfire risks, the DEEP regularly posts updates about wildfire risk and circulates warnings to the press. On March 27, the following DEEP press release was issued and picked up by several news agencies:

DEEP Reminds State Residents of Spring Fire Danger – Forest Fire Danger Level is Very High

As firefighters battle a large brush fire that is threatening two homes near Devils Hopyard State Park, East Haddam, the Connecticut Department of Energy and Environmental Protection (DEEP) today reminded residents that the Forest Fire Danger Level is currently VERY HIGH and that weather conditions will cause any brush fires to spread rapidly.

With this fire danger, open burning of brush is NOT allowed – even if a resident has a permit from the local open burning official.

In addition, the National Weather Service has issued a Red Flag Warning for Connecticut because of weather conditions conducive to the rapid spread of fire. Red Flag warnings are issued when high winds will be sustained or there will be frequent gusts above a certain threshold (normally 25 mph), as is expected to be the case today. Red Flag conditions are also defined by humidity levels, below 30%, and precipitation for the previous five days of less than ¼-inch.

"Residents need to know that any permit to burn brush is not valid when the Forest Fire Danger is rated high, very high, or extreme," said DEEP Deputy Commissioner Susan Frechette. "Anyone spotting a forest fire should remain calm and dial 911 to report the fire as quickly as possible to the local fire Department."

DEEP's Division of Forestry constantly monitors the danger of forest fire to help protect Connecticut's 1.8 million acres of forested land. Forest fire danger levels are classified as low, moderate, high, very high or extreme.

DEEP firefighters are currently assisting local fire departments in fighting a fire in East Haddam in the vicinity of Devils Hopyard State Park. The first efforts to battle this blaze began Monday evening and continue today.

Later that day, the Valley's own *Valley Independent Sentinel* picked up the press release and published its own article written by the Seymour Deputy Fire Marshal:

Forest Fire Danger Level Tuesday: Very High
by Timm Willis | Seymour Deputy Fire Marshal | Mar 27, 2012 11:22 am

The day after a forest fire burned through about 25 acres at a state park in East Haddam Monday, the Connecticut Department of Energy and Environmental Protection has listed the forest fire danger level as "very high."

Spring is always a dangerous time of the year for brush and wild-land fires. Low humidity coupled with high winds creates a great potential for fires to get out of control.

Prior to the growth of new leaves on the trees, any debris on the ground will dry out quickly, even after rain. It is important that we pay attention to the conditions and avoid activities that could potentially cause fires to occur.

The Connecticut Department of Energy and Environmental Protection makes some of the following suggestions to homeowners, in order to protect your home and your families.

- Make a fire zone around your house by cleaning flammable vegetation and debris from at least 30 feet around your home.
- Remove tree limbs that may hang over your roof or chimney.
- Don't store firewood up against your home.
- Properly dispose of smoking materials once they've been extinguished.
- Stay with outside fires until they are completely out.
- Dispose of wood ashes in a metal bucket and soak them with water before dumping them.
- If you spot a fire, please remember to remain calm and dial 911 to report the fire as soon as it is safe to do so.

For additional information on fire safety, please go to www.nfpa.org or www.usfa.fema.gov.

9.5 Vulnerabilities and Risk Assessment

The most common causes of wildfires are arson, lightning strikes, and fires started from downed trees hitting electrical lines. Thus, wildfires have the potential to occur anywhere and at any time in both undeveloped and lightly developed areas. The extensive forests and fields covering the state are prime locations for a wildfire. In many areas, structures and subdivisions are built abutting forest borders, creating areas of particular vulnerability. Wildfires are more common in rural areas than in developed areas as most fires in populated areas are quickly noticed and contained.

However, the likelihood of a severe and expansive wildfire developing in Connecticut is lessened by the vast network of water features in the state, which creates natural breaks likely to stop the spread of a fire. It is noted that during long periods of drought these natural features may dry up, increasing the vulnerability of the state to wildfires.

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

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.

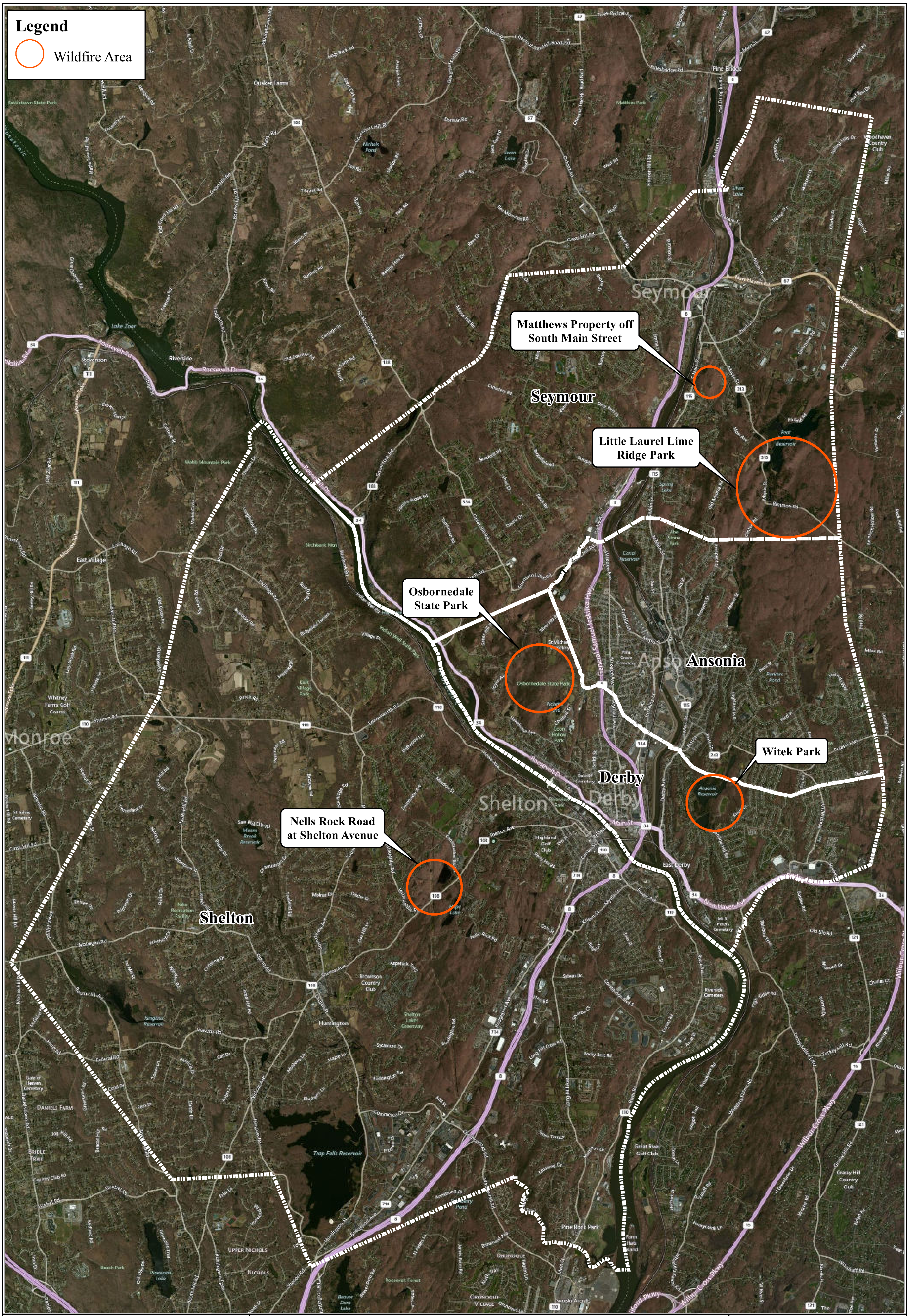
Ansonia city officials report that wildfires are almost nonissues in the city. After review of the landcover, it is apparent that the northeast corner of Ansonia near the municipal border with Seymour and Woodbridge is most susceptible to wildfires. This area is not easily accessible and is densely forested. Refer to Figure 9-1 for a depiction of the higher-risk areas throughout the region.

In Derby, it was reported by city officials that fires occur in the two large parks in Derby, Witek Park and Osbornedale State Park. Officials believe that the fires are often set by people; however, none have grown large historically as the Derby Fire Department has acted quickly and efficiently to extinguish the areas of fire. It was additionally noted that the development of ball fields in Witek Park has resulted in a fewer number of fires. After a review of aerial photography, it appears that the northeast corner of Derby near the municipal border with Seymour and Woodbridge could also be susceptible to wildfires as it is largely open space and not easily accessible as no public roadways are located here.

According to Seymour town officials, Seymour is subject to at least one wildfire each spring in the Route 34 area along the steep slope in the Little Laurel Lime Ridge Park area of town. Additionally, the Matthies property off South Main Street has a history of brush fires. According to officials, in spring 2011, it took the Fire Department approximately six to seven hours to fight a fire in this area.

In addition to the problematic areas described by officials, a pocket in northwestern Seymour between Route 334 and Stanley Drive, which includes Cemetery Road, is another location with a significant amount of open space. Another pocket of open space lies between Route 8 and Bungay Road in central Seymour. This area is also nearly nondeveloped because of steep slopes near the Naugatuck River. Another substantial area of open space with limited roadway access is along the northwest border of town near Beacon Falls and Oxford. This area may also be susceptible to future wildfires although these described areas were not mentioned by officials as being problematic.

In Shelton, the lone area of the city that was indicated by city officials as being problematic with a history of wildfires is the area of Shelton Avenue at Nells Rock Road. According to city officials, this area of the city had areas of burning for a period of five to six weeks in 1995. The only other pocket of considerable open space is the area around the Shelton Lakes Greenway in southern Shelton to the north of Bridgeport Avenue (Route 714). However, this area was not described by city officials as being problematic.



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
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Figure 9-1: Wildfire Risk Areas

Location: **Ansonia, Derby, Seymour & Shelton, CT**

VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig9-1_Wildfires.mxd
1st Version: 3/1/2012
Revision: 6/27/2012
Scale: 1 in = 4,500 ft

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Although there have been some historical lengthy battles with wildfires in the VCOG municipalities, for the majority of cases, the preparedness and responsiveness of the VCOG Fire Departments is very strong. As a result, the overall vulnerability of VCOG municipalities to wildfire hazards is believed to be relatively low despite the risks for occurrence. In other words, wildfires are considered a likely event each year but, when one occurs, it is generally contained to a small range with limited damage to nonforested areas.

The low overall vulnerability notwithstanding, there are areas of the VCOG municipalities where roads are narrow and/or one way or are windy through areas of steeper slopes. Amongst other issues, this hinders emergency access to fight fires. These types of areas exist in most pockets described above, further complicating matters.

Should a wildfire occur, it is reasonable to estimate that the average area to burn would be five acres during a drought period and one to two acres during wetter periods, consistent with the state averages. In the case of an extreme wildfire during a long drought on forested lands, it is estimated that up to 300 acres could burn before containment due to the limited access of those lands. This is also consistent with actual data in Connecticut. Residential areas bordering such lands would thus be vulnerable to wildfires.

Recall from Figures 2-7 through 2-9 that elderly persons and persons with disabilities reside in the VCOG municipalities. In comparing these figures with the wildfire risk areas described above, it is possible that several hundred of the population impacted by a wildfire could consist of the elderly, and numerous people with disabilities could reside near wildfire impact areas. Thus, it is important for the Fire Departments of the VCOG municipalities to be prepared to assist these special populations during emergencies, including wildfire.

9.6 Potential Mitigation Measures, Strategies, and Alternatives

Potential mitigation measures for wildfires include a mixture of prevention, education, and emergency planning. Educational materials should be made available at all applicable municipal offices. Education of homeowners on methods of protecting their homes is far more effective than trying to steer growth away from potential wildfire areas, especially given that the available land that is environmentally appropriate for development may be forested. Water system improvement is another important class of potential mitigation for wildfires.

For each VCOG municipality, the following recommendations could be implemented to mitigate fire risk:

All Communities

- ❑ Continue to support public outreach programs to increase awareness of forest fire danger, equipment usage, and protecting homes from wildfires.
- ❑ Ensure that provisions of Subdivision Regulations regarding fire protection facilities are being enforced.
- ❑ Enforce regulations and permits for open burning.
- ❑ Continue to require that utilities be installed underground.
- ❑ Pursue additional sources of fire-fighting water where adequate supplies do not exist.
- ❑ Continue to patrol city- and town-owned open space and parks to prevent campfires.
- ❑ Continue to utilize and promote intermunicipal cooperation in fire-fighting efforts.

Ansonia

- ❑ When wildfire threats are high, monitor the area in the northeastern section of the city for development of fires.

Derby

- ❑ Continue to pat close attention to Witek Park and Osbornedale State Park during busy use season and provide patrols as available/needed to limit fire setting by people.

Seymour

- ❑ Continue to monitor Route 313 in the Little Laurel Lime Ridge Park area of town and provide patrols/support as needed and available especially during the spring.
- ❑ Continue to monitor the Matthies property off South Main Street, which has a history of brush fires.

Shelton

- ❑ Continue to monitor the area near Nells Rock Road along Shelton Avenue, which has had a history of wildfires.

In addition, specific recommendations that apply to all hazards are listed in Section 11.1.

10.0 LANDSLIDES

10.1 Setting

The word "landslide" is a general term for most types of landforms and processes involving the downslope movement of soil and rock materials. Landslides have many causes, but most involve earth materials with low shear strength, high groundwater saturation, an interruption of the slope by natural causes or human activities, or a combination of the above.

There are several areas within the VCOG municipalities at risk for landslides. These areas are described below. As the word "Valley" in "VCOG" implies, the municipalities of the region have many areas where the topography is extremely steep. In these areas, landslides have developed due to the combination of the steep topography and high-density development with groundwater saturation or some other human-induced or naturally occurring event or process that disrupts the earthen material's state of equilibrium. Debris from landslides can flow or move beyond the bottom of the slope or may impact utilities, resulting in the effects of the landslide being felt in a wider area.

10.2 Hazard Assessment

According to the USDA, landslides occur in all 50 states, causing $1 to 2 billion in damage and more than 25 fatalities on average each year. Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production. Landslides commonly accompany other major natural disasters, such as earthquakes and floods, exacerbating relief and reconstruction efforts. Expanded development onto less desirable slopes and soils has increased the incidence of landslide disasters.

According to the USDA, there are two primary causes for slope failure or landslides. One involves an uneven distribution of weight on a slope. Adding weight to the top of a slope (fill, a structure, tall trees, soil saturation, etc.) or removing weight at the toe of a slope (excavation, erosion, drainage, landslide, etc.) causes the weight on the slope to be uneven and thus often results in slope failure. The second cause of slope failure is typically the wetting of a weak layer that is inclined at the same angle as the ground surface. Water can reduce the strength and lubricate the layer, allowing the upper block of wet soil to slide down the slope. A variation of this cause is the accumulation of water on a soil or rock layer with a low permeability rate. The water can saturate the layers above the water restriction, adding weight to the upper layers. The water on top of the restrictive layer can also reduce the shear strength of the soil and lubricate any failure planes, causing a slope failure.

Landslides are common throughout the Appalachian region and New England. The greatest hazard in these areas is from sliding of clay-rich soils. Landslides are hazardous to life and property both in the landslide itself and in the areas where the landslide material is deposited. While some landslides are stable and unlikely to move again, others can be reactivated by basal undercutting, such as that caused by stream erosion or by excavation. Excavation for road construction can be particularly hazardous. Movement can also recur because of increased groundwater pressure, such as that induced by the removal of forest cover or the diversion of drainage water.

According to the USDA, the following locations are generally prone to landslides:

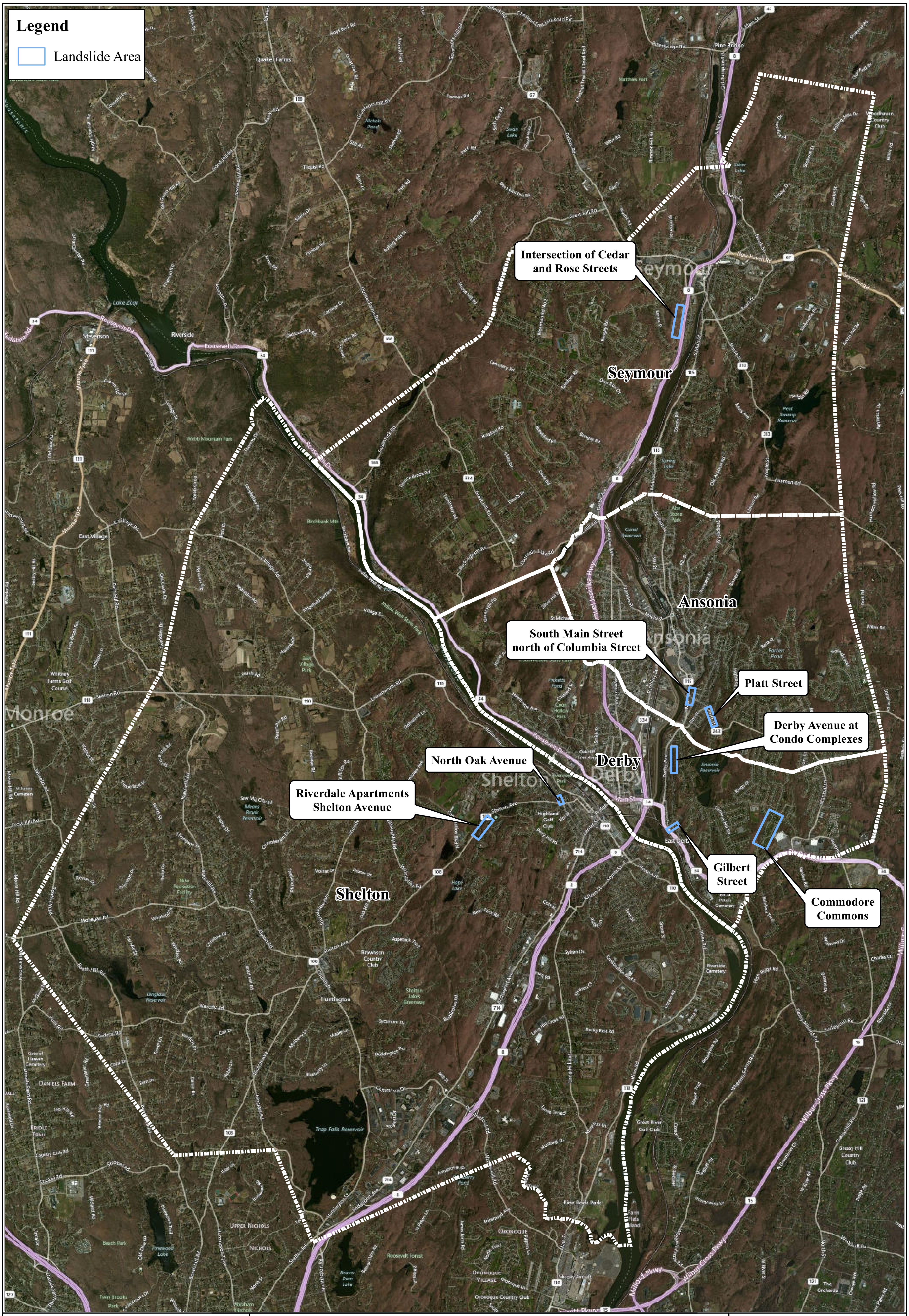
- Existing old landslides
- Steep slopes or the base of slopes
- Areas in or at the base of minor drainage hollows
- The base or top of an old fill slope or steep cut slope
- Areas where part of the natural slope is interrupted
- Developed hillsides where leach field septic systems are used

As noted above, steeply sloping terrain comprises areas in all four VCOG municipalities. Such areas have the potential for a landslide to develop, especially when the terrain is characterized by poorly draining soils or served by an inadequate drainage system. Most landslides in the VCOG municipalities develop due to heavy rainfall saturating the upper parts of the soil although some have been taking place for some time and have yet to cause substantial destruction.

Overall, the likelihood of a landslide occurring in the VCOG municipalities is believed to be moderate for any given year as only the most severe of rain events will potentially trigger a landslide, slump, or slope failure. However, as noted below, there are several recent examples of slides.

10.3 Historic Record

Mostly minor to moderate landslides have occurred throughout the VCOG municipalities. Steep slopes exist across the VCOG municipalities, and this topography is generally present in areas that have been developed. Landslides in the VCOG municipalities tend to occur as a result of extreme rainfall coupled with human activities such as grading and development. These slides occur in short- and long-scale time frames. Recent examples of landslides in the VCOG municipalities are provided below. Refer to Figure 10-1 for a map of the locations.



SOURCE(S):
Base Map:
"Bing Maps Hybrid" Datalayer
(c) 2010 Microsoft Corporation
and its data suppliers

Figure 10-1: Landslide Risk Areas

Location: **Ansonia, Derby, Seymour & Shelton, CT**

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VCOG Hazard Mitigation Plan

Map By: SMG
MMI#: 3211-04
MXD: H:\3211-04\GIS\VCOG-wide\Maps\Fig10-1_Landslides.mxd
1st Version: 3/1/2012
Revision: 6/27/2012
Scale: 1 in = 4,500 ft

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Ansonia

- South Main Street – A wall along South Main Street entirely composed of granite blocks is coming apart just to the north of Columbia Street. Over time, large trees have grown on the top of the wall and have rooted themselves into the wall. The wall is in danger of collapsing and the hillside giving way at some point in the future.

- Platt Street – A landslide occurred along the face of the steep slope here in 2011.

Derby

- Derby Avenue – Landslides have occurred behind condominium complexes at 233 Derby Avenue and an adjacent complex. Earth has moved toward the condominiums, and the problems have been largely addressed by the property owners.

- Commodore Commons – The complex is reportedly sliding downhill toward the Housatonic River. This issue is currently being addressed by the property owners.

- Gilbert Street – City officials fear that steep slopes near the base of the street could eventually be problematic.

Seymour

- Cedar and Rose Streets – According to town officials, 10 to 15 years ago a landslide occurred at the intersection of the two roads.

Shelton

- Shelton Avenue – The section of Shelton Avenue at the Riverdale Apartments was subject to a substantial landslide event during a heavy rainfall event in 2010. As a result, a residence was removed.

- North Oak Avenue – A severe slide occurred in 2009, undermining a home and requiring its removal. The following article was picked up by the Associated Press:

Photo Courtesy of Fox 61 News

The Associated Press, December 16, 2009

SHELTON, Conn. (AP) - A house in Shelton is set to be torn down after a mudslide left it in danger of sliding down a steep hill toward a condominium complex. Police and firefighters were called to the vacant house on North Oak Avenue Tuesday afternoon after the mudslide brought down part of the nearly 100-year-old colonial as well as trees, retaining walls and boulders. Crews are expected to demolish the house Wednesday. Authorities evacuated eight units at the condominium complex at the bottom of the nearly 100-foot hill. No one was injured. Officials believe the mudslide happened after water pipes in the house burst and the hill was flooded. A real estate agent trying to sell the house says its elderly owners left about a month ago because they couldn't afford to pay back taxes.

10.4 Existing Programs, Policies, Capabilities, and Mitigation

Specific landslide prevention programs, policies, or mitigation measures are not outlined in the regulations governing zoning, land use, or development plans in the VCOG municipalities. Landslides, slumps, and retaining wall failures that occur on private properties are considered to be the responsibility of the property owners. When such failures occur on municipal property or affect municipal utilities, then, generally, the Public Works Department of that VCOG municipality is in charge of repairs.

Many of the programs and policies regarding steep slopes will help address landslides. These were introduced in Section 7.4. Consider Section 4-19-5 of the Subdivision Regulations of the Town of Shelton. The section discusses steep slopes in the context of open space stating that "not more than 25% of the of the minimum required Open Space area shall consist of designated inland wetlands and/or steep slopes in excess of 30%..." This is an attempt to reduce the tendency for developers to reserve steep slopes for open space, instead requiring that some of the adjacent developable land is set aside for open space as well.

The POCDs for Ansonia, Derby, and Seymour all make reference to steep slopes in their "strategies" lists within the natural resources discussions, indicating that these three communities desire avoiding development on steep slopes. However, much of the available land in the Valley region consists of steep slopes, and the VCOG municipalities will need to be careful in their review of development proposals.

10.5 Vulnerabilities and Risk Assessment

As noted in Section 10.2, the overall likelihood of a landslide occurring in the VCOG municipalities is considered to be moderate for any given year. Although direct landslide damage generally impacts only a small area on and at the base of the slope that has failed, utilities damaged by a landslide can have more of a widespread impact. Therefore, it is important for the VCOG municipalities to identify areas that are or are likely to be in the future prone to slope failure and to restrict development, clearing, and excavation activities in order to mitigate damages at those locations.

Landslides and slumps do not always occur near watercourses. In areas where the drainage network is comprised only of sheet flow, roadways can act as watercourses and break apart. For example, when construction activities undermine the natural grade of a hill, the hillside can collapse.

All of the developed areas on steep slopes are considered vulnerable to landslides. These areas are found throughout the four VCOG communities but are concentrated on the *peripheries* of the central business districts or historic downtown areas of Seymour, Ansonia, Derby, and Shelton. Of the nine recent landslides listed above in Section 10.3, most are typical of these peripheral areas. Vulnerabilities are highest in these areas and will continue to be high as infill occurs, as properties are redeveloped, and as annual precipitation increases.

On the other hand, the downtown areas are often more level and occupied by commercial and industrial structures as they are located immediately adjacent to the Housatonic and Naugatuck Rivers; the rural parts of the municipalities are less densely developed. Landslide risks are lower in these areas and, thus, the vulnerabilities are also lower.

10.6 Potential Mitigation Measures, Strategies, and Alternatives

The hydrologic conditions that can trigger landslides in the VCOG municipalities cannot be prevented. However, human activities that develop or undermine steep slopes can be regulated to prevent landslide damage. A discussion of various mitigation measures is included below.

Prevention

Heavy rainfall cannot be prevented from falling onto a certain area. However, in an area of steep slopes, a properly designed drainage system can prove most beneficial for mitigating landslides. Areas of steep slopes should be a consideration for where the VCOG municipalities expand their drainage networks and should be discussed in any comprehensive stormwater management plan that the municipalities may implement.

Damage from landslides can be prevented by restricting development in landslide-prone areas. The VCOG municipalities should consider adopting regulations restricting development on slopes of 25% or greater wherever not in current regulations and should restrict excavation and clearing activities on lands above such slopes. The Ansonia POCD implies that slopes in excess of 15% are considered steep.

In addition, the USDA offers the following guidelines regarding development in areas where landslides are a concern that could be considered by regulatory agencies in the VCOG communities:

- Avoid steep slopes or areas with noticeable mass movement when selecting a building site.
- Watch for naturally wet areas with seeps and springs that might indicate water problems.
- Slope stability decreases as water moves into the soil. Do not allow surface waters to saturate a sloping soil. Springs, seeps, roof runoff, gutter downspouts, septic systems, and poorly graded sites can all result in ponding or surface runoff that often increases the risk of landslides.
- Properly locate diversion channels to help redirect runoff away from areas disturbed during construction. Runoff should be channeled and water from roofs and downspouts piped to stable areas at the bottom of slopes.
- Seek professional assistance in selecting the appropriate type and location of a septic system. Septic systems located in fill material can saturate soil and increase the risk of landslides.
- Note unusual cracks or bulges at the soil surface. These might be typical signs of soil movement that may lead to slope failure.
- Landslides are less likely to occur on sites where disturbance has been minimized. Alter the natural slope of the building site as little as possible during construction. Never remove soil from the toe or bottom of the slope or add soil to the top of the slope. Seek professional assistance before earth-moving begins.
- Trees develop extensive root systems that are very useful in slope stabilization and also lower the groundwater table. Remove as few trees and other vegetation as possible. Trees and other kinds of permanent plant cover should be established as rapidly as possible and maintained to reduce the risks of erosion and landslides.

Property Protection

Individual property owners should be encouraged to have their retaining walls inspected by a professional engineer skilled in such structures to determine their susceptibility to failure. VCOG municipalities should also determine areas that are on or below steep slopes that could be impacted by a landslide and encourage the property owners to develop emergency plans. The municipalities should identify different areas that should be carefully monitored during large-scale rain events.

Public Education and Awareness

Landslides do not occur frequently enough in the VCOG municipalities to be a major concern. Still, the public and municipalities should be instructed on identifying warning signs indicating possible landslide conditions. According to the USDA, these signs include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements, or sidewalks
- Soil moving away from foundations
- Ancillary structures, such as decks and patios, tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning or offset telephone poles, trees, retaining walls, or fences
- Sticking doors and windows and visible open spaces indicating jambs and frames out of plumb

Emergency Services

The VCOG municipalities should continue to encourage and/or require through streets over dead-end streets to the furthest extent possible. Two modes of egress reduces the risk that residents can be cut off from critical facilities should a landslide block an entire street. In addition, the municipalities should consider connecting dead ends through to other streets where possible.

Utility providers should be made aware of landslide-prone areas. Emergency teams associated with each utility should be prepared to control breaks and reroute service when possible so that larger areas are not affected. This service is especially important for water, electrical, and telephone service. Sanitary sewer service affected by landslides should be rerouted or controlled as soon as possible to prevent septic conditions in downgradient soils.

10.7 Summary of Recommended Mitigation Measures, Strategies, and Alternatives

The following recommendations are applicable to mitigating landslide occurrence in the VCOG municipalities:

All Municipalities

- Consider implementing regulations restricting construction on 15%, 20%, 25%, or greater slopes [the Ansonia POCD specifies 15% whereas the Derby and Seymour POCDs specify 25%] and restricting excavation and clearing activities above and below such slopes.
- Consider adopting or codifying some or all of the USDA guidelines in Section 10.1 to regulate development in areas of steep slopes.
- Consider preserving areas of steep slopes as protected open space through acquisition or modified zoning.

- Continue to encourage through streets over dead-end streets.
- Ensure that local utility providers are aware of landslide potential and have responder teams ready to repair damage to their utilities caused by landslides.
- Make education and outreach materials available at the Building and Engineering Departments regarding how to identify potential landslide areas.
- Consider expanding and oversizing drainage systems in the vicinity of steep slopes.
- Encourage private property owners to have their retaining walls inspected by a professional structural engineer.

Ansonia

- Provide support as needed to the owner of the wall along South Main Street, which is coming apart just north of Columbia Street.
- Consider landslide deterrence methods along the face of the Platt Street steep slope.

Derby

- If needed, provide support to the condominium complexes along Derby Avenue.
- When necessary, provide support to the property owners at Commodore Commons.
- Look to combat any future landslides by acting proactively and enforcing landslide preventive methods along the steep slopes near the base of Gilbert Street.

Seymour

- Pay close attention to the steep slope near the intersection of Cedar and Rose Streets, which has been the site of at least one historical landslide.

Shelton

- As necessary, provide support to the Riverdale Apartments on Shelton Avenue to decrease the chance of a future landslide event taking place.
- Monitor the slope below North Oak Avenue.

In addition, important recommendations that apply to all hazards are listed in Section 11.1.

11.0 RECOMMENDATIONS

11.1 Additional Recommendations

Recommendations that are applicable to critical facilities were presented in Section 2.11. Recommendations for mitigating specific hazards were discussed in the applicable subsections of Sections 3.0 through 10.0. A remaining class of recommendations is applicable to all hazards because it includes recommendations for improving public safety and planning for emergency response. Instead of repeating these recommendations in section after section of this plan, these are listed below.

- Obtain copies of the disaster planning guides and manuals from the "Are You Ready?" series (http://www.ready.gov/are-you-ready-guide) and make them available at the City and Town Halls and Community Centers.
- Disseminate additional informational pamphlets regarding natural hazards to public locations such as Community Centers, City and Town Halls, libraries, and the like.
- Develop a checklist for land development applicants that cross references regulations and codes related to disaster resilience.
- Require that utilities be placed underground in new developments.
- Pursue funding to place utilities underground in existing developments.
- Encourage residents to purchase and use NOAA weather radio with an alarm feature.

11.2 Summary of Specific Recommendations

As noted above, recommendations that are applicable to critical facilities were presented in Section 2.11 whereas recommendations for mitigating specific hazards were discussed in the applicable subsections of Sections 3.0 through 10.0. For completeness, all of these recommendations are provided below:

Critical Facilities and Evacuation

The following recommendations are suggested:

- Review and update the evacuation route maps for the VCOG municipalities at least once annually and consider posting them to the VCOG municipalities' websites.
- Acquire and install evacuation signs in SFHAs throughout the VCOG municipalities.
- Pursue funding and install generators at both Derby shelters (Derby Middle School and the Bradley School) and at the three fire stations that are currently designated by the city as temporary shelters.
- Following the installation of generators at the Derby shelters, certify them with the ARC.
- Pursue funding and install a generator at Shelton High School.
- Consider floodproofing measures for critical facilities located in designated flood zones:

- o Derby Police Station
- o Seymour Police Station
- o Citizens Engine No. 2 Fire House in Seymour
  ARMS facility at 22 West Main Street
- o Ansonia WPCA Sewage Pump Stations throughout Ansonia
- o Derby WTP at the south end of Factory Street
- o Derby WPCA Stormwater Pump Stations throughout Derby
- o Seymour Water Pollution Control facility at 723 Derby Avenue
- o Seymour Public Works facility at 721 Derby Avenue

❑ Develop site-specific evacuation plans for various critical facilities in designated flood zones that house vulnerable populations:
- o Julia Day Nursery and Kindergarten (Daycare) at 76 Central Street in Ansonia
- o John J. Stevens Apartments (Elderly) at 75 Central Street in Ansonia
- o Riverside Housing Complex (Multi-Lingual/Limited Transportation) at 36 Olsen Drive
- o Riverview Apartments (Disabled and Elderly) at 15 West Main Street
- o Capital Plaza (Disabled and Elderly) at 290 Main Street

❑ Develop an evacuation plan for residents at the end of Indian Well Road in Shelton who can be cut off by floodwaters from the Housatonic River.

❑ Develop an evacuation plan for residents in northern Shelton who can be cut off by floodwaters from the Housatonic River.

<u>Flooding</u>

<u>Prevention</u>

❑ Continue to regulate activities within SFHAs to the greatest extent possible using the municipal codes, Zoning Regulations, and Subdivision Regulations.

❑ Consider requiring new buildings in floodprone areas to be protected to the highest recorded flood level regardless of SFHA status.

❑ Ensure that new buildings be designed and graded to shunt drainage away from the building.

❑ Require developers to demonstrate whether detention or retention of stormwater is the best option for reducing peak flows downstream.

❑ Consider revising Section 195-112(C) of the Derby Zoning Regulations as this section explains that an applicant must be notified that flood insurance premiums will be higher than typical if permission is granted for construction of a structure below the base flood elevation. This implies that the Planning and Zoning Commission has the authority to permit such construction below the base flood elevation. Such actions are not advisable in the community.

❑ Ensure that redevelopment of O'Sullivan's Island in Derby is flood damage resistant.

❑ Ensure that redevelopment of the vacant RLP on River Road in Seymour is flood damage resistant.

Property Protection

- Provide technical assistance to owners of nonresidential structures that suffer flood damage regarding floodproofing measures such as wet and dry floodproofing.
- Pursue elevation of residential properties that suffer flood damage. Properties may be classified as repetitive loss or not classified as repetitive loss, but RLPs should be prioritized. The Maples and McConney Grove neighborhoods are a high priority for home elevations.

Natural Resource Protection

- Pursue acquisition/demolition of floodprone residential properties for open space. Properties may be classified as repetitive loss or not classified as repetitive loss, but RLPs should be prioritized.
- Pursue the acquisition of additional municipal open space in SFHAs.
- Selectively pursue conservation recommendations listed in the POCDs and other studies and documents.
- Strictly regulate or prohibit development in protected and sensitive areas, including steep slopes, wetlands, SFHAs, and other floodprone areas.

Public Education

- Consider enrolling each municipality in the CRS.
- Develop an annual outreach program to floodprone residential and commercial property owners. Provide technical information regarding structure elevation, dry and wet floodproofing, and other improvement techniques. Insurance information should also be provided.
- Ensure that EMDs, Building, Engineering, or Public Works personnel attend DEEP and other training workshops annually. FEMA-sponsored training seminars at the EMI in Emmitsburg, Maryland should be considered as well. All of these workshops are free of charge. Annual training sessions include emergency management, environmental reviews, the FEMA grant programs, the NFIP and CRS, and others related to the other hazards.

Structural Projects

- Develop a hydrologic and hydraulic model of the river systems in the VCOG region that have been subject to repeated flooding as a way to prioritize mitigation activities such as culvert and bridge upgrades, property acquisitions and elevations, and retention/detention. Examples include Means Brook/Farmill River and Bladens River.
- Upgrade the drainage network including piping and culverts along the unnamed tributary to Beaver Brook in the Prindle Avenue area of Ansonia to reduce flooding that has occurred.
- Upgrade the Wakelee Avenue (Route 334) drainage network in Ansonia as needed to reduce nuisance flooding.
- Review and upgrade/replace the drainage network associated with the unnamed stream in the Ells Street section of Ansonia to reduce flooding.

- Work with the Connecticut DOT to review the drainage network associated with Route 8 in the area to the east of Route 8 that becomes inundated after large-scale rain events in Ansonia and upgrade as needed to reduce the potential for private property damage.
- Consider using localized floodwalls or berms for the area of Olsen Drive in Ansonia that was almost flooded following Tropical Storm Irene in 2011. As an alternative, ensure that structures are flood damage resistant and that dry land access is made available if this area is redeveloped.
- Implement the drainage improvements for the Gilbert Street area in Derby to reduce the incidence and severity of flooding in the neighborhood. Acquire properties as needed to make these improvements.
- Work with the owners of detention basins along the tributary of Twomile Brook upstream of Sodom Lane to ensure that the basins are maintained for continued functionality.
- Upgrade and replace the culvert for the watercourse at Walnut Street in Seymour to the extent needed to reduce flooding.
- Consider drainage improvements or installation of a new drainage network to reduce flooding from the hillside along Roosevelt Drive (Route 34) in Seymour.
- Replace and upgrade, as needed, the drainage network associated with Bladens River in the Beach Street section of Seymour. Investigate opportunities to reduce the overbank conditions that also lead to flooding in this neighborhood.
- Replace and upgrade, as needed, the drainage network associated with Little River in the Bank Street section of Seymour. Investigate opportunities to reduce the overbank conditions that may also lead to flooding in this area.
- Upgrade or replace the Walnut Tree Hill Road culvert that conveys the Farmill River in Shelton to reduce flooding.
- Upgrade or replace the Long Hill Avenue stone masonry culvert in Shelton that conveys Burying Ground Brook to reduce flooding.
- Upgrade or replace the Brookwood Lane culvert in Shelton that conveys an unnamed watercourse to reduce flooding.
- Upgrade or replace the Oak Avenue drainage network that conveys unnamed watercourses to reduce nuisance flooding in Shelton.
- The culverts along Shelton Avenue (Route 108) in Shelton conveying Means Brook and Pole Brook are in need of hydraulic analyses, and the city should work with the Connecticut DOT to analyze and replace/upgrade them as needed.

<u>Wind Damage Related to Hurricanes, Summer Storms, Tornadoes, Winter Storms</u>

- Expand the current programs of placing utilities underground and look for opportunities to relocate utilities underground.
- Continue, improve, and/or implement tree limb inspections and maintenance and outreach to private property owners regarding branches above power lines.
- Increase funding for the Tree Wardens to address a wide range of tree limb hazards.
- Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards for wind and include such

literature on the municipality websites and in posts on the municipalities' social media platforms.

- Encourage the use of wind-mitigation structural techniques in new structures, especially critical facilities, to protect new buildings to a greater level than the required standard.

Winter Storms

- Conduct a study to identify municipal buildings, critical facilities, and commercial/industrial buildings that are vulnerable to roof damage or collapse due to heavy snow loads.
- Develop a plan to prioritize snow removal from the roof of municipal buildings (especially critical facilities) and make funding available for clearing.
- Retrofit or modify critical facilities as needed to strengthen roofs and structures and make them more resilient to snow loading.
- Consider posting the snow plowing routes in municipal buildings, the municipal websites, and on social media platforms.
- Identify areas that are difficult to access during winter storm events and develop contingency plans.
- Provide information for mitigating icing, insulating pipes, and retrofits for flat-roofed buildings.

Earthquakes and Landslides

- Consider preventing residential development in areas prone to collapse such as below steep slopes or in areas prone to liquefaction.
- Consider implementing regulations restricting construction on 15%, 20%, 25%, or greater slopes [the Ansonia POCD specifies 15% whereas the Derby and Seymour POCDs specify 25%] and restricting excavation and clearing activities above and below such slopes.
- Consider adopting or codifying some or all of the USDA guidelines to regulate development in areas of steep slopes.
- Consider preserving areas of steep slopes as protected open space through acquisition or modified zoning.
- Continue to require adherence to the state building codes.
- Continue to encourage through streets over dead-end streets.
- Ensure that local utility providers are aware of landslide potential and have responder teams ready to repair damage to their utilities caused by landslides.
- Make education and outreach materials available at the Building and Engineering Departments regarding how to identify potential landslide areas.
- Consider expanding and oversizing drainage systems in the vicinity of steep slopes.
- Encourage private property owners to have their retaining walls inspected by a professional structural engineer.
- Ensure that municipal departments and critical facilities have adequate backup facilities in case quake or landslide damage occurs to critical facilities.

- ❑ Work with the owner of the property with the granite block wall along South Main Street just to the north of Columbia Street in Ansonia to remove the large trees that have grown at the top of the wall and have rooted into the wall.
- ❑ Work with property owners of the Platt Street landslide site in Ansonia and conduct maintenance as necessary to limit future landslides.
- ❑ Work with the condominium owners at 233 Derby Avenue and the complex adjacent in Derby to perform maintenance as necessary to counter future landslides at the rear of the complexes.
- ❑ Provide support as necessary to the owners of Commodore Commons in Derby, which is reportedly moving downhill toward the Housatonic River.
- ❑ Look to combat any future landslides by acting proactively and enforcing landslide preventive methods along the steep slopes near the base of Gilbert Street.
- ❑ Conduct maintenance as necessary at the historical site of a landslide event at Cedar and Rose Streets in Seymour.
- ❑ As necessary, provide support to the Riverdale Apartments on Shelton Avenue to decrease the chance of a future landslide event taking place.
- ❑ Monitor the slope below North Oak Avenue in Shelton.

<u>Dam Failure</u>

- ❑ Include dam failure areas in the Reverse 911 and CodeRed emergency contact databases.
- ❑ Work with the RWA to develop a specific EOP and maintenance plan for Peat Swamp Reservoir Dam if none exists.
- ❑ Work with the CT DEEP to develop a specific EOP for the Quillinan Reservoir Dam.
- ❑ The City of Derby should develop an EOP and maintenance plan for the Upper and Lower Ansonia Reservoirs.
- ❑ Work with Beach Properties Ltd. to develop a specific EOP and maintenance plan for the Bladens River Dam in Seymour.
- ❑ Work with Kinneytown Hydro, Inc. to develop a specific EOP and maintenance plan for the Kinneytown Dam in Seymour.
- ❑ The Town of Seymour should develop a specific EOP and maintenance plan for the Sochrin Pond Dam.
- ❑ Work with John Fanotto et al. to develop an EOP and maintenance plan for Silver Lake Dam in Seymour and work to address increased runoff issues and any elevated sedimentation in Silver Lake.
- ❑ Locate and work with the owner of the Clarks Pond Dam in Seymour, Leonora Gaudreau, to develop an EOP and maintenance schedule for the dam.
- ❑ Locate and work with Thomas and Elaine Bombero, the owners of the Far Mill River Dam in Shelton, to develop an EOP and maintenance schedule for the dam.
- ❑ The City of Shelton should locate/develop/update an EOP for Shelton Reservoir Dam #2.

Wildfires

- Continue to support public outreach programs to increase awareness of forest fire danger, equipment usage, and protecting homes from wildfires.
- Ensure that provisions of Subdivision Regulations regarding fire protection facilities are being enforced.
- Enforce regulations and permits for open burning.
- Continue to require that utilities be installed underground.
- Pursue additional sources of fire-fighting water where adequate supplies do not exist.
- Continue to patrol city- and town-owned open space and parks to prevent campfires.
- Continue to utilize and promote intermunicipal cooperation in fire-fighting efforts.
- When wildfire threats are high, monitor the area in the northeastern section of the city of Ansonia for development of fires.
- Continue to pay close attention to Witek Park and Osbornedale State Park in Derby during busy use season and provide patrols as available/needed to limit fire setting by people.
- Continue to monitor Route 313 in the Little Laurel Lime Ridge Park area of Seymour and provide patrols/support as needed and available especially during the spring.
- Continue to monitor the Matthews property off South Main Street in Seymour, which has a history of brush fires.
- Continue to monitor the area near Nells Rock Road along Shelton Avenue in Shelton, which has had a history of wildfires.

11.3 Prioritization of Specific Recommendations

To prioritize recommended mitigation measures, it is necessary to determine how effective each measure will be in reducing or preventing damage. A set of criteria commonly used by public administration officials and planners was applied to each proposed strategy. The method, called STAPLEE, stands for the "Social, Technical, Administrative, Political, Legal, Economic and Environmental" criteria for making planning decisions. The following questions were asked about the proposed mitigation strategies:

- **Social**: Is the proposed strategy socially acceptable to the community? Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- **Technical**: Will the proposed strategy work? Will it create more problems than it will solve?
- **Administrative**: Can the community implement the strategy? Is there someone to coordinate and lead the effort?
- **Political**: Is the strategy politically acceptable? Is there public support both to implement and maintain the project?
- **Legal**: Is the community authorized to implement the proposed strategy? Is there a clear legal basis or precedent for this activity?

- **Economic**: What are the costs and benefits of this strategy? Does the cost seem reasonable for the size of the problem and the likely benefits?
- **Environmental**: How will the strategy impact the environment? Will the strategy need environmental regulatory approvals?

Each proposed mitigation strategy was evaluated and assigned a score based on the above criteria as described in Section 1.4. An evaluation matrix with the total scores from each strategy can be found in Appendix A. After each strategy was evaluated using the STAPLEE method, it was then possible to prioritize the strategies according to the final scores.

Theoretically, the highest scores would be determined to be of more importance economically, socially, environmentally, and politically and, hence, these recommendations would be prioritized over those with lower scores. However, the scoring system inherently favors recommendations that have no incremental costs, such as continuing to enforce regulations (which is accomplished by existing municipal personnel and commissions).

In consideration of the STAPLEE ranking results and the risks and vulnerabilities described in this plan, the following recommendations from each category were identified as the highest priority projects and/or policies:

General Recommendations

- Obtain copies of the disaster planning guides and manuals from the "Are You Ready?" series (http://www.ready.gov/are-you-ready-guide) and make them available at the City and Town Halls and Community Centers.
- Require that utilities be placed underground in new developments.
- Pursue funding to place utilities underground in existing developments.

Critical Facilities and Evacuation

- Pursue funding and install generators at both Derby shelters (Derby Middle School and the Bradley School) and at the three fire stations that are currently designated by the city as temporary shelters.
- Pursue funding and install a generator at Shelton High School.
- Consider floodproofing measures for critical facilities located in designated flood zones:
  - Derby Police Station
  - Seymour Police Station
  - Derby WTP at the south end of Factory Street
  - Seymour Water Pollution Control facility at 723 Derby Avenue
  - Seymour Public Works facility at 721 Derby Avenue
- Develop site-specific evacuation plans for various critical facilities in designated flood zones that house vulnerable populations:

- John J. Stevens Apartments (Elderly) at 75 Central Street in Ansonia
- Riverview Apartments (Disabled and Elderly) at 15 West Main Street
- Capital Plaza (Disabled and Elderly) at 290 Main Street

- Develop an evacuation plan for residents at the end of Indian Well Road in Shelton who can be cut off by floodwaters from the Housatonic River.

Flooding

- Continue to regulate activities within SFHAs to the greatest extent possible using the municipal codes, Zoning Regulations, and Subdivision Regulations.
- Ensure that redevelopment of O'Sullivan's Island in Derby is flood damage resistant.
- Ensure that redevelopment of the vacant RLP on River Road in Seymour is flood damage resistant.
- Pursue elevation of residential properties that suffer flood damage. Properties may be classified as repetitive loss or not classified as repetitive loss, but RLPs should be prioritized. The Maples and McConney Grove neighborhoods are a high priority for home elevations.
- Develop an annual outreach program to floodprone residential and commercial property owners. Provide technical information regarding structure elevation, dry and wet floodproofing, and other improvement techniques. Insurance information should also be provided.
- Upgrade the drainage network including piping and culverts along the unnamed tributary to Beaver Brook in the Prindle Avenue area of Ansonia to reduce flooding that has occurred.
- Implement the drainage improvements for the Gilbert Street area in Derby to reduce the incidence and severity of flooding in the neighborhood. Acquire properties as needed to make these improvements.
- Replace and upgrade, as needed, the drainage network associated with Bladens River in the Beach Street section of Seymour. Investigate opportunities to reduce the overbank conditions that also lead to flooding in this neighborhood.
- The culverts along Shelton Avenue (Route 108) in Shelton conveying Means Brook and Pole Brook are in need of hydraulic analyses, and the city should work with the Connecticut DOT to analyze and replace/upgrade them as needed.

Wind Damage Related to Hurricanes, Summer Storms, Tornadoes, Winter Storms

- Increase funding for the Tree Wardens to address a wide range of tree limb hazards.
- Encourage the use of wind-mitigation structural techniques in new structures, especially critical facilities, to protect new buildings to a greater level than the required standard.

Winter Storms

- Develop a plan to prioritize snow removal from the roof of municipal buildings (especially critical facilities) and make funding available for clearing.

- Retrofit or modify critical facilities as needed to strengthen roofs and structures and make them more resilient to snow loading.

Earthquakes and Landslides

- Consider preventing residential development in areas prone to collapse such as below steep slopes or in areas prone to liquefaction.
- Consider implementing regulations restricting construction on 15%, 20%, 25%, or greater slopes [the Ansonia POCD specifies 15% whereas the Derby and Seymour POCDs specify 25%] and restricting excavation and clearing activities above and below such slopes.
- Ensure that municipal departments and critical facilities have adequate backup facilities in case quake or landslide damage occurs to critical facilities.

Dam Failure

- Include dam failure areas in the Reverse 911 and CodeRed emergency contact databases.
- The City of Derby should develop an EOP and maintenance plan for the Upper and Lower Ansonia Reservoirs.
- The Town of Seymour should develop a specific EOP and maintenance plan for the Sochrin Pond Dam.
- The Town of Seymour should develop a specific EOP and maintenance plan for the Great Hill Reservoir Dam.

Wildfires

- Ensure that provisions of Subdivision Regulations regarding fire protection facilities are being enforced.
- Pursue additional sources of fire-fighting water where adequate supplies do not exist.
- Continue to patrol city- and town-owned open space and parks to prevent campfires.
- Continue to utilize and promote intermunicipal cooperation in fire-fighting efforts.

11.4 Sources of Funding

The following sources of funding and technical assistance may be available for the priority projects listed above. Funding requirements and contact information are provided in Section 12.0.

Beach Replenishment and Erosion Control

- U. S. Army Corps of Engineers – *funding for beach nourishment*
- U.S. Department of Agriculture – *technical assistance for erosion control*

- U.S. Fish and Wildlife National Coastal Wetlands Conservation Grant Program - *matching funds at the state level for projects that conserve, restore, and protect coastal wetlands. Nationally competitive.*
- 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.*

Flood Mitigation

- FEMA Flood Mitigation Assistance (FMA) Program – *grants for pre-disaster flood hazard mitigation planning and projects such as property acquisition, relocation of residents, and flood retrofitting*
- 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*

Hurricane Mitigation

- FEMA State Hurricane Program – *financial and technical assistance to local governments to support mitigation of hurricanes and coastal storms*
- FEMA Hurricane Program Property Protection – *grants to hurricane-prone states to implement hurricane mitigation projects*

Wildfire Mitigation

- Assistance to Firefighters Grant Program – *pre-disaster grants to organizations such as fire departments that are recognized for expertise in fire prevention and safety programs*

General Hazard Mitigation

- FEMA Hazard Mitigation Grant Program (HMGP) – *funding for hazard mitigation projects following a presidentially declared disaster*
- FEMA Pre-Disaster Mitigation Grant Program (PDM) – *funding for hazard mitigation projects on a nationally competitive basis*
- Massachusetts Land Acquisition & Conservation Program – *funding for open space acquisition*
- AmeriCorps – *teams may be available to assist with landscaping projects such as surveying, tree planting, restoration, construction, and environmental education.*

12.0 PLAN IMPLEMENTATION

12.1 Implementation Strategy and Schedule

The following boards are authorized to implement applicable portions of this HMP as needed working with the EMDs:

TABLE 12-1
Implementation Responsibilities

Community	Lead Agency	Emergency Management Director
Ansonia	Board of Aldermen	Kevin Hale
Derby	Board of Aldermen	Charles Sampson
Seymour	Board of Selectmen	Thomas Eighmie
Shelton	Board of Aldermen	John Millo

As individual recommendations of the HMP are implemented in each community, they must be implemented by the municipal commissions and departments that oversee these activities. The Boards of Aldermen and Selectmen, Emergency Management Agencies, Public Works Departments, Building and Engineering Departments, Planning and Zoning Commissions, and Fire Departments will primarily be responsible for implementing selected projects and studies. Appendix A incorporates an implementation strategy and schedule for each community, detailing the responsible department and anticipated time frame for the specific recommendations listed throughout this document.

Upon adoption, this HMP will be made available to applicable municipal departments and commissions as a planning tool to be used in conjunction with existing documents and regulations. It is expected that revisions to other municipal plans and regulations such as the POCD, department annual budgets, and Zoning and Subdivision Regulations may reference this plan and its updates. The EMDs and the Offices of the Mayor/First Selectman will be responsible for ensuring that the actions identified in this HMP are incorporated into ongoing municipal planning activities.

The Offices of the Mayor/First Selectman will be responsible for assigning appropriate municipal officials to update the POCD, Zoning Regulations, Subdivision Regulations, and EOP to include the provisions from this HMP if it is determined that such updates are appropriate. However, should a general revision be too cumbersome or cost prohibitive, simple addendums to these documents will be added that include the provisions of this HMP.

Each POCD is the single document that is most likely to benefit from the inclusion of the HMP in the community's library of planning documents. When each POCD is updated, elements of this HMP will be incorporated. The EMDs and the Offices of the

Mayor/Selectman will be responsible for the transfer of mitigation-related goals and recommendations to the next edition of the POCD.

Finally, information and projects in this HMP will be included in the annual budget and capital improvement plans as part of implementing the projects recommended herein. This will primarily include the annual budget and capital improvement projects lists maintained and updated by the Public Works Departments and the Offices of Emergency Management.

12.2 Progress Monitoring and Public Participation

The EMDs and the Offices of the Mayor/First Selectman will be the parties responsible for monitoring the successful implementation of the plan as part of their oversight of all municipal departments. Participants in this review may include but need not be limited to representatives of the departments listed in Section 12.1.

Site Reconnaissance for Specific Recommendations – The EMDs or their agents will annually perform reconnaissance-level inspections of sites that are subject to specific recommendations between April 1 and November 1 each year. This will ensure that these recommendations remain viable and appropriate. Examples include home acquisitions or elevations and structural projects such as culvert replacements. The worksheet in Appendix I will be filled out for specific project-related recommendations. This worksheet is taken from the FEMA 386 series.

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

The RLPs shall be subject to a windshield survey at least once every two years to ensure that the list (available from the state) is reasonably accurate relative to addresses and other basic information.

RLPs to be viewed biennially

Annual Reporting and Meeting – Matters to be reviewed on an annual basis will include the goals and objectives of the HMP, hazards or disasters that occurred during the preceding year (for example, the recent damage from Tropical Storm Irene and Winter Storm Alfred), mitigation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and recommendations for new projects and revised activities. The annual meeting shall be conducted in July or August each year, at least two months before the annual application cycle for pre-disaster grants under the HMA programs[1]. This will enable a list of possible projects to be circulated for municipal departments to review, with sufficient time for developing applications. The EMDs and the Offices of the Mayor/First Selectman (or their designees) shall jointly prepare a report based on the

Annual meeting to be conducted in July or August each year

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

review of recent events and ongoing or recent mitigation activities for review at this annual meeting. Results of the site reconnaissance efforts will be reviewed as well.

<u>*Post-Disaster Reporting and Meeting*</u> – Subsequent to federally declared disasters in the state of Connecticut and within two months, a meeting shall be conducted to develop a list of possible projects for developing an HMGP application. The EMDs and the Offices of the Mayor/First Selectman (or their designees) shall jointly prepare a report based on the review of recent events and ongoing or recent mitigation activities for review at the HMGP meeting. Public outreach shall be solicited for HMGP applications at a separate meeting.

Meeting to be conducted within two months of each federal disaster declaration in Connecticut

<u>*Continued Public Involvement*</u> – Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the HMP. Public input will be solicited through community meetings, presentations on local cable access channels, input to web-based information-gathering tools, and articles in the *Huntington Herald*, the *Valley Times*, the *Valley Sentinel*, and the *Shelton Patch*. Direct input from the homeowners of the Maples and McConnney's Grove neighborhoods is anticipated to continue each year as well.

The EMDs and the Offices of the Mayor/First Selectman will continue to provide the linkage to other municipal departments throughout the plan monitoring and evaluations each year relative to communication and participation.

12.3 <u>Updating the Plan</u>

The EMDs and the Offices of the Mayor/First Selectman will update this plan at least once every five years or sooner if a consensus to do so is reached by the EMDs and the Offices of the Mayor/First Selectman. To update the plan, the EMDs will work with many of the same departments solicited for input to this plan. In addition, local business leaders, community and neighborhood group leaders, relevant private and nonprofit interest groups, and the neighboring municipalities will be solicited for representation.

To update the plan, the project recommendation worksheets (Appendix I) and annual reports described above will be reviewed. In addition, the following questions will be discussed and answered by the EMDs:

- ❑ Do the mitigation goals and objectives still reflect the concerns of residents, business owners, and officials?
- ❑ Have conditions in the community 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? For example, revised DFIRMs could be released in the future.
- ❑ If risks and vulnerabilities have changed, do the mitigation goals and objectives still reflect the risk assessment?

- What hazards have caused damage in the community since the last edition of the plan was developed? Were these anticipated and evaluated in the plan, or should these hazards be added to the plan?
- Are current personnel and financial resources of the community 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 recommendations 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?

Updates may include deleting recommendations as projects are completed, adding recommendations as new hazard effects arise, or modifying hazard vulnerabilities as land use changes. In addition, the lists of shelters and critical facilities should be updated as necessary or at least every five years.

12.4 Technical and Financial Resources

This section is comprised of a list of resources to be considered for technical assistance and potential 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 predisaster and postdisaster environments. The **Risk Insurance Branch** mitigates flood losses by providing affordable flood insurance for property owners and by encouraging communities to adopt and enforce floodplain management regulations.

FEMA programs administered by the Risk Analysis Branch include:

- *Flood Hazard Mapping Program*, which maintains and updates National Flood Insurance Program maps
- *National Dam Safety Program*, which provides state assistance funds, research, and training in dam safety procedures
- *National Hurricane Program*, which conducts and supports projects and activities that help protect communities from hurricane hazards
- *Mitigation Planning*, a process for states and communities to identify policies, activities, and tools that can reduce or eliminate long-term risk to life and property from a hazard event

FEMA programs administered by the Risk Reduction Branch include:

- *Hazard Mitigation Grant Program (HMGP)*, which provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration
- *Flood Mitigation Assistance Program (FMA)*, which provides funds to assist states and communities to implement measures that reduce or eliminate long-term risk of flood damage to structures insurable under the National Flood Insurance Program
- *Pre-Disaster Mitigation Grant Program (PDM)*, which provides program funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event
- *Severe Repetitive Loss Program (SRL)*, which provides funding to reduce or eliminate the long-term risk of flood damage to "severe repetitive loss" structures insured under the National Flood Insurance Program
- *Community Rating System (CRS)*, a voluntary incentive program under the National Flood Insurance Program that recognizes and encourages community floodplain management activities
- *National Earthquake Hazards Reduction Program (NEHRP)*, which in conjunction with state and regional organizations supports state and local programs designed to protect citizens from earthquake hazard

The Risk Insurance Branch oversees the *National Flood Insurance Program (NFIP)*, which enables property owners in participating communities to purchase flood insurance. The NFIP assists communities in complying with the requirements of the program and publishes flood hazard maps and flood insurance studies to determine areas of risk.

FEMA also can provide information on past and current acquisition, relocation, and retrofitting programs and has expertise in many natural and technological hazards. FEMA also provides funding for training state and local officials at the EMI in Emmitsburg, Maryland.

The Mitigation Directorate also has in place several *Technical Assistance Contracts (TAC)* that support FEMA, states, territories, and local governments with activities to enhance the effectiveness of natural hazard reduction program efforts. The TACs support FEMA's responsibilities and legislative authorities for implementing the earthquake, hurricane, dam safety, and floodplain management programs. The range of technical assistance services provided through the TACs varies based on the needs of the eligible contract users and the natural hazard programs. Contracts and services include:

- *The Hazard Mitigation Technical Assistance Program (HMTAP) Contract* – supporting postdisaster program needs in cases of large, unusual, or complex projects; situations where resources are not available; or where outside technical assistance is determined to be needed. Services include environmental and biological assessments, benefit/cost analyses, historic preservation assessments, hazard identification, community planning, training, and more.

- *The Wind and Water Technical Assistance Contract (WAWTAC)* – supporting wind and flood hazards reduction program needs. Projects include recommending mitigation measures to reduce potential losses to post-FIRM structures, providing mitigation policy and practices expertise to states, incorporating mitigation into local hurricane program outreach materials, developing a Hurricane Mitigation and Recovery exercise, and assessing the hazard vulnerability of a hospital.

- *The National Earthquake Technical Assistance Contract (NETAC)* – supporting earthquake program needs. Projects include economic impact analyses of various earthquakes, vulnerability analyses of hospitals and schools, identification of and training on nonstructural mitigation measures, and evaluating the performance of seismically rehabilitated structures postearthquake.

<u>Response & Recovery Division</u>

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. This includes the Public Assistance Grant Program (PA), which provides 75% grants for mitigation projects to protect eligible damaged public and private nonprofit 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.

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

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

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

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

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

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

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

- *Capitalization Grants for State Revolving Funds*: Low-interest loans to governments to repair, replace, or relocate wastewater treatment plants 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, Bureau of Water Management, Planning and Standards Division.

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 CDBG. 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 and 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 postflood 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% federally funded up to $100,000, with additional costs shared equally. Costs for preparation of plans and construction are funded 65% with a 35% non-federal match. In certain cases, the non-federal share for construction could be as high as 50%. The maximum federal expenditure for any project is $7 million.

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

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

- *Section 208 – Clearing and Snagging Projects:* This section of the 1954 Flood Control Act authorizes the Corps to perform channel clearing and excavation with limited embankment construction to reduce nuisance flood damages caused by debris and minor shoaling of rivers.

Cost sharing is similar to Section 205 projects above. The maximum federal expenditure for any project is $500,000.

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

In addition, the Corps also provides emergency flood assistance (under Public Law 84-99) after local and state funding have been used. This assistance can be used for both flood response and postflood 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 Boulevard
Taunton, MA 02780
(508) 824-5116
http://www.nws.noaa.gov/

The National Weather Service prepares and issues flood, severe weather, and coastal storm warnings. Staff hydrologists can work with communities on flood warning issues and can give technical assistance in preparing flood warning plans.

U.S. Department of the Interior
National Park Service
Steve Golden, Program Leader
Rivers, Trails, & Conservation Assistance
15 State Street
Boston, MA 02109
(617) 223-5123
http://www.nps.gov/rtca/

The National Park Service provides technical assistance to community groups and local, state, and federal government agencies to conserve rivers, preserve open space, and develop trails and greenways as well as identify nonstructural options for floodplain development.

U.S. Fish and Wildlife Service
New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
(603) 223-2541
http://www.fws.gov/

The U.S. Fish and Wildlife Service provides technical and financial assistance to restore wetlands and riparian habitats through the North American Wetland Conservation Fund and Partners for Wildlife programs. It also administers the *North American Wetlands Conservation Act Grants Program*, which provides matching grants to organizations and individuals who have developed partnerships to carry out wetlands projects in the United States, Canada, and Mexico. Funds are available for projects focusing on protecting, restoring, and/or enhancing critical habitat.

U.S. Department of Agriculture
Natural Resources Conservation Service (formerly Soil 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 Economic and Community Development
505 Hudson Street
Hartford, CT 06106-7106
(860) 270-8000
http://www.ct.gov/ecd/

The Connecticut Department of Economic and Community Development administers HUD's state CDBG Program, awarding smaller communities and rural areas grants for use in revitalizing neighborhoods, expanding affordable housing and economic opportunities, and improving community facilities and services.

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

The Connecticut DEEP provides technical assistance to subapplicants for planning efforts and HMA projects. The department includes several divisions with various functions related to hazard mitigation:

Bureau of Water Management, Inland Water Resources Division - This division is generally responsible for flood hazard mitigation in Connecticut, including administration of the NFIP. Other programs within the division include:

- *National Flood Insurance Program State Coordinator*: Provides flood insurance and floodplain management technical assistance, floodplain management ordinance review, substantial damage/improvement requirements, community assistance visits, and other general flood hazard mitigation planning including the delineation of floodways.

- *State Hazard Mitigation Officer (shared role with the Department of Emergency Management and Homeland Security)*: Hazard mitigation planning and policy; oversight of administration of the Hazard Mitigation Grant Program, Flood Mitigation Assistance Program, and Pre-Disaster Mitigation Program. Has the responsibility of making certain that the State Natural Hazard Mitigation Plan is updated every three years.

- *Flood Warning and Forecasting Service*: Prepares and issues flood, severe weather, and coastal storm warnings. Staff engineers and forecaster can work with communities on flood warning issues and can give technical assistance in preparing flood warning plans. This service has helped the public respond much faster in flooding condition.

- *Flood & Erosion Control Board Program*: Provides assistance to municipalities to solve flooding, beach erosion, and dam repair problems. Has the power to construct and repair flood and erosion management systems. Certain nonstructural measures that mitigate flood damages are also eligible. Funding is provided to communities that apply for assistance through a Flood & Erosion Control Board on a noncompetitive basis.

- *Stream Channel Encroachment Line Program*: Similar to the NFIP, this state regulatory program places restrictions on the development of floodplains along certain major rivers. This program draws in environmental concerns in addition to public safety issues when permitting projects.

- *Inland Wetlands and Watercourses Management Program*: Provides training, technical assistance, and planning assistance to local Inland Wetlands Commissions; reviews and approves municipal regulations for localities. Also controls flood management and natural disaster mitigations.

- *Dam Safety Program*: Charged with the responsibility for administration and enforcement of Connecticut's dam safety laws. Regulates the operation and maintenance of dams in the state. Permits the construction, repair, or alteration of dams, dikes, or similar structures and maintains a registration database of all known dams statewide. This program also operates a statewide inspection program.

- *Rivers Restoration Grant Program*: Administers funding and grants under the Clean Water Act involving river restoration and reviews and provides assistance with such projects.

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

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

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

EMHS is the lead division responsible for emergency management. Specifically, responsibilities include emergency preparedness, response and recovery, mitigation, and an extensive training program. EMHS is the state point of contact for most FEMA grant and assistance programs. EMHS administers the earthquake and hurricane programs described above under the FEMA resource section. Additionally, EMHS operates a mitigation program to coordinate mitigation throughout the state with other government agencies. Additionally, the agency is available to provide technical assistance to subapplicants during the planning process.

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

Office of the State Building Inspector **-** The Office of the State Building Inspector is responsible for administering and enforcing the Connecticut State Building Code and is also responsible for the municipal Building Inspector Training Program.

Connecticut Department of Transportation
2800 Berlin Turnpike
Newington, CT 06131-7546
(860) 594-2000
http://www.ct.gov/dot/

The Department of Transportation administers the federal Intermodal Surface Transportation Efficiency Act (ISTEA) that includes grants for projects that promote alternative or improved methods of transportation. Funding through grants can often be used for projects with mitigation benefits such as preservation of open space in the form of bicycling and walking trails. Connecticut DOT is also involved in traffic improvements and bridge repairs that could be mitigation related.

Private and Other Resources

Association of State Dam Safety Officials
450 Old Vine Street
Lexington, KY 40507
(859) 257-5140
http://www.damsafety.org

ASDSO is a nonprofit organization of state and federal dam safety regulators, dam owners/operators, dam designers, manufacturers/suppliers, academia, contractors, and others interested in dam safety. Their mission is to advance and improve the safety of dams by supporting the dam safety community and state dam safety programs, raising awareness, facilitating cooperation, providing a forum for the exchange of information, representing dam safety interests before governments, providing outreach programs, and creating a 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 with a membership of over 1,000 that assists communities with the NFIP. ASFPM has developed a series of technical and topical research papers and a series of Proceedings from their annual conferences. Many "mitigation success stories" have been documented through these resources and provide a good starting point for planning.

Institute for Business & Home Safety
4775 East Fowler Avenue
Tampa, FL 33617
(813) 286-3400
http://www.ibhs.org/

A nonprofit organization put together by the insurance industry to research ways of reducing the social and economic impacts of natural hazards. The institute advocates the development and implementation of building codes and standards nationwide and may be a good source of model code language.

Multidisciplinary Center for Earthquake Engineering and Research (MCEER)
University at Buffalo
State University of New York
Red Jacket Quadrangle
Buffalo, NY 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 that 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 EMDs 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 ASFMP for floodplain management publications. The Natural Hazards Center is located at the University of Colorado in Boulder. Staff can use key words to identify useful publications from the more than 900 documents in the library.

New England Flood and Stormwater Managers Association, Inc. (NEFSMA)
c/o MA DEM
100 Cambridge Street
Boston, MA 02202

NEFSMA is a nonprofit organization made up of state agency staff, local officials, private consultants, and citizens from across New England. NEFSMA sponsors seminars and workshops and publishes the *NEFSMA News* three times per year to bring the latest flood and stormwater management information from around the region to its members.

***Volunteer Organizations* -** Volunteer organizations including the ARC, 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 MATRICES

Applicable Community	Strategies for the Valley Council of Governments (VCOG) Communities	Associated Report Sections: Inland Flooding	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Landslides	Earthquakes	Dam Failure	Wildfires	Category (1. Prevention; 2. Property Protection; 3. Natural Resource Prot.; 4. Structural Projects; 5. Public Information; 6. Emergency Services)	Responsible Department[1]	Schedule (A. Ongoing; B. 2012-2017; C. 2017-2022; D. 2022 onward)	Cost (Low = Minimal[2]; Intermediate = <$100,000; High = >$100,000)	Federal Funding Potential (NA, Unlikely, Possible, or Likely with Grant Program listed)	Weighted STAPLEE Criteria – Benefits: Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	Costs: Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	Total STAPLEE Score
	ALL HAZARDS FOR VCOG MUNICIPALITIES																														
	General Recommendations																														
All	Obtain copies of the disaster planning guides and manuals from the "Are You Ready?" series and make them available at the City and Town Halls	x	x	x	x	x	x	x	x	5	EMD	B	Low	NA	1							**1**								**0**	***1***
All	Disseminate informational pamphlets regarding natural hazards to public locations	x	x	x	x	x	x	x	x	5	EMD	B	Low	NA	1							**1**								**0**	***1***
All	Develop checklists for permittees that cross-references regulations and codes related to disaster resilience	x	x	x	x	x	x	x	x	1, 2	PZC, B&E, EMD	B	Low	NA		1	1			1	1	**6**			-1	-1				**-2**	***4***
All	Require that utilities be placed underground in new developments	x	x	x	x			x	x	1	PZC	A	Low	NA		1	1				1	**4**								**0**	***4***
All	Pursue funding to place utilities underground in existing developments	x	x	x	x			x	x	1	BOS/BOA	C, D	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
All	Encourage residents to purchase and use NOAA weather radio with an alarm feature	x	x	x	x			x		5	EMD	B	Low	NA	1							**1**								**0**	***1***
All	Review and update evacuation route maps at least annually	x	x	x	x	x	x	x	x	6	EMD	A	Low	NA	1	1						**3**			-1					**-1**	***2***
All	Install evacuation signs in SFHAs	x	x	x				x		6	EMD	B	Intermediate	Unlikely	1	1	1					**4**						-1		**-2**	***2***
	Specific Recommendations for Critical Facilities																														
Ansonia	Consider establishing a back-up EOC as the ARMS building at 22 West Main Street is in the floodplain	x	x	x	x	x	x	x	x	1, 6	EMD	C	Intermediate	Possible - HMA	1		1	1				**3**						-1		**-2**	***1***
Ansonia	Consider floodproofing measures for sewer pumping stations in SFHAs	x	x	x				x		2	PW	C, D	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
Ansonia	Develop a site-specific evacuation plan for Riverside Housing Complex	x	x	x						6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Ansonia	Develop a site-specific evacuation plan for John J. Stephens Apartments at 75 Central Street	x	x	x						6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Ansonia	Develop a site-specific evacuation plan for Riverview Apartments	x	x	x						6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Ansonia	Develop a site-specific evacuation plan for Capital Plaza at 290 Main Street	x	x	x						6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Ansonia	Develop a site-specific evacuation plan for Julia Day Nursery & Kindergarten	x	x	x						6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Derby	Consider floodproofing measures at the Derby WWTP on Factory Street	x	x	x				x		2	PW	C	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
Derby	Consider floodproofing measures at the Derby Police Station	x	x	x				x		2, 6	EMD, PD	C	High	Possible - HMA		1	1			1		**5**						-1		**-2**	***3***
Derby	Consider floodproofing measures for sewer pumping stations in SFHAs	x	x	x				x		2	PW	C, D	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
Derby	Purchase and install a generator for Derby Middle School (one of the two sheltors) at 10 Nutmeg Avenue	x	x	x	x	x	x	x	x	6	EMD	B	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Derby	Purchase and install a generator for Bradley School (one of the two shelters) at 155 David Humphrey Road	x	x	x	x	x	x	x	x	6	EMD	B	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Derby	Consider purchasing and installing a generator at Storm Engine Company No. 2 (temporary shelter) at 151 Olivia Street	x	x	x	x	x	x	x	x	6	EMD	C	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Derby	Consider purchasing and installing a generator at East End Hose Company No. 3 (temporary shelter) on Derby-Milford Road	x	x	x	x	x	x	x	x	6	EMD	C	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Derby	Consider purchasing and installing a generator at Paugassett Hook & Ladder Company No. 4 (temporary shelter) at 57 Derby Avenue	x	x	x	x	x	x	x	x	6	EMD	C	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Derby	Pursue ARC certification of Derby shelters	x	x	x	x	x	x	x	x	6	EMD	B	Low	NA	1		1		1	1		**5**								**0**	***5***
Seymour	Consider floodproofing measures at the Police Department at 11 Franklin Street	x	x	x						2, 6	EMD, PD	C	High	Possible - HMA		1	1			1		**5**						-1		**-2**	***3***
Seymour	Consider floodproofing measures at Citizens Engine No. 2 at 26 DeForest Street	x	x	x						2, 6	EMD	C	High	Possible - HMA		1	1			1		**5**						-1		**-2**	***3***
Seymour	Consider floodproofing measures at the Public Works Department at 721 Derby Avenue	x	x	x						2, 6	EMD, PW	C	High	Possible - HMA		1	1			1		**5**						-1		**-2**	***3***
Seymour	Consider floodproofing measures at the WPCF at 723 Derby Avenue	x	x	x						2, 6	EMD, PW	C	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
Shelton	Consider floodproofing measures at the WPCF at 10 Riverdale Avenue	x	x	x				x		2	EMD, PW	C	High	Possible - HMA		1	1			1	1	**6**						-1		**-2**	***4***
Shelton	Install an emergency generator for Public Works Garage at 41 Myrtle Street	x	x	x	x	x	x	x	x	6	EMD, PW	B	High	Unlikely	1	1	1			1		**6**						-1		**-2**	***4***
Shelton	Install an emergency generator for Shelton High School	x	x	x	x	x	x	x	x	6	EMD	B	High	Unlikely	1	1	1					**4**						-1		**-2**	***2***
Shelton	Develop an evacuation plan for residents of Indian Well Road that can be isolated during flooding	x	x	x				x		6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
Shelton	Develop an evacuation plan for residents of northern Shelton that can be isolated during flooding	x	x	x				x		6	EMD	B	Low	NA	1		1	1				**3**			-1					**-1**	***2***
	FLOODING																														
	Prevention																														
All	Continue to regulate activities within SFHAs to the greatest extent possible with the municipal codes and Zoning and Subdivision Regulations	x	x	x				x		1	PZC, B&E	A	Low	NA	1	1	1			1	1	**7**				-1				**-1**	***6***
All	Consider requiring new buildings in floodprone areas to be protected to the highest recorded flood level regardless of SFHA status	x	x	x				x		1, 2	PZC, B&E	B	Low	NA	1	1	1			1	1	**7**			-1	-1	-1			**-3**	***4***
All	Ensure that new buildings be designed and graded to shunt drainage away from the building	x	x	x				x		1, 2	PZC, B&E	B	Low	NA		1	1			1		**5**					-1			**-1**	***4***
All	Require developers to demonstrate whether detention or retention of storm water is the best option for reducing peak flows downstream	x	x	x				x		1, 4	PZC, B&E	B	Low	NA		1	1				1	**4**			-1	-1				**-2**	***2***
Derby	Consider revising the section of the Derby Zoning Regulations that implies that structures can be built below flood elevation (195-112(C))	x	x	x				x		1, 2	PZC	B	Low	NA	1	1	1					**4**				-1				**-1**	***3***
Derby	Ensure that redevelopment of O'Sullivan's Island in Derby is flood damage resistant	x	x	x				x		1, 2	PZC, B&E	B, C	Low	NA		1	1			1	1	**6**			-1						***6***
Seymour	Ensure that redevelopment of the vacant RLP on River Road in Seymour is flood damage resistant	x	x	x				x		1, 2	PZC, B&E	B, C	Low	NA		1	1			1	1	**6**			-1						***6***
	Property Protection for Repetitive Loss Properties and Severe Repetitive Loss Properties																														
All	Provide technical assistance to owners of non-residential structures regarding floodproofing measures such as wet and dry floodproofing	x	x	x				x		2	EMD, B&E	B, C	Low	NA		1				1		**4**			-1					**-1**	***3***
All	Pursue elevation of residential structures that suffer flood damage; RLPs should be prioritized.	x	x	x				x		2	EMD, BOS/BOA	B, C	High	Possible - HMA	1	1	1			1		**6**						-1		**-2**	***4***
	Public Education																														
All	Consider enrolling in the Community Rating System	x	x	x				x		5	EMD, B&E	B	Low	NFIP insurance benefits only	1	1		1				**4**			-1					**-1**	***3***
All	Provide outreach regarding structure elevation, flood barriers, dry and wet floodproofing, and other improvement techniques	x	x	x				x		5	EMD, B&E	B	High	NA		1						**2**			-1					**-1**	***1***
All	Ensure that EMDs and other personnel attend DEEP and other training workshops such as the FEMA-sponsored training at EMI in Maryland	x	x	x	x	x	x	x	x	5	EMD, B&E	A	Low	NA		1	1					**3**									***3***
	Natural Resource Protection																														
All	Pursue acquisition/demolition of residential structures that suffer flood damage; RLPs should be prioritized.	x	x	x				x		2	EMD, BOS/BOA	B, C	High	Possible - HMA		1	1				1	**4**						-1		**-2**	***2***
All	Pursue the acquisition of additional municipal open space in SFHAs	x	x	x				x		3	BOS/BOA	B, C, D	High	NA	1	1	1				1	**5**						-1		**-2**	***3***
All	Selectively pursue conservation recommendations listed in the Plan of Conservation and Development and other studies and documents	x	x	x				x		3	BOS/BOA	B, C, D	High	NA	1	1	1				1	**5**						-1		**-2**	***3***
All	Continue to regulate development in protected and sensitive areas, including steep slopes, wetlands, and floodplains	x	x	x			x	x		3	PZC	A	High	NA	1	1	1				1	**5**				-1				**-1**	***4***
	Structural Projects																														
All	Develop a hydraulic/hydrologic model of floodprone river systems to prioritize mitigation such as bridge and culvert replacement, property acquisitions, etc.	x	x	x				x		4	EMD, PW	C	High	NA	1	1		1			1	**5**								**0**	***5***
Ansonia	Upgrade the Wakelee Avenue (Route 334) area drainage network to reduce flooding	x	x	x				x		4	PW, CT DOT	C	High	Possible - HMA	1	1		1				**4**						-1		**-2**	***2***
Ansonia	Upgrade and replace drainage along Prindle Avenue which carries a tributary to Beaver Brook which causes home flooding	x	x	x				x		4	PW	B	High	Possible - HMA	1	1		1		1	1	**7**						-1		**-2**	***5***
Ansonia	Upgrade/replace the drainage network associated with the unnamed stream in the Ells Street area to reduce flooding	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1		1	1	**7**						-1		**-2**	***5***
Ansonia	Work with CT DOT to review drainage east of Route 8 where flooding occurs after rain events, and upgrade as needed to reduce potential for property damage	x	x	x				x		4	PW, CT DOT	D	High	Possible - HMA	1	1		1				**4**						-1		**-2**	***2***
Ansonia	Pursue drainage/culvert improvements at Kielys Lane to reduce nuisance flooding	x	x	x				x		4	PW	B	High	Possible - HMA	1	1		1		1		**6**						-1	-1	**-3**	***3***
Ansonia	Consider localized flood walls or berms for the Olsen Drive area; or ensure that structures are flood damage resistant with dry land access available	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1		1		**6**						-1		**-2**	***4***
Derby	Implement the drainage improvements to the Gilbert Street area to reduce flooding; acquire properties as needed to facilitate	x	x	x				x		4	PW	B	High	Possible - HMA	1	1		1		1		**6**						-1		**-2**	***4***

Applicable Community	Strategies for the Valley Council of Governments (VCOG) Communities	Associated Report Sections								Category 1. Prevention 2. Property Protection 3. Natural Resource Prot. 4. Structural Projects 5. Public Information 6. Emergency Services	Responsible Department[1]	Schedule A. Ongoing B. 2012-2017 C. 2017-2022 D. 2022 onward	Cost Low = Minimal[2] Intermediate = <$100,000 High = >$100,000	Federal Funding Potential (NA, Unlikely, Possible, or Likely with Grant Program listed)	Weighted STAPLEE Criteria: Benefits								Weighted STAPLEE Criteria: Costs								Total STAPLEE Score
		Inland Flooding	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Landslides	Earthquakes	Dam Failure	Wildfires						Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	STAPLEE Subtotal	
Derby	Work with owners of ret. ponds along Twomile Brook trib. that are causing nuisance flooding in the O'Sullivan Rd/Sodom Ln area to ensure they are maintained	x	x	x				x		4	PW	B	High	NA	1	1		1		1	1	**7**						-1		**-2**	*5*
Seymour	Improve drainage or install new drainage system to reduce flooding from hillside along Route 34	x	x	x				x		4	PW, CT DOT	C	High	Possible - HMA	1	1		1				**4**						-1		**-2**	*2*
Seymour	Upgrade or replace the culvert near Walnut Street to reduce flooding	x	x	x				x		4	PW	B	High	Possible - HMA	1	1		1		1	1	**7**						-1		**-2**	*5*
Seymour	Replace/upgrade drainage associated with Bladens River near Beach Street; pursue opportunities to reduce overbank flooding	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1		1		**6**						-1		**-2**	*4*
Seymour	Replace/upgrade drainage associated with Little River near Bank Street; pursue opportunities to reduce overbank flooding	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1		1		**6**						-1		**-2**	*4*
Shelton	Upgrade Walnut Tree Hill culvert to reduce flooding along the Farmill River	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1		1	1	**7**						-1		**-2**	*5*
Shelton	Upgrade the Long Hill Avenue stone masonry arch culvert conveying Burying Ground Brook to reduce flooding	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1			1	**5**						-1		**-2**	*3*
Shelton	Upgrade and replace the Brookwood Lane culvert to reduce flooding	x	x	x				x		4	PW	C	High	Possible - HMA	1	1		1			1	**5**						-1		**-2**	*3*
Shelton	Upgrade and replace the Oak Avenue drainage system to reduce nuisance flooding	x	x	x				x		4	PW	B	High	Possible - HMA	1	1		1			1	**5**						-1		**-2**	*3*
Shelton	Work with CT DOT to assess and replace culverts along Shelton Avenue (Route 108) conveying Means Brook and Pole Brook if needed	x	x	x				x		4	PW, CT DOT	D	High	Possible - HMA	1	1		1			1	**5**						-1		**-2**	*3*
	WIND DAMAGE RELATED TO HURRICANES, SUMMER STORMS, AND WINTER STORMS																														
All	Continue tree limb inspections and maintenance and outreach to private property owners regarding branches above powerlines		x	x	x					1	TW	A	Low	NA	1	1	1	1		1	1	**8**						-1		**-2**	*6*
All	Increase funding for the Tree Warden to address a wider range of tree limb hazards than the current budget allows		x	x	x					1	TW, BOS/BOA	B	Intermediate	NA	1	1	1	1		1	1	**8**						-1		**-2**	*6*
All	Provide for the Building Department to make literature available during the permitting process regarding appropriate design standards for wind		x	x	x					2	B&E	B	Low	NA	1	1					1	**4**								**0**	*4*
All	Encourage the use of wind-mitigation structural techniques in new structures to protect new buildings to a greater level than the required standard		x	x	x					2	B&E	B	Intermediate	NA	1	1	1			1		**6**						-1		**-2**	*4*
	WINTER STORMS																														
All	Conduct a study to identify municipal buildings, critical facilities, and commercial/industrial buildings that are vulnerable to roof damage or collapse				x					2	PW, B&E	B	Intermediate	NA	1	1	1					**4**			-1					**-1**	*3*
All	Develop a plan to prioritize snow removal from the roof of municipal buildings (especially critical facilities) and have funding available for clearing				x					2	PW, B&E	B	Intermediate	NA	1	1	1					**4**			-1					**-1**	*3*
All	Retrofit or modify critical facilities as needed to strengthen roofs and structures and make them more resilient to snow loading				x					2	PW, B&E	C	Intermediate	NA	1	1	1					**4**						-1		**-2**	*2*
All	Consider posting the snow plowing routes in municipal buildings and the municipal web sites				x					5	PW	B	Low	NA	1							**1**					-1			**-1**	*0*
All	Identify areas that are difficult to access during winter storm events and develop contingency plans				x					6	PW	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
All	Provide information for mitigating icing, insulating pipes, and retrofits for flat roofed buildings				x					5	PW, B&E	B	Low	NA	1							**1**								**0**	*1*
	EARTHQUAKES AND LANDSLIDES																														
All	Consider preventing residential development in areas prone to collapse such as below steep slopes, or in areas prone to liquefaction					x	x			1	PZC	B	Low	NA	1	1					1	**4**			-1	-1				**-2**	*2*
All	Consider restricting construction on 15%, 20%, or 25% slopes* and restricting excavation and clearing above and below such slopes					x	x			1	PZC	B	Low	NA	1	1					1	**4**			-1	-1				**-2**	*2*
All	Consider adopting or codifying USDS guidelines to regulate development in areas of steep slopes					x	x			1	PZC	B	Low	NA	1	1					1	**4**			-1	-1				**-2**	*2*
All	Consider preserving areas of steep slopes as protected open space through acquisitions or modified zoning					x	x			1	BOS/BOA	B, C, D	High	NA	1	1					1	**4**						-1		**-2**	*2*
All	Continue to require adherence to the state building codes					x	x			2	B&E	A	Low	NA	1	1	1					**4**								**0**	*4*
All	Encourage through-streets instead of dead-end streets					x	x			6	PZC	B	Low	NA	1	1	1					**4**							-1	**-1**	*3*
All	Ensure that utility providers are aware of landslide potentials and have responder teams available to repair damage caused by slides					x	x			6	EMD	C	Low	NA	1	1		1				**4**			-1					**-1**	*3*
All	Make education materials available at Building and Engineering departments regarding identification of landslide risk areas					x	x			5	B&E	B	Low	NA	1	1						**3**								**0**	*3*
All	Consider expanding and over-sizing drainage systems in the vicinity of steep slopes					x				4	PW	C	High	NA	1	1					1	**4**						-1		**-2**	*2*
All	Encourage property owners to have retaining walls inspected by structural engineers					x	x			1	EMD	C	Low	NA		1				1	1	**5**	-1			-1				**-2**	*3*
All	Ensure that municipal departments and critical facilities have adequate backup facilities in case damage occurs						x			6	EMD	C	Intermediate	Unlikely	1	1	1					**4**						-1		**-2**	*2*
Ansonia	Work with property owner to remove trees and reinforce the wall along South Main Street just to the north of Columbia Street					x	x			4	PW	B	Intermediate	Unlikely	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Ansonia	Work with the owners of the Platt Street landslide site to conduct maintenance and prevent future slides					x	x			4	PW	B	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Derby	Work with the owners of the 233 Derby Avenue and adjacent landslide sites to conduct maintenance and prevent future slides					x	x			4	PW	B	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Derby	Proactively pursue landslide prevention methods at the base of Gilbert Street in advance of problems					x	x			4	PW	C	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Derby	Provide support as necessary to Commodore Commons property owners					x	x			4	PW	B	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Seymour	Consider stabilizing the area that has historically been a location of landslides at the intersection of Rose and Cedar Streets					x	x			2	PW	B	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Shelton	Provide support as necessary to Riverdale Apartments on Shelton Avenue to decrease chances of future slides					x	x			4	PW	B	Intermediate	Possible - HMA	1	1	1	1		1	1	**8**			-1			-1		**-3**	*5*
Shelton	Monitor the slope below North Oak Avenue					x	x			1	PW	B	Intermediate	Unlikely	1	1	1	1		1	1	**8**			-1					**-1**	*7*
	DAM FAILURE																														
All	Include dam failure areas in the Reverse 911 and CodeRed emergency contact database	x						x		6	EMD	B	Intermediate	NA	1	1	1					**4**			-1					**-1**	*3*
Seymour	Work with RWA to develop an EOP and maintenance plan for Peat Swamp Reservoir Dam if none exists	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Ansonia	Work with DEEP to develop an EOP for Quillinan Reservoir Dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Derby	Develop an EOP and maintenance plan for the Upper and Lower Ansonia Reservoirs	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Seymour	Work with Beach Properties to develop EOP and maintenance plan for Bladens River Dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Seymour	Work with Kinneytown Hydro to develop EOP and maintenance plan for Kinneytown Dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Seymour	Develop EOP and maintenance plan for Sochrin Pond Dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
Seymour	Work with Fanotto et al to develop EOP and maintenance plan for Silver Lake Dam; also address runoff and elevated sedimentation as needed	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1		-1			**-2**	*2*
Seymour	Work with owner of Clarks Pond Dam to develop EOP and maintenance plan for the dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1		-1			**-2**	*2*
Shelton	Work with T. and E. Bombero to develop EOP and maintenance plan for the Far Mill River dam	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1		-1			**-2**	*2*
Shelton	Develop or update the EOP for Shelton Reservoir Dam #2	x						x		1, 6	EMD	B	Low	NA	1	1	1					**4**			-1					**-1**	*3*
	WILDFIRES																														
All	Continue to support public outreach programs to increase awareness of forest fire danger, equipment usage, and protecting homes from wildfires								x	5	FD	A	Low	NA	1	1		1			1	**5**								**0**	*5*
All	Ensure that provisions of Subdivision Regulations regarding fire protection facilities are being enforced								x	2	PZC	A	Low	NA	1	1		1			1	**5**								**0**	*5*
All	Pursue additional sources of fire-fighting water where adequate supplies do not exist								x	2	FD, BOS/BOA	B	High	Possible - DWSRF, AFGP, HMA	1	1		1			1	**5**						-1		**-2**	*3*
All	Patrol municipal-owned open space and parks to prevent campfires								x	1	FD, PD	A	Low	NA	1	1					1	**4**								**0**	*4*
All	Continue to promote inter-municipal cooperation in fire-fighting efforts								x	6	FD	A	Low	NA	1	1		1			1	**5**								**0**	*5*
Ansonia	When wildfire threats are high, monitor the northeast section of Ansonia								x	1	FD	A	Low	NA	1	1					1	**4**			-1					**-1**	*3*
Derby	Continue to give close attention to Witek Park and Osbornedale Park in Derby during the busy season								x	1	FD	A	Low	NA	1	1					1	**4**			-1					**-1**	*3*
Seymour	Continue to monitor Route 113 in the Little Laurel Lime Ridge Park area, especially during the spring season								x	1	FD	A	Low	NA	1	1					1	**4**			-1					**-1**	*3*

Applicable Community	Strategies for the Valley Council of Governments (VCOG) Communities	Associated Report Sections								Category 1. Prevention 2. Property Protection 3. Natural Resource Prot. 4. Structural Projects 5. Public Information 6. Emergency Services	Responsible Department[1]	Schedule A. Ongoing B. 2012-2017 C. 2017-2022 D. 2022 onward	Cost Low = Minimal[2] Intermediate = <$100,000 High = >$100,000	Federal Funding Potential (NA, Unlikely, Possible, or Likely with Grant Program listed)	Weighted STAPLEE Criteria																Total STAPLEE Score
															Benefits								*Costs*								
		Inland Flooding	Hurricanes and Tropical Storms	Summer Storms and Tornadoes	Winter Storms	Landslides	Earthquakes	Dam Failure	Wildfires						Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	**STAPLEE Subtotal**	
Seymour	Continue to monitor the Matthies property off South Main Street in Seymour which has a history of brush fires								x	1	FD	A	Low	NA	1	1					1	**4**			-1					**-1**	***3***
Shelton	Continue to monitor the Nells Rock Road area in Shelton which has a history of fires								x	1	FD	A	Low	NA	1	1					1	**4**			-1					**-1**	***3***
All	Enforce regulations and permits for open burning								x	1	FD, PD	A	Low	NA	1	1					1	**4**			-1					**-1**	***3***

[1]**Notes**
PW = Public Works
BOS/BOA = Board of Selectmen/Board of Alderman
EMD = Emergency Management Director
FD = Fire Department
PD = Police Department
PZC = Planning & Zoning Commissions
B&E = Building and Engineering Departments or Personnel
DPR = Director of Parks and Recreation
TW = Tree Warden

2. To be completed by existing staff and volunteers, or costs involve only copying/printing.

*Ansonia Plan of Conservation and Development suggests 15%; Derby and Seymour Plans of Conservation and Development suggest 25%

Beneficial or favorable ranking = 1
Neutral or Not Applicable ranking = 0
Unfavorable ranking = -1

Technical and Economic Factors have twice the weight of the remaining categories
(i.e. their values are counted twice in each subtotal).

APPENDIX B
PLAN DEVELOPMENT MEETING MINUTES

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR THE VALLEY COUNCIL OF GOVERNMENTS
Shelton, Derby, Ansonia, and Seymour, Connecticut
Kick-off Meeting
October 17, 2011

I. Welcome and Introductions

The following individuals attended the data collection meeting:

- David Murphy, P.E., CFM, Milone & MacBroom, Inc. (MMI)
- Shawn Goulet, Milone & MacBroom, Inc. (MMI)
- Kevin Hale, City of Ansonia Chief of Police Department and EMD
- Charles Sampson, City of Derby OEM
- Thomas Eighmie, Town of Seymour OEM
- John Millo, City of Shelton EMD
- Rick Dunne, Valley Council of Governments
- David Elder, Valley Council of Governments

II. History, Purpose, and Need for a Hazard Mitigation Plan

Mr. Murphy described the basis for the natural hazard planning process and possible outcomes, including the mitigation grant programs, with a Microsoft Power Point presentation. The project scope, schedule and data needs to complete the project were discussed.

III. Hazards

Following the presentation and discussion mentioned above, a few of the following hazards were discussed in short. However, it was agreed by the group that the key discussions regarding the material to be placed in the Plan will happen at meetings held at each VCOG town over the next few weeks.

- Flooding
- Hurricanes and tropical storms
- Winter storms and nor'easters
- Summer storms and tornadoes
- Earthquakes
- Dam Failure
- Wildfires
- Landslides

IV. Project Scope

Mr. Murphy distributed a copy of the scope of services with four main tasks summarized:

- Task 1 – Project Initiation and Data Collection
- Task 2 – Risk and Vulnerability Assessment

- ❑ Task 3 – Recommendations and Plan Development
- ❑ Task 4 – FEMA Review and Plan Adoption

Yellow highlights in the scope of services are keyed on meetings and milestones.

V. Schedule

Mr. Murphy presented the proposed schedule. An aggressive schedule is needed to work toward grant eligibility in 2012.

Month	Tasks	Description
October 2011	1	Kick-off meeting and data collection meetings
November 2011	1	Continue data collection and field reconnaissance
December 2011	1, 2	Continue with field reconnaissance if needed; begin vulnerability analysis
January 2012	2	Vulnerability analysis and HAZUS modeling
February 2012	2	Vulnerability analysis and HAZUS modeling
March 2012	3	Begin plan
April 2012	3	Complete draft plan and submit draft to VCOG and advisory committees
May 2012	3	Work with VCOG and advisory committees to incorporate edits
June 2012	3, 4	Draft plan submitted to FEMA
July 2012	4	CT DEEP review
August 2012	4	CT DEEP review & FEMA review
September 2012	4	FEMA review and conditional approval
October 2012	4	Municipal adoptions

VI. Data Collection & Discussion

Critical Facilities

- ❑ Mr. Elder will provide MMI with a list of critical facilities once approval is given by each member town.

Noted Flooding and/or Drainage Problem Areas

- ❑ It was noted by Mr. Eighmie that the Bladens River had three or four floods in 2011 and that the Little River did not present as much of a flooding issue to the town.

- ❑ The municipalities are meeting with First Light on October 20, 2011 regarding flooding along the Housatonic River. The meeting is reportedly going to be an opportunity to discuss water management behind the Stevenson Dam and proper notification to the communities and the Maples and McConney Grove neighborhoods.

- Mr. Millo noted that money from an HMGP grant is funding some elevations in the Maples neighborhood of Shelton.

- Mr. Eighmie added that it is not until the Housatonic River reaches a flow of 60,000 cfs that they begin to worry about flooding affecting homes along the Housatonic River in Seymour.

- Mr. Eighmie mentioned that in heavy rainstorms nuisance flooding occurs in the right-hand lane of 34 northbound. Water enters the roadway when it drains off the adjacent mountainside via sheet flow. Mr. Eighmie said that there are six homes that typically flood when this occurs.

- Mr. Dunne explained that the City of Derby is restricted by the amount of stormwater that can migrate through the levee system and exit the outfalls on the Housatonic River during major storms or the combination of a major storm event with a high tide stage. During a large storm event, the flaps on the outfalls will close once the river reaches a certain stage. At that point, the outfalls become dysfunctional and the capacity of stormwater needs an alternate release point. Due to the fact that there are a limited amount of gates and pipes within the system, the capacity of the outfalls needs to be reviewed.

- Mr. Millo stated that the downstream areas of the city and the marinas were flooded with Irene. Additionally, he offered that Indian Well Road was subject to flooding.

Landslide Areas

- It was noted by Mr. Millo that Division Avenue (in 2007), Indian Well Road, and the condominium units off Shelton Avenue at Wooster Street are areas of concern for landslides in Shelton.

- Mr. Sampson mentioned that Commodore Commons off David Humphrey Road in Derby is an area of landslide activity.

Tornadoes

- It was noted by Mr. Millo that Shelton experienced a tornado in July of 2010 and that he will provide photographs of the event.

Acquisitions

- Municipal regulations and Plans of Conservation and Developments are to be provided by Mr. Elder.

VII. Next Steps

- Local advisory committee members will be assembled by Chief Hale, Mr. Sampson, Mr. Millo, and Mr. Eighmie.

- Local advisory committee meeting dates could occur during the weeks of October 24 and October 31, 2011.

- The group discussed the pros and cons of holding one public information meeting or four (with one in each municipality) and determined that <u>one</u> public information meeting was appropriate.

- Mr. Murphy will send expense tracking forms to Mr. Elder or work with CT DEEP to get tracking forms to VCOG.

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR VALLEY COUNCIL OF GOVERNMENTS (VCOG)
Data Collection Meeting for the City of Ansonia
November 3, 2011

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- Kevin J. Hale, City of Ansonia Chief of Police Department/Emergency Medical Dispatch (EMD)
- Fred D'Amico, City of Ansonia City Engineer
- Michael Schryver, City of Ansonia Director of Public Works
- David Elder, VCOG
- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Shawn Goulet, MMI

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

Mr. Murphy from MMI briefly described the basis for the natural hazard planning process and possible outcomes, including the role of the completed plan in grant application support for the municipalities within the VCOG.

III. Hazards to Address

The VCOG plan will address flooding, hurricanes and tropical storms, winter storms and nor'easters, summer storms and tornadoes, earthquakes, dam failure, wildfires and landslides. These were discussed, along with critical facilities and development trends.

Critical Facilities

- Critical Facilities include:

  Shelters

  - Ansonia High School (20 Pulaski Highway) is the primary and the John C. Meade School (75 Ford Street) is the secondary Red Cross-recognized shelter facility. The City is in the process of approving Ansonia Middle School (115 Howard Avenue) as the City's third shelter. The City is in need of a third shelter in the chance that the Naugatuck River were to split the City in half. The John C. Meade School is also an animal-compatible shelter so long as owners remain with their animals. There is a generator on the grounds of each of the City's shelters.

Emergency Communications

- The Ansonia Police Department (PD) (2 Elm Street) is the Emergency Operations Center (EOC). The Hilltop Hose Company No. 5 (80 Pulaski Highway) has radio communication functionability and is the backup EOC. The Prendergast School (59 Finney Street) has radio and other forms of communication capabilities coupled with its high elevation deems it a critical facility.
- Ansonia Rescue Medical Services (ARMS) (22 West Main Street) used to be the City's EOC as it has both a generator and radio tower. However, it is located in a floodplain and, therefore, the Police Department became the EOC.

Housing, Health Services & Daycare Facilities

- Hilltop Health Center (126 Ford Street) is capable of housing approximately 90 patients offering nursing and rehabilitation services.
- The Riverside Housing Complex (36 Olsen Drive) is a 165-unit public housing development with hundreds of occupants speaking different languages and having limited to no means of personal transportation on property of less than five acres. The complex is situated within the 500 year floodplain of the Naugatuck River and was a large concern during the recent tropical storm Irene. There are plans to demolish and rebuild portions of the complex in the near future.
- Julia Day Nursery and Kindergarten (76 Central Street) houses approximately 60 young children during the weekdays.
- Ansonia Community Action (4 Fourth Street) is a community center located in the north end of Ansonia and offers daycare services.
- Valley YMCA (12 States Street) offers daycare services at their location and also at the Boys & Girls Club of the Lower Naugatuck Valley (28 Howard Avenue).
- The John J. Stevens Apartments (75 Central Street) are a 34-unit elderly housing development.
- The Monsignor Hynes Apartments (70 Woodlawn Avenue) is a 74-unit elderly housing high rise.
- The James J. O'Donnell Apartments (63 Woodlawn Avenue) are a 40-unit elderly housing development of two buildings.
- Riverview Apartments (15 West Main Street) and Capital Plaza (290 Main Street) are housing for mostly disabled and some elderly adults.

City-Owned Properties/Facilities

- Ansonia Department of Public Works (DPW) Building (100 Division Street) houses the majority of the City's equipment.
- The Ansonia Armory (6 State Street) has a maintenance area which houses some equipment for both the City DPW and PD equipment.

  - The City Hall does not have a generator and is generally not considered a critical facility.
  - Five Fire Stations:
    - Fountain Hose Company No. 1 (191 Howard Avenue)
    - Webster Hose Company No. 3 (67 Platt Street)
    - Charters Hose Company No. 4 (4 Murray Street)
    - Hilltop Hose Company No. 5 (previously mentioned)
    - Eagle Hose Company No. 6 (1 Main Street)

  Utilities

  - The United Illuminating Company (UI) owns and operates a substation on Riverside Drive within the 100 year floodplain.
  - There are 17 sewage pump stations throughout the City, the three (3) major pump stations are of concern during a natural disaster.

Development Trends

- There are four developments that are either on the table or in the early stages of construction:
  - Castle Lane (Castle Lane Development Corp.) proposes a 22-24 lot subdivision with steep slopes, no sidewalks and retaining walls for each lot. The City and VCOG consider the property to be marginal to poor for residential development.
  - Pulaski Highway is an approved subdivision for 25 lots but has yet to proceed because of the economy.
  - A plan has been proposed to demolish and rebuild half of the existing Riverside Apartments at their same location within the 500 year floodplain of the Naugatuck River.
  - The Downtown Central Design District (DCDD) is in place to encourage re-use of brownfields in the floodplains. A parking study was performed in conjunction with the development of the DCDD.
  - Construction has already begun on the Fountain Lake Industrial Park. The road has already been roughed out and plans are to include 10-12 lots with 3-4 large buildings and access off of Birmingham Boulevard.

- All new developments are required to have underground utilities.

Noted Flooding and/or Drainage Problem Areas

- There are no properties in the City that were included in the states Repetitive Loss/Severe Repetitive Loss list.

- Flooding is not problematic along Beaver Brook or Two Mile Brook. The primary flooding problem is along a tributary of Beaver Brook. A tributary of Beaver Brook north through undersized culverts and in open air which extends from Fairview Street to the east of Upland Terrace to just north of Shortell Drive. The tributary flows northward to the east of Prindle Avenue through the Nelligan Park area. A few homes on Prindle Avenue get flooded (finished basements and yards). Between Mr. Schryver and Mr. D'Amico, the City will be able to inform MMI of the addresses that are flooded.

- Nuisance Flooding:
  - Flooding along Wakelee Avenue just north of the Wakelee Avenue/Franklin Street intersection takes place as a result of DOT drainage problems. The road becomes flooded during large-scale rain events.
  - Nuisance flooding takes place along Ells Street where a drainage course runs under two to three homes and through backyards. One home experienced significant flooding at the headwall. The City has an easement on this area and again, between Mr. Schryver and Mr. D'Amico, the address of the home that experienced major flooding will be provided to MMI.
  - A marshy area located to the east of Route 8 at the western end of the streets off Wakelee Avenue receives a significant amount of ponding during significant rain events. Residents of the area attended a recent public meeting and were concerned with an alleged pipe from Route 8.
  - A home on Woodbridge Avenue Extension has recently been reporting issues with property flooding.

- The levee system is functioning correctly thus far with no ponding or back-ups along either the Naugatuck River or Beaver Brook.
- During Tropical Storm Irene, the flood gates on the Naugatuck River were closed for the first time in 47 years. Bus companies refused to send buses to the Riverside Apartments because of the high winds. During the storm, the Housatonic River experienced backwater conditions because of the incoming storm surge which lead to water moving northward up the Naugatuck River. Olson Drive almost was flooded.

Tree Maintenance

- The City has a tree maintenance program is in place with Mr. Schryver as the City's Tree Warden. As such, a budget is in place for tree maintenance and the City performs regular visual inspections. UI performs a limited amount of tree trimming which typically includes branches within five feet of their wires. The City can (and does) remove entire trees that pose threats to human life and property. The City often points out problematic instances on private lands so that home/facility owners can take the time to remove those threats. However, if a private home-facility owner does not heed the City's warning, the City will step in when the threat becomes serious.

Landslide Areas

- A wall along South Main Street, entirely composed of granite blocks, is coming apart just to the north of Columbia Street. Large trees that have grown at the top of the wall are now rooted into areas and it is only a matter of time until the wall gives way.
- A landslide occurred on Platt Street in 2011.

Wildfires and Dams

- Both wildfires and dams were said to be non-issues in the City.

V. Data Needs

- All needed regulations will be provided by VCOG. This likely includes, but is not limited to, all current zoning, subdivision and wetland regulations and the Plan of Conservation and Development.

VI. Acquisitions

Emergency Operations Plan (8/1/09)
City files for FEMA claims, 2003 – 2011 (to be returned to the City)

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR
VALLEY COUNCIL OF GOVERNMENTS (VCOG)
Data Collection Meeting for the City of Derby
November 9, 2011

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- Charles Sampson, Derby Office of Emergency Management
- Ron Culmo, Derby Public Works Department
- David Elder, VCOG
- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)

Ms. Sheila O'Malley was not able to attend the meeting and will be contacted at a later date.

II. Description and Need for Hazard Mitigation Plans

Mr. Murphy from MMI briefly described the basis for the natural hazard planning process and possible outcomes, including the role of the completed plan in grant application support for the municipalities within the VCOG.

III. Critical Facilities and Development Trends

- ***Shelters***
  - Derby has two shelters, which are designated as such by Mr. Sampson. They are the middle school at 10 Nutmeg Ave and Bradley School at 155 David Humphrey Road. Neither has a generator. Each of the four fire stations is a temporary shelter. People may congregate at these fire stations while awaiting transport to the two designated shelters.

- ***Emergency Communications***
  - The City Hall basement is the Emergency Operations Center (EOC). A generator is located in the parking lot. The four fire stations and the police department are also critical facilities. The police station is reportedly located in the floodplain.

- ***Housing, Health Services & Daycare Facilities***
  - Griffin Hospital and the adjacent cancer center.
  - The two assisted living facilities are Marshall Lane Manor on Marshall Lane and Birmingham Health Center at 219 Chatfield Street.
  - The four elderly housing complexes are Stygar Terrace, Guardiano Terrace, Cicia Manor, and the old high school on Minerva Street (Hallock's Landing).

- ***City-Owned Properties/Facilities***
  - The Department of Public Works (DPW) at 65 Coon Hollow Road is a critical facility.

- ***Utilities***
  - The WPCF is a critical facility.
  - Four or five sewage pumping stations are located throughout the City, and all but one serve enough people to be considered critical facilities. One of them is located in the basement of a house and might only serve the house, although it is city-owned. MMI has a list of the pumping stations.
  - Flood control pumping stations.
  - The Derby Dam power house is a privately-owned critical facility. The owner (McCollum Enterprises) reportedly sells the electricity to the grid.

Development Trends

- The City is generally considered built out and lacking space, but four potential areas of development are notable aside from local in-fill:
  - Main Street redevelopment (vacant land on south side of street).
  - The proposed commerce park between Route 8 and the Naugauck River
  - A four-lot residential subdivision off Belleview Drive.
  - An I-C zoned industrial park off Hine Terrace, much of which is floodplain.

- New developments are required to have underground utilities and appropriate street widths for emergency access.

IV. Hazards

Noted Flooding and/or Drainage Problem Areas

- The listed Repetitive Loss Property on O'Sullivan's Island is the old fire training school that has been demolished. The property is vacant and insured structures are not present. The listing is apparently in error and dates back to the building being present.

- The Gilbert Street area is a problem. The City has a policy of drawing down the two dams at Witek Park to provide some flood abatement and reduce flows in the outlet stream. This isn't done as part of a dam EOP. Instead, it is written in the Public Works policy manual. However, high flows sometimes occur, which jump the culverts and cause flooding downstream in the Gilbert Street area. *The plan must describe this area and recommend that flood mitigation be pursued.* Homes and properties are experiencing damage to basements and driveways. Hundreds of thousands of dollars in claims have been made against the City, and the City has paid some. One home must be acquired for implementation of the current mitigation plan, but the owner will not sell it. He is an alderman and is holding out for more than its current market value.

- The stream associated with Gilbert Street flows under Route 34 in a culvert and into the river. During high flows, the stream overtops the road and Route 34 is flooded with up to a foot of water and must be closed. Overtopping is also encouraged when the river is high and backwaters block the stream from freely flowing from the culvert. The same thing also happens at the Roosevelt/North Avenue intersection.

- McConney’s Grove was discussed. Mr. Sampson believes that these residents will not be in favor of elevations or acquisitions. However, a range of options must be addressed in the plan. Mr. Murphy explained that the plan does not constitute a mandate, but instead is a vehicle for FEMA funding. Also, the presence of Repetitive Loss properties in this area requires that the plan include recommendations.

- First Light’s operation of the Stevenson Dam was briefly discussed. All agreed that the dam and lake do not provide significant flood abatement or storage. If flooding conditions develop upstream of the dam, the water must be passed over the dam.

- Nuisance flooding is occurring downstream of O’Sullivan Road toward Sodom Lane. Retention ponds are not being maintained by the owners, and flooding is occurring downstream. The City reportedly helps fund their maintenance, but the owners are not conducting maintenance. The plan may address this lightly, as it is not significant flooding.

Tree Maintenance

- The City has a tree maintenance program with Mr. Culmo as the City's Tree Warden. The tree maintenance program has been in place for about six years. He maintains and removes old and risky trees in the City’s rights of way and on City property. He does not take care of trees on private property. He believes that the City’s aggressive tree policy has helped during events like Irene and the October 29-30 snow storm. Only 125 properties lost power during Irene and only 42 lost power on October 29-30.

Snow Management

- CT DOT plows Routes 8, 34, and 115. The City plows other roads.
- The City plows according to priority, with main roads first, then secondary. There are seven or eight routes.
- There is typically enough money in the budget each winter, and it can be moved from other budgets when needed. This year, 80% of the budget has been used for Irene clean-up.

- None of the collapsed roofs were in Derby last winter.

Landslide Areas

- Landslides have occurred behind the condos on Derby Avenue (#233 Derby Avenue and the adjacent complex). Earth has moved toward the condos. These problems have been largely addressed by the property owners.
- Commodore Commons is reportedly sliding downhill toward the river. This problem is being addressed by the property owners.
- Steep slopes near the base of the Gilbert Street area could be problematic.

Wildfires

- Fires occur in the two large parks (Witek and Osbornedale State Park). Mr. Sampson believes that many of these are set by people. However, none of the fires grow large. Also, the development of the ball fields in Witek Park have resulted in fewer fires there.

V. Public Meeting

- The regional public meeting could be held in the Derby City Hall. Potential dates with room availability are November 29 and 30 and December 1, 6, 7, and 8.
- The three weekly newspapers are Valley Times, Valley Gazette, and Valley Independent Sentinel. The daily newspaper is the Register, although residents in Shelton may read the Post.

VI. Follow-Up

- The Emergency Operations Plan is being revised by December 2011. Mr. Sampson will provide a new copy when available.
- The Subdivision and Wetland regulations were provided.
- The City's Flood Damage Prevention requirements are in the City Code (Section 92-2 through 92-12) <u>and</u> the Zoning Regulations. Copies of both were obtained
- While discussing the City's Flood Damage Prevention requirements, the Building Official remarked that many residents – in particular, condo owners – were being asked to purchase flood insurance as a result of MapMod. In some cases, the condos are in the floodplain, but others are above the flood elevation. FEMA has advised that each unit must apply for a Letter of Map Revision (LOMR) as appropriate.

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR
VALLEY COUNCIL OF GOVERNMENTS (VCOG)
Meeting with the City of Derby Engineer
November 10, 2011

The Derby City Engineer, Mr. Michael Joyce, offered clarifications based on the data collection meeting of November 9, 2011. Additional issues were discussed as well.

- Regarding critical facilities, the police station is located in a floodplain but within an area protected by levees. This is similar to many other areas in the City. In addition to the levee pumping stations being critical facilities, the pressure conduits may be considered critical facilities. A discussion about the levee system resulted in the potential inclusion of the entire flood protection system as a critical facility.

- Regarding areas of potential development, much of the development in Derby will include small parcels of infill development. The four larger areas noted on November 9 were discussed and verified. The I-C zone off Hine Terrace is indeed located among Zone A floodplains, but much of the land is developable. Access roads will need to cross floodplains. Two more areas of development were noted: (1) the Pershing Drive commercial area near downtown will be subject to redevelopment in the future as empty store fronts and restaurants are occupied; a Walgreens may be developed in this area; and (2) additional commercial development in the Fountain Lake area is possible, which is adjacent to the Fountain Lake commerce center in Ansonia.

- The City Engineer underscored the significance of the Gilbert Street flooding problem. Much of this area was developed in the 1970s, which was relatively recent. Plans are available that depict a solution to the problem involving replacement of various drainage components. The City understands that formal Emergency Operations Plans are needed for the Witek Park dams. DEP noted this during a recent investigation or inspection.

- Recent zoning changes will require all reconstruction of non-conforming properties in McConney's Grove to result in adherence to flood damage prevention regulations.

- The flooding issues downstream of O'Sullivans Drive near Sodom Lane were clarified. This is a complex problem involving detention basins, drainage, and watercourses. One watercourse flows to the south from a detention basin off the Jeanetti Drive cul-de-sac. Another watercourse flows southeast from a detention basin off the Lanzieri Court cul-de-sac (which is a street off of O'Sullivans Drive). The two streams join prior to flowing into a small pond (isolated flood zone A) in the "Onopiak" open space property and then under Sodom Lane in a new culvert installed several years ago to enable more conveyance. On the south side of Sodom Lane, the stream flows beneath a warehouse in a culvert. Nuisance flooding in the vicinity of the warehouse is common. Two small office buildings are also flooded. The flooding is believed to be caused, at least in part, by the development upstream in combination with a detention basin that is not functional. Runoff from the developed areas is very fast and the stream is flashy, so some detention would help. However, the basin located off the Lanzieri Court cul-de-sac has been observed dry on a consistent basis. It does not retain or detain any water during and after storms. The outflow is believed to be too large and set at an elevation that does not hold water in the basin. Complicating matters, the property owner who “owns” the basin and collects fees for its maintenance has been unwilling to cooperate with the City. Although she has performed some maintenance, and collects fees from the City, she does not allow anyone to access the basin. The police are routinely notified if City public works personnel attempt to inspect the basin.

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR
VALLEY COUNCIL OF GOVERNMENTS (VCOG)
Data Collection Meeting for the Town of Seymour
November 30, 2011

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- Tom Eighmie, Director the Office of Emergency Management (OEM)
- Tim Willis, Deputy Fire Marshal & Deputy Emergency Management Director
- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Shawn Goulet, MMI

II. Description and Need for Hazard Mitigation Plans

Mr. Murphy from MMI briefly described the basis for the natural hazard planning process and possible outcomes, including the role of the completed plan in grant application support for the municipalities within the VCOG.

III. Critical Facilities

- ***Shelters***
  - The shelter is Seymour Middle School (211 Mountain Road). The Paul E. Chatfield Elementary School (51 Skokorat Street) will be the second shelter once it comes online by September 2012 when renovations are done and a full-capacity generator is available. Seymour Middle School is currently recognized as an Army American Red Cross (ARC) shelters.

- ***Emergency Services***
  - Great Hill Hose Fire Company (140 Botsford Road) is the Emergency Operations Center (EOC). A generator is located on site.
  - The Town's current emergency alert system (CodeRed) was not discussed and will be discussed in the Plan.
  - Seymour has two Fire Stations, Great Hill Hose Company (aforementioned) and Citizens Engine Company No. 2 (26 DeForest Street). Neither have generators. The Citzens Engine Company No. 2 is located in the FEMA 500-Year Flood Zone.
  - Seymour EMS is located at 4 Wakeley Street.
  - Seymour Police Department is located at 11 Franklin Street and is in the FEMA 500-Year Flood Zone.
  - Town Hall does not have a generator and, therefore, is not listed as a contributor to emergency services in Town.

- ***Elderly & Assisted Living Facilities***
  - The Norman Ray House (133 Walnut Street) is elderly housing and has between 40 and 60 units.
  - The Reverend Callahan House (32 Smith Street), also an elderly housing development that includes approximately 85 units.
  - Smithfield Gardens (26 Smits Street) is an assisted living development consisting of approximately 56 units.
  - Shady Knoll (43 Skokrat Street) is an assisted living with approximately 70 units.

- ***City-Owned Properties/Facilities***
  - The Department of Public Works Garage (721 Derby Avenue) is also in the FEMA 100-Year Flood Zone.
  - The WPCF (723 Derby Avenue) is right next door to the DPW Garage.

- ***Utilities***
  - The WPCF (10 Riverdale Avenue) is a critical facility.
  - The RWA Wellfield on Route 34 is a regional asset and feeds Griffin Hospital in Derby.

Development Trends

Residential

- There are no requirements for utilities to be installed underground with new development, however most are, especially the larger developments.
- "Rolling Hills" is a planned development that is to be located in the northeast corner of Town adjacent to the Town of Beacon Falls Chatfield Farms development. The development is planned to incorporate up to 200 units in total. Approximately 80 are currently built.
- A townhouse development on Route 34 is planned to incorporate 50 units. However it is on hold and will not take place until a sewer system is in place.
- Ten units are approved for 2012 construction on George Street.
- The owner of Villa Bianca (located on Route 34) wants to build a convention center to go along with the existing inn and banquet hall in the southwestern part of Town. Like the approved townhouse development, the owner is waiting for a sewer system to be installed. The restaurant/banquet hall is also expanding and is currently approximately 5,000 square feet.

Commercial/Industrial

- "Actors Colony Plaza", located on Route 34 is a commercial/retail development of six approved units.
- 172 North Street, located between the two dams along Route 67 is an 8,000 square foot commercial development which is approved for up to eight units.
- Connecticut Basement Systems (60 Silvermine Road) is adding a new building for vehicle storage.

IV. Hazards

Noted Flooding and/or Drainage Problem Areas

- The home at 25 Walnut Street is repeatedly subject to flooding. Seymour has paid to replace some property damage; however, the storm drainage needs to be re-piped.

- Along Roosevelt Drive near Derby and across from the wellfield, there are five (5) homes that are subject to flooding from water sheet draining down the mountain. This is a poor drainage issue and does not have to do with a water body.

- There are two (2) ponds at and above the Kerite Dam (Class BB according to the 1997 Dam Survey by CT DEEP) are almost full of silt and fine sediments and have no storage capacity. When the water level raises above the Bladens River Dam (Class B according to the survey) upstream of the Kerite Dam, the water flows down Beach Street and sometimes flows down Pearl and Day Streets.

- Two (2) homes on Beach Street (11 and 15 Beach Street) are subject to flooding due to Route 67 storm drainage which began after CT DOT work had completed. This inundation is in addition to Bladens River overflow.

- On Mountain Road, at the corner, the drainage mechanism is insufficient. The culvert is undersized and there are repeated road closures. However, there have not been any home flooding.

- The lone RLP in Seymour is a destroyed building.

Tree Maintenance

- The Town has a boom truck and a chipper. The DPW will be contacted by MMI for more information.

Snow Management

- Plowing in the Town takes place from the main Town roads to the least used side roads.

October 2011 Storm Albert

- The Beacon Falls Substation went offline which caused the outage in Town.
- Areas of Town had a substantial amount of total snowfall due to the higher elevations compared to the rest of the Town.

- Five (5) snow plow trucks went offline during the storm because of the heavy, wet snow.
- CL&P provides power to Seymour, while UI provides power to Ansonia, Derby and Shelton.

Landslide Areas

- There have been no recent significant landslides.
- Approximately 10-15 years ago there was a landslide at the intersection of Cedar and Rose Streets.

Wildfires

- Seymour is subject to at least one (1) wildfire each spring in the Route 34 area along the steep slope. This is in the Little-Laurel Lime Ridge Park area of Town.
- The Matthews property off South Main Street has brush fires. In the spring of 2011, it took the fire department 6-7 hours to fight a fire in this area.

V. Dams

- The Town knows nothing about the Great Hill Reservoir Dam (Class C and owned by the Town) which is located in the Keith Mitchell Forest.
- The Kerite Dam does not have an emergency spillway although the dam was renovated in the late 1990s. This needs to be reviewed and confirmed.
- The Hoadley Pond Dam was refurbished in 2003 or 2004.
- The Wire Company Dam #2 has not had work completed on it in some time.

VI. Acquisitions

- The following were acquired from the Town prior to the meeting:

  - Zoning Regulations (Effective 8/17/00)
  - Land Subdivision Regulations (1992 General Revision)
  - Inland Wetlands Regulations (Ammended 9/22/08)

VII. Follow-Up

- The DPW will be contacted and VCOG is to supply the Town's current Conservation and Development Plan, which was not available prior to the meeting.

Meeting Minutes

NATURAL HAZARD MITIGATION PLAN FOR
VALLEY COUNCIL OF GOVERNMENTS (VCOG)
Data Collection Meeting for the City of Shelton
November 17, 2011

I. Welcome & Introductions

The following individuals attended the data collection meeting:

- John Millo, Director the Office of Emergency Management (OEM)
- Daniel Bednarsky, Assistant Director of the OEM
- Joel Hurliman, Chief of Police Department
- Jim Tortora, Fire Marshal
- Nick Verdicchio, Assistant Chief of the Fire Department
- John Anglace, Shelton B.O.A.
- Karen Spargo, Naugatuck Valley Health District Director of Health
- Matt Lawrence, Shelton Fire No. 3
- William Dimas, Shelton Fire No. 3
- Charlene DeFilippo, Grants Coordinator of the City of Shelton
- Bob Kulacz, City of Shelton
- Paul DiMauro, City of Shelton
- Michael Chaffee, Echo House Ambulence
- Eugene Kiever, Guest
- David Elder, VCOG
- David Murphy, P.E., Milone & MacBroom, Inc. (MMI)
- Shawn Goulet, MMI

II. Description and Need for Hazard Mitigation Plans

Mr. Murphy from MMI briefly described the basis for the natural hazard planning process and possible outcomes, including the role of the completed plan in grant application support for the municipalities within the VCOG.

- ***HMP and Grants***
  - The current HMP was completed in 2008 and approved by FEMA in 2009. Minor amendments were made in 2010 which was also approved by FEMA.
  - An HMG was applied for three (3) years ago (after the April 2007 nor'easter). The application was made available for most all households on Indian Well Road and only seven (7) households participated. Only 4 were approved for a raise in elevation. Some of the original seven included acquisitions, however only four elevation increases were approved.

III. Critical Facilities

- ***Shelters***
  - The primary shelter is Shelton High School (120 Meadow Street). The secondary (back-up) shelter is the Community Center (41 Church Street). Both are recognized

as Army American Red Cross (ARC) shelters. The Animal Shelter (20 Riverdale Avenue) houses pets during emergencies. Owners of the pets must remain with their pet(s) throughout the duration of being housed.

- ***Emergency Communications***
  - The City Hall (54 Hill Street) is the Emergency Operations Center (EOC). A generator is located on site. The Police Department (85 Wheeler Street) is the back-up EOC and is outfitted with a generator as well. The four Fire Stations listed below are also critical facilities outfitted with a generator:

    1. Echo Hose Hook and Ladder Company No. 1 (379 Coram Avenue)
    2. Huntington Fire Company No. 3 (44 Church Street)
    3. Pine Rock Fire Company No. 4 (722 Long Hill Avenue)
    4. White Hills Fire Company No. 5 (2 School Street)

  - The City's current emergency alert system was not discussed should be discussed in the Plan.

- ***Housing, Health Services & Daycare Facilities***
  - Assisted living complexes, convalescent homes, medical facilities, daycare facilities, special needs facilities, daycare facilities, and mobile home parks are either described in the existing Shelton Hazard Mitigation Plan or available as a list and will be made available to Mr. Elder by Mr. Bednarsky.

- ***City-Owned Properties/Facilities***
  - The Department of Public Works (DPW) at 41 Myrtle Street is a critical facility.

- ***Utilities***
  - The WPCF (10 Riverdale Avenue) is a critical facility.

Development Trends

- Mr. Bednarksy will be sending information regarding ongoing development in the City.

IV. Hazards

Noted Flooding and/or Drainage Problem Areas

- Mr. Bednarsky will provide a list of flooding and drainage problem areas throughout the City. Two maps were left with the City for mark-up and will be delivered to Mr. Elder once they have been marked.

- One area that was briefly discussed was Route 108 near the Post Office. This area causes nuisance flooding during storms with a large amount of precipitation.

Tree Maintenance

- The City has a Tree Warden and the duties, day-to-day schedule, responsibilities, and/or procedures will be provided to Mr. Elder by Mr. Bednarsky.

Snow Management

- Mr. Bednarsky will provide the Mr. Elder with the City's snow management procedures and how they are implemented during a snow and/or ice storm. Also, any roads that are given the highest priority (main roads, roads with hills, narrow roads, etc.)

Landslide Areas

- The area of Shelton Avenue at the Riverdale Apartments was subject to substantial landslide activity during a heavy rainfall event in 2010. As a result, a house was removed.

Wildfires

- The only area of the City that was outlined as having a history with wildfires is the area of Shelton Avenue at Nells Rock Road. According to Mr. Millo, this section of the City had areas burning for a period of five to six weeks in 1995.

V. Public Meeting

- The regional public meeting will be held in the Derby City Hall on December 1. Both Mr. Millo and Mr. Bednarksy will be in attendance.
- The public notice for the public meeting will be run in the three weekly newspapers (Valley Times, Valley Gazette, and Valley Independent Sentinel and the Register).

VI. Acquisitions

- The following were acquired from the City following the meeting:

  - Inland Wetlands and Watercourses Regulations (Rev. 7/1/10)
  - Plan of Conservation and Development (7/31/06)
  - Subdivision Regulations (Amendments through 6/1/01; Reprinted April, 2003)
  - Zoning Regulations (Updated and Reprinted 9/09)

VII. Follow-Up

- ❑ In addition to the highlighted items above, the following are to be provided to Mr. Bednarsky by November 23, 2011:

  - Hazard Mitigation Plan (HMP)
  - Emergency Operations Plan (EOP)

APPENDIX C
PUBLIC MEETING ANNOUNCEMENTS AND PRESENTATION, DECEMBER 2011

Forum on Natural Hazards Mitigation

appropriate

The April 2007 Nor'Easter, Tropical Storm Irene, and snowstorm Albert are recent events that caused severe damage in the region and resulted in Federal disaster declarations. Flooding, heavy snow, wind, and downed power lines cause damage to property, disrupt our daily routines, close our schools and businesses, and jeopardize the health and safety of Shelton citizens.

What can be done to minimize our vulnerabilities to natural hazards? The City of Shelton is collaborating with Ansonia, Derby, and Seymour to develop a regional natural hazard mitigation plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life, and the costs to all of us. The plan is being funded by the Federal Emergency Management Agency (FEMA) and will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, dam failure, and landslides. The plan will outline the steps that Shelton, Ansonia, Derby, and Seymour can take to mitigate for future natural hazards.

In order to gain input to the hazard mitigation plan, the Valley Council of Governments will host a forum at the assembly room in the Derby City Hall on Thursday December 1, at 7 PM. Residents and business owners are invited to share their experiences with natural hazards and offer ideas for minimizing the damage that occurs and the costs that are borne by our towns and citizens. For more information, please contact Mr. David Elder of the Valley Council of Governments at (203) 735-8688 or info1@valleycog.org.

How Can The Valley Prepare For Disasters?

BY **Dave Murphy | Milone & MacBroom** | NOV 29, 2011 12:32 PM
(0) | Log in to Post a Comment | Send link to a friend | E-mail the Author

POSTED TO: Ansonia, Derby, Shelton, News by You

The Valley Council of Governments will host a forum at the assembly room in the Derby City Hall on Thursday Dec. 1, at 7 p.m. to get input from residents of Ansonia, Derby and Shelton on a proposed hazard mitigation plan.

The Town of Seymour and the Cities of Shelton, Ansonia, and Derby are developing a natural hazard mitigation plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life, and the costs to all of us.

The April 2007 Nor'Easter, Tropical Storm Irene, and October snowstorm Albert are recent events that caused severe damage in the region and resulted in Federal disaster declarations.

Flooding, heavy snow, wind, and downed power lines cause damage to property, disrupt our daily routines, close our schools and businesses, and jeopardize the health and safety of Valley citizens.

The plan is being funded by the Federal Emergency Management Agency (FEMA) and will discuss the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, dam failure, and landslides. The plan will outline the steps that Ansonia, Derby, Seymour, and Shelton can take to mitigate for future natural hazards.

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'Keeping teens safe:'

Kate Czaplinski

Students at Mohegan Elementary School supported a fellow classmate and helped achieve a new Guinness World Record by participating in the "Worlds Largest Sport Stacking Event" with thousands of schools. Stacking is when students stack 12 specifically designed cups called "speed stacks" in pre-determined sequences as fast as they can. Organized by Physical Education teacher David Blackmore, the event raised money for Mohegan student, Naomi Tyrrell, who has Niemann-Pick Disease. The school has held fund-raisers for Naomi the past, raising about $1,200.

Forum on hazard plan Dec. 1

In the wake of severe weather like October's snowstorm and Tropical Storm Irene, Shelton is collaborating with other Valley towns to develop a regional natural hazard mitigation plan.

The Valley Council of Governments will host a forum on Thursday, Dec. 1 at 7 p.m. in Derby City Hall, 1 Elizabeth St., to receive residents' input on a natural hazard mitigation plan.

Seymour, Ansonia, Derby and Shelton are developing the plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life and costs, according to VCOG.

At the forum, residents and business owners are invited to share their experiences with natural hazards, including with recent storms and April 2007 Nor'Easter.

The plan is being funded by the Federal Emergency Management Agency (FEMA) and will cover the occurrence and consequences of

- see **Forum** on page 18A

Continued from page 1A

floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, dam failure and landslides.

It will outline the steps that Ansonia, Derby, Seymour, and Shelton can take to mitigate for future natural hazards.

For more information, call David Elder of VCOG at 203-735-8688 or e-mail him at info1@valleycog.org.

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Spotlight

a class for $7. No dance experience required. Features Latin and international rhythms combined with easy and challenging moves for everyone to follow. Parking lot is located on Bank Street. Classes taught by licensed Zumba instructor and Derby firefighter Linda Goodman. For more information, call her at 203-231-2987, e-mail LRGFit@hotmail.com or visit facebook.com/LRGFit.

Assumption School registration — Assumption School, 51 North Cliff St., Ansonia, is accepting registration for the 2011-12 school year, for pre-kindergarten, age 3, Monday-Friday, 9-1; extended hours available; prekindergarten, age 4, Monday-Friday, 9-1; or Monday-Friday, 9-3; full day kindergarten, grades 1-8; before and after school child care. Information: 203-734-0855; kmolner@assumptionschool.net; assumption.eduk12.net.

Guided house tours — David Humphreys House, 37 Elm St., Ansonia, is open for guided tours every third Saturday of the month. Derby Historical Society docents lead tours. Cost: $5/adult; $3/seniors and children 8 and older; free/children under 8; 203-735-1908.

Low vision support group — Meets fourth Wednesday of the month, 3 p.m., Crosby Commons at Wesley Village, 580 Long Hill Ave., Shelton. Available for Valley residents. Presentation on support for those with low vision. Information: Mary Ann Milano, 203-225-5018; mamilano@umh.org.

Al-anon — weekly meetings held Wednesdays at the Spooner House, 30 Todd Road, Shelton, 1-2:30 p.m., to support family members of those affected by drinking.

Smiles within a Village Happiness Club — For Valley residents 50 and older, meets third Wednesday of the month, 6-8 p.m., Crosby Commons at Wesley Village, 580 Long Hill Ave., Shelton; Mary Ann Milano, 203-225-5018; mamilano@umh.org.

Dog Meets Baby — For the expectant couple who wants to introduce their dog to the newest member of the family. Learn what to do before the baby arrives, how to introduce the dog and baby, how to read subtle signs and setting boundaries; one price per couple. $20 for CD, paid to instructor. Register at vrae.org. Information: 203-209-3712; onesmartdogct.com; dawn@onesmartdogct.com.

MS support group — Derby MS Support Group meets third Wednesday of the month, 4:30-5:30, Griffin Hospital, 130 Division St., Derby; 203-231-4716.

Seymour Lions Club — meets second Wednesday of month at John J. Sullivan's restaurant, 557 Wakelee Ave., Ansonia; 203-430-9356.

Ansonia Lions Club — The Lions Club of Ansonia meets the first Tuesday of the month 7 p.m., La Rosina Room, Ansonia; 203-735-7434.

Volunteers sought — Shady Knoll Health Center, 41 Skokorat St., Seymour has volunteer positions available. Orientation will be presented to individuals meeting proper requirements. Call Sandra Pniewski, Director of Therapeutic Recreation, 203-881-2555.

Addiction support group — Do you have a problem with alcohol, substance abuse, compulsive behavior or living with a loved one's addition? Higher Ground Ministry, a non-denominational ministry offers help through Biblical precepts, Fridays, 7-8:30 p.m., First Baptist Church, 178 Leavenworth Road; 203-929-7704.

Marine Moms of Connecticut — Connecticut Marine moms, a new support group, meets the last Friday of each month. Destination will be in Middletown, at Harbor Park Restaurant, Friday, 3 p.m. Information: Anna Florczak, 203-922-1068; Yahoo Groups ctmarinemoms.

Food donations — Seymour Oxford Rotary Club requests donations of non-perishable food items and blankets, mittens, hats and scarves for local food bank and those in need. Drop off donations at Sandwich Man Restaurant, Klarides Plaza, Seymour.

Oxford Animal Shelter — donations are being collected by the Oxford Library staff. Collection box is in the library; 203-888-6944.

Circle of Parents' network — peer support and resources, meets the first and third Tuesdays, 6-8 p.m., First Baptist Church, Ansonia; 1-800-244-5373.

o Legion Pool

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non-perishable food item to be distributed to local food banks.

Those who won't attend the Santa event but wish to donate food may drop off donations on Dec. 10 from 3 p.m. on at the Henry Hamel Environmental Building at Legion Pool.

For more information, visit seymourlandtrust.org. or on Facebook, keyword Seymour Land Trust.

Forum slated to discuss hazard plan

The Valley Council of Governments will host a forum on Thursday, Dec. 1 at 7 p.m. in Derby City Hall to receive residents' input on a natural hazard mitigation plan.

Seymour, Ansonia, Derby and Shelton are developing the plan to identify activities that can be undertaken before natural hazards occur in order to minimize property damage, risk of life and costs, according to VCOG.

At the forum, residents and business owners are invited to share their experiences with natural hazards, including the October snowstorm, Tropical Storm Irene and the April 2007 nor'easter and offer ideas for minimizing the damage.

The plan is being funded by the Federal Emergency Management Agency (FEMA) and will cover the occurrence and consequences of floods, winter storms, tornadoes, hurricanes and tropical storms, wildfires, earthquakes, dam failure and landslides.

It will outline the steps that Ansonia, Derby, Seymour, and Shelton can take to mitigate for future natural hazards.

For more information, call David Elder of VCOG at 203-735-8688 or e-mail him at info1@valleycog.org.

Multi-Jurisdictional Natural Hazard Mitigation Plan
Valley Council of Governments

Valley Council of Governments
Serving the Communities of Ansonia, Derby, Seymour & Shelton

Presented by:
David Murphy, P.E., CFM
Associate
Milone & MacBroom, Inc.

December 1, 2011

History of Hazard Mitigation Planning

- Authority
  - Disaster Mitigation Act of 2000 (amendments to Stafford Act of 1988)
- Goal of Disaster Mitigation Act
  - Encourage disaster preparedness
  - Encourage hazard mitigation measures to reduce losses of life and property

History of Hazard Mitigation Planning

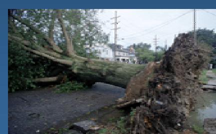
- Local municipalities must have a FEMA-approved Hazard Mitigation Plan in place to receive Federal Grant Funds for Hazard Mitigation Projects
  - PDM (Pre-Disaster Mitigation)
  - HMGP (Hazard Mitigation Grant Program)
  - FMA (Flood Mitigation Assistance)
  - RFC (Repetitive Flood Claims)
  - SRL (Severe Repetitive Loss)
- Shelton currently has an approved plan

History of Hazard Mitigation Planning

State	Description	Grant
Connecticut	Home elevations	$641,025
Connecticut	Culvert replacement	$500,000
Connecticut	Home acquisition	$411,000
Connecticut	East Haven home elevation	$75,206
Connecticut	Home elevation	$64,575
Connecticut	Home elevation	$56,700
Maine	Floodplain acquisition and structure removal	$2,157,678
Massachusetts	Downtown flood mitigation/culvert replacement	$3,000,000
Massachusetts	Pond flood hazard project	$1,745,700
Massachusetts	Flood hazard mitigation project	$1,079,925
Massachusetts	Culvert project	$525,000
Massachusetts	Housing elevation and retrofit	$473,640
Massachusetts	Housing elevation and retrofit	$449,935
Massachusetts	Road mitigation project	$186,348
Massachusetts	Flood mitigation project	$145,503
New Hampshire	Water planning for firefighting	$134,810
New Hampshire	Culvert project	$112,500
New Hampshire	Box culvert project	$102,000
New Hampshire	Culvert project	$72,750
New Hampshire	Dry hydrants	$15,251
New York	Beach road elevation	$1,792,521
New York	Subdivision utilities: overhead to underground	$300,767
New York	WWTP Floodwall construction	$223,200
New York	Culvert project	$122,664
Vermont	Fluvial erosion risk assessment	$337,498
Vermont	Road mitigation project	$140,441
Vermont	Inundation & erosion controls to a public building	$99,188

What is a Natural Hazard?

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



What is Hazard Mitigation?

- ***Pre-disaster*** actions that reduce or eliminate long-term risk to people, property, and resources from natural hazards and their effects

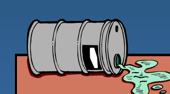
Long-Term Goals of Hazard Mitigation

- Reduce loss of life and damage to property and infrastructure
- Reduce the cost to residents and businesses
- Educate residents and policy-makers about natural hazard risk and vulnerability
- Connect hazard mitigation planning to other community planning efforts
- Enhance and preserve natural resource systems in the community

What a Hazard Mitigation Plan Does Not Address

- Terrorism and Sabotage

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



Components of Hazard Mitigation Planning Process

- Identify natural hazards that could occur in the region
- Evaluate the vulnerability of structures and populations and identify critical facilities and areas of concern
- Assess adequacy of mitigation measures currently in place such as regulations and emergency services
- Evaluate potential mitigation measures that could be undertaken to reduce risk and vulnerability
- Develop recommendations for future mitigation actions

Critical Facilities

- Schools – when used as shelters
- Other shelters
- Emergency operations centers
- Municipal facilities such as City Halls and Town Hall
- Fire and Police Departments
- Public Works and Highway Garages
- Hospitals
- Assisted Living and Nursing Homes

Potential Mitigation Categories

Potential Mitigation Measures

- 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

Primary Natural Hazards Facing the Region

- Inland flooding
- Coastal flooding and sea level rise
- Hurricanes and tropical storms
- Summer storms and tornadoes
- Winter storms and nor'easters
- Earthquakes
- Wildfires
- Dam failure
- Landslides

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Inland Flooding

- Riverine/Overbank
- Shallow
- Nuisance
- Poor drainage

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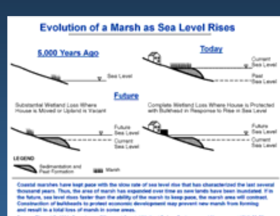
Coastal Flooding

- Lower Housatonic River is tidal
- Combination of high flows and storm surge
- Sea level rise causes
  - Accelerated coastal erosion
  - Inundation
  - Increased incidence of flooding



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Hurricanes and Tropical Storms

- Strong winds
- Heavy rain / flooding

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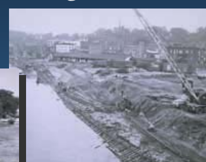
Hurricanes and Tropical Storms

- Hurricanes of the 1950s devastated the region





Photos courtesy of http://www.cthistoryonline.org/cdm-cho/cho/journeys/j_infra_disast_1955.html

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Summer Storms and Tornadoes

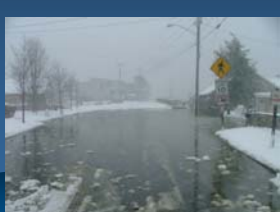
- Tornadoes
  - Wethersfield in 2009
  - Bridgeport & Shelton in 2010
  - Springfield in 2011
- Downbursts
- Lightning
- Heavy rain
- Hail

Photos courtesy of the Hartford Courant


MILONE & MACBROOM®

Winter Storms and Nor'easters

- Blizzards and nor'easters
- Coastal flooding
- Heavy snow and drifts
- Freezing rain / ice
- Downed trees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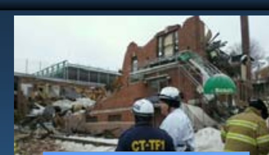
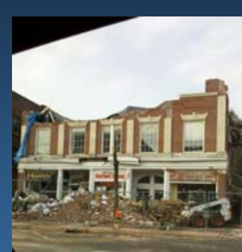
Winter Storms and Nor'easters

- Collapsed Buildings

Photos courtesy of the Hartford Courant

MILONE & MACBROOM®

Earthquakes

- Chester, CT experienced a magnitude 2.0 earthquake on March 11, 2008
- Did everyone feel the Virginia earthquake earlier this year?
- Can cause dam failure, shaking, liquefaction, slides/slumps

Photos courtesy of FEMA

MILONE & MACBROOM®

Wildfires

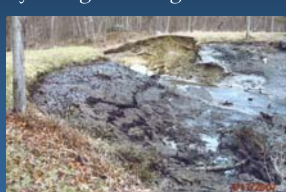
- Fire
- Heat
- Smoke
- April is the month of maximum risk in Connecticut

Photos courtesy of FEMA and the Town of Sherman, CT

MILONE & MACBROOM®

Dam Failure

- Severe rains or earthquakes can cause failure
- Possibility of loss of life and millions of dollars in property damage
- Approximately 20 registered high-hazard dams in region



Recent dam failure in Sherman, CT

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Landslides

- Recent slide in Shelton
- Steep topography and dense development in the Valley region

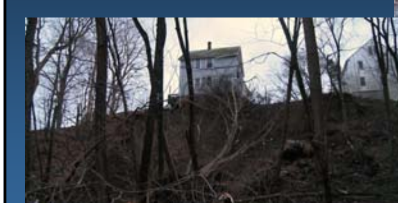
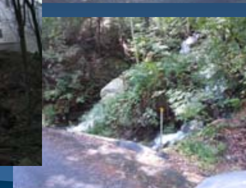


Photo courtesy of New Haven Register



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Area-Specific Problems

- Housatonic River throughout region
- Naugatuck River throughout region
- Far Mill River watershed in Shelton
- Bladens River & Little River in Seymour
- Witek Reservoirs outlet stream/Gilbert Street in Derby
- Sodom Lane in Derby
- Beaver Brook tributary in Ansonia

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Area-Specific Problems

- "Shallow flooding" zone in downtown Shelton
- Indian Well Road in Shelton
- Wakelee Ave, Ells Street, Route 8 in Ansonia
- Route 34 in Seymour
- Slides in Shelton
- Slides in Derby
- Slides in Ansonia

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Flooding

- Riverine – Housatonic River at Maples Neighborhood

- *Numerous Repetitive Loss Properties are located in this area*

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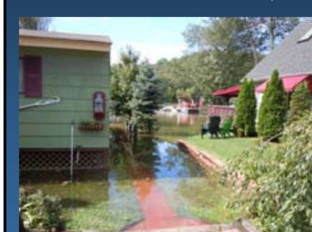
Flooding

- Riverine – Housatonic River at McConney's Grove and Roosevelt Drive in Derby



- *Several Repetitive Loss Properties are located in this area*

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Flooding

- Riverine – Housatonic River at Seymour

Flooding

- Riverine – Naugatuck River

- *Much of the river is lined by a levee system*

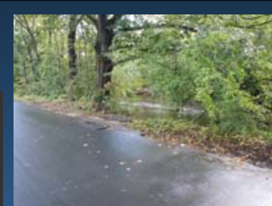
Flooding

- Riverine – Far Mill River watershed including Means Brook
  - Undersized culverts and bridges, structures in floodplains

  - *Several Repetitive Loss Properties are located in this watershed*

Flooding

- Riverine – Little River and Bladens River



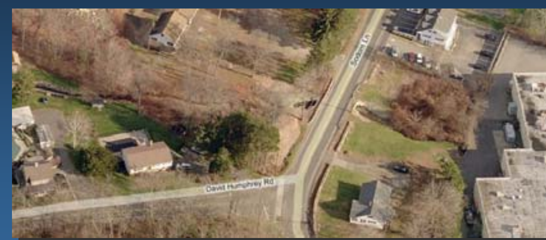
- *Low-lying areas are flooded, affecting homes and streets*

Flooding

- Witek Reservoirs outlet stream/ Gilbert Street area

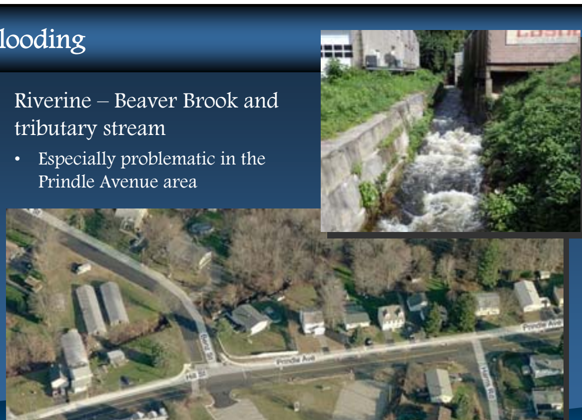
Flooding

- Riverine – Sodom Lane & nearby areas



Flooding

- Riverine – Beaver Brook and tributary stream
  - Especially problematic in the Prindle Avenue area

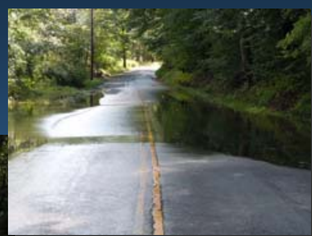


Flooding

- FEMA "Shallow" Special Flood Hazard Area in Shelton

Flooding

- Nuisance flooding along Indian Well Road
  - River backwater
  - Small stream crossings



MILONE & MACBROOM®

Other Nuisance Flooding

- Hillside Avenue, Shelton – drainage problems
- Wakelee Ave, Ansonia – drainage problems
- Ells Street, Ansonia – unnamed stream floods homes
- Route 8, Ansonia – ponding in residential area
- Route 34, Seymour – runoff and drainage issues

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Other Nuisance Flooding

- Poor drainage networks throughout the region

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Landslides in Shelton, Derby, and Ansonia

- Slides in Shelton
  - Division Ave
  - Indian Well Road
  - Shelton Ave/Wooster Street
  - North Oak Drive
- Slides in Derby
  - Commodore Commons
  - Condos along Derby Avenue
- Slides in Ansonia
  - Platt Street
  - South Main Street

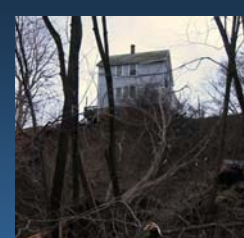

Photo courtesy of New Haven Register

MILONE & MACBROOM®

Next Steps

- Incorporate input from residents
- Rank hazard vulnerabilities
- Develop mitigation strategies
- Prepare the draft plan with recommendations for review by the municipalities and the public
- Adopt and implement the plan

Questions & Additions

APPENDIX D
RECORDS OF MUNICIPAL ADOPTION

RESOLUTION

City of Ansonia

Aldermen ______All______, of the ______All______ Ward, introduced the following Resolution: **City of Ansonia Multi-Jurisdiction Hazard Mitigation Plan**

WHEREAS, the Disaster Mitigation Act of 2000 encourages communities to prepare a Hazard Mitigation Plan to outline natural hazard vulnerability and potential mitigation measures; and

WHEREAS, in light of recent natural disasters that severely impacted public infrastructure and private properties in the City of Ansonia, the City participated in the development of a Multi-Jurisdiction Hazard Mitigation Plan through the Valley Council of Governments to understand local conditions and plan accordingly; and

WHEREAS, the primary goal of the plan is to reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters; and

WHEREAS, the Hazard Mitigation Plan recommends many hazard mitigation actions that will protect the people and property affected by the natural hazards that potentially face the city; and

WHEREAS, some of the recommended mitigation actions may qualify for Federal funding but only if the City of Ansonia officially adopts the Hazard Mitigation Plan; and

WHEREAS, Public information meetings were held to solicit public input and recommendations and to review the updated plan as required by law;

THEREFORE BE IT RESOLVED by the Board of Aldermen of the City of Ansonia that the Multi-Jurisdiction Hazard Mitigation Plan (Ansonia portions) is hereby adopted as an official plan of the City of Ansonia and that the Mayor and Board of Aldermen shall implement the provisions of the Plan relevant to Ansonia; the Mayor is empowered to execute any necessary documents to implement and proceed with the plan and that all municipal departments will report regularly on their activities, accomplishments, and progress relative to the Plan for the City of Ansonia.

BE IT FURTHER RESOLVED that the City of Ansonia is authorized to apply for and accept any future Federal or State grant assistance to accomplish the goals of the plan.

Approved December 14, 2012 Adopted December 11, 2012

J. T. Della Volpe
Mayor

Madeline H. Bottone
City Clerk

Certification is hereby made that this is a true and exact copy of Document on record in the Office of Town and City Clerk Ansonia, Conn.

JAN 08 2013
Date

Madeline H. Bottone
Town & City Clerk

RESOLUTION

CITY OF DERBY
MULTI-JURISDICTION HAZARD MITIGATION PLAN

WHEREAS, the Disaster Mitigation Act of 2000 encourages communities to prepare a Hazard Mitigation Plan to outline natural hazard vulnerability and potential mitigation measures; and

WHEREAS, in light of recent natural disasters that severely impacted public infrastructure and private properties in the city of Derby, the city participated in the development of a Multi-Jurisdiction Hazard Mitigation Plan through the Valley Council of Governments to understand local conditions and plan accordingly; and

WHEREAS, the primary goal of the plan is to reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters; and

WHEREAS, the Hazard Mitigation Plan recommends many hazard mitigation actions that will protect the people and property affected by the natural hazards that potentially face the city; and

WHEREAS, some of the recommended mitigation actions may qualify for federal funding but only if the City of Derby officially adopts the Hazard Mitigation Plan; and

WHEREAS, public information meetings were held to solicit public input and recommendations and to review the updated plan as required by law;

BE IT RESOLVED by the Board of Aldermen of the City of Derby that the Multi-Jurisdiction Hazard Mitigation Plan (Derby portions) is hereby adopted as an official plan of the City of Derby and that the Mayor and Board of Aldermen shall implement the provisions of the plan relevant to Derby; and that all municipal departments will report regularly on their activities, accomplishments, and progress relative to the plan for the City of Derby.

BE IT FURTHER RESOLVED that the City of Derby is authorized to apply for and accept any future federal or state grant assistance to accomplish the goals of the plan.

Adopted this **27th** of **December, 2012** by the Board of Aldermen of Derby, Connecticut.

Anthony Staffieri, Mayor

Laura A. Wabno, City/Town Clerk

Office Of The First Selectman
Town of Seymour
1 First Street
Seymour, Connecticut 06483

W. Kurt Miller
First Selectman

RESOLUTION

TOWN OF SEYMOUR
MULTI-JURISDICTION HAZARD MITIGATION PLAN

WHEREAS, the Disaster Mitigation Act of 2000 encourages communities to prepare a Hazard Mitigation Plan to outline natural hazard vulnerability and potential mitigation measures; and

WHEREAS, in light of recent natural disasters that severely impacted public infrastructure and private properties in the town of Seymour, the town participated in the development of a Multi-Jurisdiction Hazard Mitigation Plan through the Valley Council of Governments to understand local conditions and plan accordingly; and

WHEREAS, the primary goal of the plan is to reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters; and

WHEREAS, the Hazard Mitigation Plan recommends many hazard mitigation actions that will protect the people and property affected by the natural hazards that potentially face the town; and

WHEREAS, some of the recommended mitigation actions may qualify for federal funding but only if the Town of Seymour officially adopts the Hazard Mitigation Plan; and

WHEREAS, public information meetings were held to solicit public input and recommendations and to review the plan as required by law;

BE IT RESOLVED by the Board of Selectmen of the Town of Seymour that the Multi-Jurisdiction Hazard Mitigation Plan (Seymour portions) is hereby adopted as an official plan of the Town of Seymour and that the First Selectman and Board of Selectmen shall implement the provisions of the plan relevant to Seymour; and that all municipal departments will report regularly on their activities, accomplishments, and progress relative to the plan for the Town of Seymour.

BE IT FURTHER RESOLVED that the Town of Seymour is authorized to apply for and accept any future federal or state grant assistance to accomplish the goals of the plan.

Adopted this 20th day of November, 2012 by the Board of Selectmen of Seymour, Connecticut

____

Telephone: 203-888-2511 • Fax: 203-881-5005 • kmiller@seymourct.org • www.seymourct.org

BOARD OF ALDERMEN
SHELTON, CONNECTICUT

FULL BOARD MEETING
THURSDAY, DECEMBER 13, 2012

Call to Order / Pledge of Allegiance

Alderman Anglace called the meeting of the Board of Aldermen to order at 7 p.m. All those present stood and pledged allegiance to the flag.

Roll Call

Alderman John F. Anglace, Jr., President – present
Alderman Lynne Farrell – excused
Alderman John "Jack" Finn – present
Alderman Stanley Kudej – present
Alderman Noreen McGorty – present
Alderman John P. Papa – present
Alderman Eric McPherson - present
Alderman Anthony Simonetti – excused

Administration:

Corporation Counsel Tom Welch
Attorney Kevin Blake

PUBLIC SESSION

Alderman Anglace asked if any member of the public wished to speak to raise their hand and address the podium.

Judson Crawford, 8 Jordan Avenue, Shelton

I would just like to find out, the Mayor was not in attendance but was any member of the Board of Aldermen invited to be in attendance at the ceremony at the school? The high school? It was for the National Honor Society.

Alderman Anglace: I don't believe any one of us were invited, Judson.

Judson Crawford: There were 59 students who were inducted into the National Honor Society. Thank you.

No one further wished to address the Board, thus Alderman Anglace closed the public portion at this point.

10.2 Multi-Jurisdiction Hazard Mitigation Plan

Alderman Papa MOVED to approve the following resolution:

WHEREAS, the Disaster Mitigation Act of 2000 encourages communities to prepare a Hazard Mitigation Plan to outline natural hazard vulnerability and potential mitigation measures; and

WHEREAS, the city developed an individual Hazard Mitigation Plan several years ago to understand local conditions and plan accordingly; and

WHEREAS, in light of recent natural disasters that severely impacted public infrastructure and private properties in the city of Shelton, the city participated in the development of a Multi-Jurisdiction Hazard Mitigation Plan through the Valley Council of Governments, and

WHEREAS, the primary goal of the plan is to reduce the loss of or a damage to life, property, infrastructure, and natural, cultural, and economic resources from natural disasters; and

WHEREAS, the Hazard Mitigation Plan recommends many hazard mitigation actions that will protect the people and property affected by the natural hazards that potentially face the city; and

WHEREAS, some of the recommended mitigation actions may qualify for federal funding but only if the City of Shelton officially adopts the Hazard Mitigation Plan; and

WHEREAS, the public information meetings were held to solicit public input and recommendations and to review the updated plan as required by law;

BE IT RESOLVED by the Board of Aldermen of the City of Shelton that the Multi-Jurisdiction Hazard Mitigation Plan (Shelton portions) is hereby adopted as an official plan of the City of Shelton and that the Mayor and Board of Aldermen shall implement the provisions of the plan relevant to Shelton; and that all municipal departments will report regularly on their activities, accomplishments, and progress relative to the plan for the City of Shelton.

BE IT FURTHER RESOLVED that the City of Shelton is authorized to apply for and accept any future federal or state grant assistance to accomplish the goals of the plan.

SECONDED by Alderman Finn

Alderman Anglace: Has anyone had a chance to read that plan? I give a lot of credit to the people who stayed up to write it, because it must have taken hours, days, weeks even months to put this together. It is comprehensive and I must say that multijurisdictional plan, having read it, bills on the exemplary job, done by the local Shelton plan- it is well done and it is going to serve a purpose.

A voice vote was taken and the MOTION PASSED 6-0.

10.3 Anti-Litter Committee Appointment

Alderman Papa MOVED to appoint Teresa Cassone-Glick to the Anti-Litter Committee effective immediately.

Teresa Cassone-Glick - R
56 Wakelee Ave. Ext Unit #52
Shelton, Ct 06484
Tel. 203-924-1938

SECONDED by Alderman McPherson. A voice vote was taken and the MOTION PASSED 6-0.

10.4 Conservation Easement – River Run Subdivision at 1017 Howe Avenue

Alderman Papa MOVED to accept the conservation easement on Lots 22 and 22a located within the River Run Subdivision at 1017 Howe Avenue and as shown on the River Run Subdivision Map. Further authorize Mayor Mark A. Lauretti to sign any and all necessary documents to effectuate same.

SECONDED by Alderman McPherson. A voice vote was taken and the MOTION PASSED 6-0.

ADJOURNMENT

Alderman Anglace MOVED to adjourn; SECONDED by Alderman Papa. A voice vote was taken and the MOTION PASSED 6-0.

The meeting adjourned at approximately 8:10 p.m.

Respectfully submitted,

Brittany Gannon, Clerk
Board of Aldermen

DATE APPROVED: 1·21·13 BY: Mark A. Lauretti

Mark A. Lauretti
Mayor, City of Shelton

APPENDIX E
NEWSPAPER ARTICLES ABOUT FLOODING IN 2011

t>

New Haven Register

Serving New Haven, CT

News > Valley

Residents of Shelton's Maples section take latest hit from Housatonic in stride (video)

Published: Tuesday, August 30, 2011

By Jean Falbo-Sosnovich, Register Correspondent
jean.sos@snet.net / Twitter: @nhrvalley

SHELTON — The flood-prone Maples area took another hit from the Housatonic River, but residents took it all in stride. Even though emergency personnel called for an evacuation Saturday ahead of Hurricane Irene, many residents decided to remain in their homes and ride the storm out.

Brian Connolly was one of those residents who stayed, and was amazed by the sight of the rising river.

“I’ve been here 56 years, and this is something I have never seen before,” he said. “The waves coming up the river were 5-6 feet high, it was incredible.”

Connolly spent a good part of the day Monday on cleanup duty, and was fortunately spared any damage to his home and property. The lower level of his three-floor home took in only about an inch of water, far less than what Maples residents incurred back in March, when massive snow melt, coupled with heavy rains, caused the Housatonic to crest 10-12 feet higher than normal.

water's edge. "And on a day like today, look at this view, this is what I have all year long."

The lower portion of the Maples roadway was still under water Monday afternoon, and many residents were using sump pumps to rid their basements of water. Others, who live at the upper portion of the Maples, incurred some damage from falling tree limbs.

All were still without power late Monday, but many residents, including Connolly, had generators humming in their yards, enabling them to cook inside and take showers.

Those without generators opted to fire up their gas grills, and were glad to have been spared from any major damage this time around.

In Seymour, First Selectman Paul Roy said Bungay Road, between Bungay School and Botsford Road remained closed Monday, due to large trees that had fallen down and became entangled in power lines. Roy said about 80 percent of Seymour's residents were without power since Sunday, but CL&P has been working around the clock to restore Roy said provisions were made to ensure seniors at the town's elderly housing complexes were a priority, and even without power, there were no reports of any medical emergencies.

All those who were evacuated from their Derby Avenue homes, which borders the Naugatuck River, late Saturday, were able to return back to their homes Sunday afternoon, Roy said, and spent the day cleaning up flooded basements.

As Housatonic rises, mandatory evacuation of Maples ordered

Anne Amato, Staff Writer
Updated 03:39 p.m., Thursday, September 8, 2011

Residents at the Maples, a low-lying area along the Housatonic River in Shelton, were at it once again Thursday after water flowed over the banks of the river and into their homes.

"I even have fish swimming in my garage, that's a first," said Brian Johnson. "There's minnows swimming in there."

Johnson was one of a number of residents gearing up for even more flooding when the river crested after 2 p.m.

He said he first realized there would be a problem when police came down the street with bullhorns around 6 a.m., alerting them to evacuate. He said the alert from the city gave him and other homeowners time to move items out of the way of the incoming flood waters. "I'm really not happy about this situation."

By noon, there was already several feet of water on the roadway and Johnson was getting his generator ready, once again, as UI crews arrived, prepared to shut off power to about two dozen homes at the lower end of the street.

Fred Anthony, another Maples resident, said he just bought his home two months ago and joked he wanted to have "a house on the water, not in it."

"I've learned a lot since the last flood" from Tropical Storm Irene, he said. Early Thursday he called Home Depot to see if they had any generators. "They did and I bought one," he said, adding he was prepared for power to be turned off.

Anthony was also wearing a pair of knee-high boots. "They were left behind by the home's former owner," he said.

City officials had asked Maples residents to "self-evacuate" earlier in the day, but ordered a "mandatory evacuation" for the lower section of the area at 3 p.m., according to Police Chief Joel Hurliman.

Across the river at McConney Grove in Derby, residents also prepared for more flooding and several planned also stayed put.

"I wasn't expecting this," said Dave Zitnay, who has lived there seven years. "I looked outside around 6 a.m. and saw the water rising." He said residents on his street received a call from the city a short time later, alerting them to the possible flooding.

"Look, the water is still rising," he said, pointing to an area at the side of his house already under about a foot of water.

Mark Beyer, who owns a construction company, said he loses money every time there's flooding at his home. "I have to leave a job to take care of this," he said, after donning boots to wade through the water.

Denise Koundry was also surveying the flood waters, once again, in her basement on Roosevelt Drive, Oxford. "The water right now is about two feet from the ceiling," she said.

After 15 years living on the banks of the Housatonic, she's experienced flooding before. "But we've recently had three of the top 10 flooding events," she said. "How is that possible? It seems like someone isn't doing their job." Koundry is pointing the finger at FirstLight Power, which oversees operations at the Stevenson Dam.

"This time, we got no warning from them at all," she said, adding she first realized there might be flooding at 7 a.m. Thursday. "Right now, we have as much water on the property as we did during Irene."

Residents in low-lying areas of the Housatonic have been flooded out three times in under six months.

The first time was March 7 when melting snow and heavy rain caused the river to rise. Residents also blamed FirstLight, operator of the Stevenson Dam, that time after water was released from floodgates. Residents have complained to government officials that they should have received more warning.

The second flooding came from Tropical Storm Irene. Thursday's flooding was because of heavy rains earlier this week.

At 2:30 p.m., the Housatonic River was at 20.52 feet -- well above the 11-foot flood stage -- and now in the major flood category.

The Housatonic rose more rapidly than expected. At 6 a.m., it was 15 feet.

The river is forecast to crest to about 20.8 feet by 2 p.m. Thursday, then begin falling. That would make it the seventh highest floodwaters in the Housatonic's history.

Heavy rain across Connecticut

Updated: Friday, 08 Jul 2011, 11:05 PM EDT
Published : Friday, 08 Jul 2011, 5:42 PM EDT

SEYMOUR, Conn. (WTNH) - Folks are dealing with severe flooding in Seymour.

Route 67 is closed between Allens Plumbing and Church Street because of debris in the roadway.

Bridges and roads are getting washed out, and authorities are rescuing people from cars.

The main drainage system at the Seymour Stop and Shop broke and water poured through the ceiling.

The major flooding is occurring on Route 8 Northbound between exits 22 and 23 where the road had reopened, but traffic is moving slowly.

severe rain is currently a concern across the state.

According to CL&P there is about 1,500 power outages in the state.

APPENDIX F
HAZUS DOCUMENTATION FOR FLOODS

Quick Assessment Report

January 2, 2012

Study Region : VCOG-2

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	58
Number of Census Tracts	16
Number of People in the Region	84,500

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	28,765	5,540,090
Commercial	1,687	1,104,703
Other	1,046	993,999
Total	31,498	7,638,792

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	17	1	0	0	18
50	244	17	1	0	262
100	1,599	158	5	1	1,763
200	4,465	704	33	16	5,218
500	8,797	2,572	294	174	11,836
1000	10,666	4,642	911	576	16,796

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	23	1	0	0	25
50	271	19	1	0	291
100	1,714	172	7	1	1,894
200	4,792	787	46	16	5,642
500	9,440	2,930	382	177	12,929
1000	11,398	5,258	1,169	585	18,410

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	21	3
500	300	63
1000	1,231	271

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption*
ReturnPeriod	*Residential*	*Total*	*(Income) Losses*
10	0	0	0
20	405	405	2
50	10,666	11,299	602
100	38,203	42,134	3,507
200	97,303	114,421	13,212
500	303,187	385,379	49,250
1000	644,975	842,100	112,899
Annualized	2,970	3,750	455

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.

Building Damage by Building Type: 10 - year Event

January 02, 2012

	Average Damage State (%)				
	None	**Minor**	**Moderate**	**Severe**	**Destruction**
Connecticut					
Fairfield					
Concrete	100.00	0.00	0.00	0.00	0.00
Masonry	100.00	0.00	0.00	0.00	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	100.00	0.00	0.00	0.00	0.00
Wood	100.00	0.00	0.00	0.00	0.00
Total	100.00	0.00	0.00	0.00	0.00
New Haven					
Concrete	100.00	0.00	0.00	0.00	0.00
Masonry	100.00	0.00	0.00	0.00	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	100.00	0.00	0.00	0.00	0.00
Wood	100.00	0.00	0.00	0.00	0.00
Total	100.00	0.00	0.00	0.00	0.00
Total	100.00	0.00	0.00	0.00	0.00
Study Region Average	100.00	0.00	0.00	0.00	0.00

Building Damage by Building Type: 20 - year Event

January 02, 2012

	Average Damage State (%)				
	None	**Minor**	**Moderate**	**Severe**	**Destruction**
Connecticut					
Fairfield					
Concrete	99.75	0.25	0.00	0.00	0.00
Masonry	99.76	0.23	0.01	0.00	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	99.76	0.24	0.00	0.00	0.00
Wood	99.98	0.02	0.00	0.00	0.00
Total	99.82	0.17	0.00	0.00	0.00
New Haven					
Concrete	99.72	0.28	0.00	0.00	0.00
Masonry	99.70	0.28	0.01	0.00	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	99.73	0.27	0.00	0.00	0.00
Wood	99.97	0.03	0.00	0.00	0.00
Total	99.79	0.21	0.01	0.00	0.00
Total	99.80	0.19	0.00	0.00	0.00
Study Region Average	99.80	0.19	0.00	0.00	0.00

Building Damage by Building Type: 50 - year Event

January 02, 2012

	Average Damage State (%)				
	None	Minor	Moderate	Severe	Destruction
Connecticut					
Fairfield					
Concrete	99.05	0.94	0.01	0.00	0.00
Masonry	98.49	1.31	0.19	0.01	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	99.09	0.89	0.03	0.00	0.00
Wood	99.36	0.62	0.02	0.00	0.00
Total	99.04	0.88	0.07	0.00	0.00
New Haven					
Concrete	98.89	1.10	0.01	0.00	0.00
Masonry	98.20	1.53	0.26	0.01	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	98.94	1.03	0.03	0.00	0.00
Wood	99.29	0.68	0.03	0.00	0.00
Total	98.87	1.02	0.10	0.01	0.00
Total	98.95	0.95	0.09	0.00	0.00
Study Region Average	98.95	0.95	0.09	0.00	0.00

Building Damage by Building Type: 100 - year Event

January 02, 2012

	Average Damage State (%)				
	None	Minor	Moderate	Severe	Destruction
Connecticut					
Fairfield					
Concrete	96.37	3.41	0.21	0.00	0.00
Masonry	93.54	5.07	1.32	0.07	0.00
Manufactured Homes	99.98	0.02	0.00	0.00	0.00
Steel	96.40	3.22	0.35	0.03	0.00
Wood	94.91	4.82	0.25	0.01	0.00
Total	95.70	3.67	0.60	0.03	0.00
New Haven					
Concrete	95.45	4.22	0.33	0.00	0.00
Masonry	92.64	5.51	1.76	0.10	0.00
Manufactured Homes	100.00	0.00	0.00	0.00	0.00
Steel	95.59	3.98	0.41	0.03	0.00
Wood	94.51	5.17	0.29	0.02	0.00
Total	95.01	4.16	0.79	0.04	0.00
Total	95.36	3.91	0.69	0.04	0.00
Study Region Average	95.36	3.91	0.69	0.04	0.00

Building Damage by Building Type: 200 - year Event

January 02, 2012

	Average Damage State (%)				
	None	Minor	Moderate	Severe	Destruction
Connecticut					
Fairfield					
Concrete	87.32	10.10	2.47	0.12	0.00
Masonry	81.71	13.03	4.82	0.39	0.05
Manufactured Homes	99.82	0.12	0.04	0.00	0.01
Steel	87.37	9.59	2.69	0.35	0.00
Wood	83.13	14.97	1.75	0.10	0.05
Total	86.55	10.29	2.89	0.24	0.02
New Haven					
Concrete	86.35	10.80	2.74	0.11	0.00
Masonry	82.18	12.20	5.22	0.37	0.02
Manufactured Homes	99.98	0.02	0.01	0.00	0.00
Steel	86.65	10.29	2.80	0.25	0.00
Wood	84.12	14.21	1.53	0.10	0.04
Total	86.55	10.16	3.06	0.21	0.01
Total	86.55	10.22	2.98	0.23	0.02
Study Region Average	86.55	10.22	2.98	0.23	0.02

Building Damage by Building Type: 500 - year Event

January 02, 2012

	Average Damage State (%)				
	None	**Minor**	**Moderate**	**Severe**	**Destruction**
Connecticut					
Fairfield					
Concrete	66.73	19.15	12.10	2.02	0.00
Masonry	61.04	22.98	13.65	1.96	0.37
Manufactured Homes	99.22	0.41	0.28	0.02	0.08
Steel	66.93	18.31	11.97	2.77	0.02
Wood	62.35	29.20	7.02	0.87	0.56
Total	68.67	19.08	10.29	1.74	0.22
New Haven					
Concrete	63.22	20.33	14.08	2.37	0.00
Masonry	60.95	22.30	14.67	1.84	0.24
Manufactured Homes	99.87	0.06	0.04	0.00	0.01
Steel	63.81	19.66	13.62	2.90	0.01
Wood	62.00	29.67	7.01	0.82	0.51
Total	67.41	19.36	11.30	1.78	0.15
Total	68.04	19.22	10.80	1.76	0.19
Study Region Average	68.04	19.22	10.80	1.76	0.19

Building Damage by Building Type: 1000 - year Event

January 02, 2012

	Average Damage State (%)				
	None	**Minor**	**Moderate**	**Severe**	**Destruction**
Connecticut					
Fairfield					
Concrete	49.22	20.70	22.04	8.04	0.00
Masonry	45.13	26.20	22.08	5.50	1.09
Manufactured Homes	98.35	0.63	0.64	0.08	0.29
Steel	49.49	19.88	21.38	9.16	0.08
Wood	45.89	35.75	13.69	2.78	1.89
Total	54.13	21.70	17.85	5.63	0.69
New Haven					
Concrete	45.37	21.76	24.07	8.80	0.00
Masonry	45.30	26.06	23.04	4.87	0.73
Manufactured Homes	99.76	0.09	0.09	0.01	0.04
Steel	45.96	21.23	23.13	9.63	0.05
Wood	45.20	36.67	13.85	2.59	1.70
Total	52.88	22.18	18.84	5.60	0.50
Total	53.50	21.94	18.34	5.62	0.59
Study Region Average	53.50	21.94	18.34	5.62	0.59

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Building Damage by Count by Building Type: 10 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Concrete	87	0	0	0	0	87
Masonry	980	0	0	0	0	980
Manufactured Homes	283	0	0	0	0	283
Steel	546	0	0	0	0	546
Wood	12,124	0	0	0	0	12,124
Total	**14,020**	**0**	**0**	**0**	**0**	**14,020**
New Haven						
Concrete	137	0	0	0	0	137
Masonry	1,749	0	0	0	0	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	686	0	0	0	0	686
Wood	13,409	0	0	0	0	13,409
Total	**15,983**	**0**	**0**	**0**	**0**	**15,983**
Total	**30,003**	**0**	**0**	**0**	**0**	**30,003**
Study Region Total	**30,003**	**0**	**0**	**0**	**0**	**30,003**

Building Damage by Count by Building Type: 20 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Concrete	87	0	0	0	0	87
Masonry	977	3	0	0	0	980
Manufactured Homes	283	0	0	0	0	283
Steel	545	1	0	0	0	546
Wood	12,123	1	0	0	0	12,124
Total	**14,014**	**6**	**0**	**0**	**0**	**14,020**
New Haven						
Concrete	137	0	0	0	0	137
Masonry	1,743	6	0	0	0	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	684	2	0	0	0	686
Wood	13,405	3	0	0	0	13,409
Total	**15,970**	**12**	**1**	**0**	**0**	**15,983**
Total	**29,984**	**18**	**1**	**0**	**0**	**30,003**
Study Region Total	**29,984**	**18**	**1**	**0**	**0**	**30,003**

Building Damage by Count by Building Type: 50 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Concrete	86	1	0	0	0	87
Masonry	963	15	2	0	0	980
Manufactured Homes	283	0	0	0	0	283
Steel	540	5	0	0	0	546
Wood	12,042	80	2	0	0	12,124
Total	**13,914**	**101**	**4**	**0**	**0**	**14,020**
New Haven						
Concrete	135	2	0	0	0	137
Masonry	1,711	32	6	0	0	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	678	7	0	0	0	686
Wood	13,308	97	4	0	0	13,409
Total	**15,835**	**138**	**10**	**1**	**0**	**15,983**
Total	**29,749**	**239**	**14**	**1**	**0**	**30,003**
Study Region Total	**29,749**	**239**	**14**	**1**	**0**	**30,003**

Building Damage by Count by Building Type: 100 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Concrete	83	4	0	0	0	87
Masonry	909	55	15	1	0	980
Manufactured Homes	282	0	0	0	0	283
Steel	523	20	3	0	0	546
Wood	11,453	638	32	1	0	12,124
Total	**13,250**	**717**	**50**	**2**	**0**	**14,020**
New Haven						
Concrete	130	7	1	0	0	137
Masonry	1,598	109	40	2	0	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	653	29	3	0	0	686
Wood	12,617	747	42	2	0	13,409
Total	**15,001**	**892**	**85**	**4**	**0**	**15,983**
Total	**28,251**	**1,609**	**136**	**7**	**1**	**30,003**
Study Region Total	**28,251**	**1,609**	**136**	**7**	**1**	**30,003**

Building Damage by Count by Building Type: 200 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Concrete	73	11	3	0	0	87
Masonry	782	138	54	5	1	980
Manufactured Homes	278	3	1	0	0	283
Steel	466	59	18	3	0	546
Wood	9,879	1,990	236	12	8	12,124
Total	**11,477**	**2,202**	**312**	**20**	**8**	**14,020**
New Haven						
Concrete	115	17	5	0	0	137
Masonry	1,392	235	114	7	0	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	586	76	22	3	0	686
Wood	11,132	2,036	221	13	7	13,409
Total	**13,227**	**2,364**	**361**	**23**	**7**	**15,983**
Total	**24,705**	**4,566**	**674**	**43**	**15**	**30,003**
Study Region Total	**24,705**	**4,566**	**674**	**43**	**15**	**30,003**

Building Damage by Count by Building Type: 500 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Concrete	51	20	14	2	0	87
Masonry	556	242	154	24	4	980
Manufactured Homes	262	11	8	0	2	283
Steel	336	113	75	21	0	546
Wood	7,160	3,839	924	120	81	12,124
Total	**8,365**	**4,226**	**1,175**	**167**	**87**	**14,020**
New Haven						
Concrete	79	31	23	4	0	137
Masonry	986	418	306	35	3	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	415	145	101	25	0	686
Wood	7,949	4,254	1,005	122	80	13,409
Total	**9,430**	**4,849**	**1,435**	**186**	**83**	**15,983**
Total	**17,795**	**9,075**	**2,610**	**353**	**171**	**30,003**
Study Region Total	**17,795**	**9,075**	**2,610**	**353**	**171**	**30,003**

Building Damage by Count by Building Type: 1000 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Concrete	32	21	26	9	0	87
Masonry	376	275	253	66	12	980
Manufactured Homes	239	18	17	2	7	283
Steel	226	123	133	64	1	546
Wood	5,051	4,686	1,736	377	273	12,124
Total	**5,923**	**5,123**	**2,164**	**518**	**292**	**14,020**
New Haven						
Concrete	52	32	38	14	0	137
Masonry	693	484	471	91	10	1,749
Manufactured Homes	2	0	0	0	0	2
Steel	287	157	166	75	1	686
Wood	5,617	5,227	1,925	378	262	13,409
Total	**6,651**	**5,900**	**2,601**	**559**	**273**	**15,983**
Total	**12,574**	**11,022**	**4,765**	**1,076**	**565**	**30,003**
Study Region Total	**12,574**	**11,022**	**4,765**	**1,076**	**565**	**30,003**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : VCOG-2

Scenario : Probabilistic

Building Damage by Count by General Occupancy 10 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Agriculture	60	0	0	0	0	60
Commercial	754	0	0	0	0	754
Education	20	0	0	0	0	20
Government	15	0	0	0	0	15
Industrial	347	0	0	0	0	347
Religion	40	0	0	0	0	40
Residential	13,415	0	0	0	0	13,415
Total	**14,651**	**0**	**0**	**0**	**0**	**14,651**
New Haven						
Agriculture	58	0	0	0	0	58
Commercial	933	0	0	0	0	933
Education	29	0	0	0	0	29
Government	29	0	0	0	0	29
Industrial	371	0	0	0	0	371
Religion	77	0	0	0	0	77
Residential	15,350	0	0	0	0	15,350
Total	**16,847**	**0**	**0**	**0**	**0**	**16,847**
Total	**31,498**	**0**	**0**	**0**	**0**	**31,498**
Study Region Total	**31,498**	**0**	**0**	**0**	**0**	**31,498**

Building Damage by Count by General Occupancy 20 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Agriculture	60	0	0	0	0	60
Commercial	752	2	0	0	0	754
Education	20	0	0	0	0	20
Government	15	0	0	0	0	15
Industrial	346	1	0	0	0	347
Religion	40	0	0	0	0	40
Residential	13,410	5	0	0	0	13,415
Total	**14,643**	**8**	**0**	**0**	**0**	**14,651**
New Haven						
Agriculture	58	0	0	0	0	58
Commercial	931	2	0	0	0	933
Education	29	0	0	0	0	29
Government	29	0	0	0	0	29
Industrial	370	1	0	0	0	371
Religion	77	0	0	0	0	77
Residential	15,337	12	1	0	0	15,350
Total	**16,830**	**16**	**1**	**0**	**0**	**16,847**
Total	**31,473**	**23**	**1**	**0**	**0**	**31,498**
Study Region Total	**31,473**	**23**	**1**	**0**	**0**	**31,498**

Building Damage by Count by General Occupancy 50 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Agriculture	59	1	0	0	0	60
Commercial	746	7	0	0	0	754
Education	20	0	0	0	0	20
Government	15	0	0	0	0	15
Industrial	343	4	0	0	0	347
Religion	40	0	0	0	0	40
Residential	13,308	102	5	0	0	13,415
Total	**14,532**	**113**	**6**	**0**	**0**	**14,651**
New Haven						
Agriculture	57	1	0	0	0	58
Commercial	923	9	0	0	0	933
Education	29	0	0	0	0	29
Government	29	0	0	0	0	29
Industrial	367	4	0	0	0	371
Religion	76	1	0	0	0	77
Residential	15,195	142	12	1	0	15,350
Total	**16,676**	**157**	**13**	**1**	**0**	**16,847**
Total	**31,207**	**271**	**19**	**1**	**0**	**31,498**
Study Region Total	**31,207**	**271**	**19**	**1**	**0**	**31,498**

Building Damage by Count by General Occupancy 100 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Agriculture	57	3	0	0	0	60
Commercial	720	30	4	0	0	754
Education	19	1	0	0	0	20
Government	14	1	0	0	0	15
Industrial	332	14	1	0	0	347
Religion	38	2	0	0	0	40
Residential	12,643	714	57	1	0	13,415
Total	**13,822**	**764**	**63**	**2**	**0**	**14,651**
New Haven						
Agriculture	54	3	0	0	0	58
Commercial	886	41	5	0	0	933
Education	28	1	0	0	0	29
Government	28	1	0	0	0	29
Industrial	353	16	2	0	0	371
Religion	73	4	0	0	0	77
Residential	14,360	884	101	4	1	15,350
Total	**15,782**	**951**	**109**	**5**	**1**	**16,847**
Total	**29,604**	**1,714**	**172**	**7**	**1**	**31,498**
Study Region Total	**29,604**	**1,714**	**172**	**7**	**1**	**31,498**

Building Damage by Count by General Occupancy 200 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Agriculture	48	8	2	1	0	60
Commercial	635	91	24	3	0	754
Education	17	2	1	0	0	20
Government	13	2	0	0	0	15
Industrial	294	40	11	2	0	347
Religion	34	5	1	0	0	40
Residential	10,908	2,166	318	14	9	13,415
Total	**11,949**	**2,316**	**357**	**21**	**9**	**14,651**
New Haven						
Agriculture	48	7	2	1	0	58
Commercial	790	111	28	3	0	933
Education	25	3	1	0	0	29
Government	24	4	1	0	0	29
Industrial	316	42	11	2	0	371
Religion	65	10	2	0	0	77
Residential	12,639	2,299	386	19	7	15,350
Total	**13,907**	**2,476**	**431**	**26**	**7**	**16,847**
Total	**25,856**	**4,792**	**787**	**46**	**16**	**31,498**
Study Region Total	**25,856**	**4,792**	**787**	**46**	**16**	**31,498**

Building Damage by Count by General Occupancy 500 - year Event

January 02, 2012

	# of Buildings					
	None	Minor	Moderate	Severe	Destruction	Total
Connecticut						
Fairfield						
Agriculture	33	16	7	3	1	60
Commercial	456	178	97	22	0	754
Education	12	5	3	0	0	20
Government	9	3	2	0	0	15
Industrial	211	77	46	13	1	347
Religion	25	10	4	1	0	40
Residential	7,918	4,124	1,144	138	90	13,415
Total	**8,665**	**4,413**	**1,303**	**178**	**92**	**14,651**
New Haven						
Agriculture	33	15	6	3	1	58
Commercial	558	222	125	28	0	933
Education	18	7	4	1	0	29
Government	17	7	4	1	0	29
Industrial	222	83	51	14	1	371
Religion	46	20	9	2	0	77
Residential	9,010	4,673	1,428	156	83	15,350
Total	**9,904**	**5,026**	**1,627**	**204**	**85**	**16,847**
Total	**18,569**	**9,440**	**2,930**	**382**	**177**	**31,498**
Study Region Total	**18,569**	**9,440**	**2,930**	**382**	**177**	**31,498**

Building Damage by Count by General Occupancy 1000 - year Event

January 02, 2012

	# of Buildings					
	None	**Minor**	**Moderate**	**Severe**	**Destruction**	**Total**
Connecticut						
Fairfield						
Agriculture	23	19	11	6	1	60
Commercial	306	205	173	68	1	754
Education	8	5	5	2	0	20
Government	6	4	4	2	0	15
Industrial	140	85	81	38	3	347
Religion	17	13	8	3	0	40
Residential	5,589	4,990	2,093	439	304	13,415
Total	**6,090**	**5,321**	**2,374**	**558**	**309**	**14,651**
New Haven						
Agriculture	23	18	10	6	1	58
Commercial	384	253	211	85	1	933
Education	13	8	6	2	0	29
Government	12	7	7	3	0	29
Industrial	156	91	84	38	2	371
Religion	32	24	16	6	0	77
Residential	6,380	5,676	2,549	472	272	15,350
Total	**6,998**	**6,077**	**2,884**	**611**	**277**	**16,847**
Total	**13,088**	**11,398**	**5,258**	**1,169**	**585**	**31,498**
Study Region Total	**13,088**	**11,398**	**5,258**	**1,169**	**585**	**31,498**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : VCOG-2

Scenario : Probabilistic

Building Damage by General Occupancy: 10 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	100.00	0.00	0.00	0.00	0.00
Commercial	4,448.34	100.00	0.00	0.00	0.00	0.00
Education	166.95	100.00	0.00	0.00	0.00	0.00
Government	109.51	100.00	0.00	0.00	0.00	0.00
Industrial	3,517.04	100.00	0.00	0.00	0.00	0.00
Religion	182.55	100.00	0.00	0.00	0.00	0.00
Residential	21,054.42	100.00	0.00	0.00	0.00	0.00
Total	29,616.67	100.00	0.00	0.00	0.00	0.00
New Haven						
Agriculture	100.89	100.00	0.00	0.00	0.00	0.00
Commercial	4,211.05	100.00	0.00	0.00	0.00	0.00
Education	262.13	100.00	0.00	0.00	0.00	0.00
Government	206.95	100.00	0.00	0.00	0.00	0.00
Industrial	3,825.70	100.00	0.00	0.00	0.00	0.00
Religion	407.98	100.00	0.00	0.00	0.00	0.00
Residential	25,449.81	100.00	0.00	0.00	0.00	0.00
Total	34,464.52	100.00	0.00	0.00	0.00	0.00
Total	64,081.19	100.00	0.00	0.00	0.00	0.00

Study Region Average	64,081.19	100.00	0.00	0.00	0.00	0.00

Building Damage by General Occupancy: 20 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	99.82	0.18	0.00	0.00	0.00
Commercial	4,448.34	99.76	0.24	0.00	0.00	0.00
Education	166.95	99.75	0.25	0.00	0.00	0.00
Government	109.51	99.73	0.27	0.00	0.00	0.00
Industrial	3,517.04	99.74	0.26	0.00	0.00	0.00
Religion	182.55	99.80	0.20	0.00	0.00	0.00
Residential	21,054.42	99.96	0.03	0.00	0.00	0.00
Total	29,616.67	99.95	0.05	0.00	0.00	0.00
New Haven						
Agriculture	100.89	99.82	0.18	0.00	0.00	0.00
Commercial	4,211.05	99.76	0.24	0.00	0.00	0.00
Education	262.13	99.74	0.26	0.00	0.00	0.00
Government	206.95	99.72	0.28	0.00	0.00	0.00
Industrial	3,825.70	99.73	0.27	0.00	0.00	0.00
Religion	407.98	99.80	0.20	0.00	0.00	0.00
Residential	25,449.81	99.92	0.08	0.01	0.00	0.00
Total	34,464.52	99.90	0.09	0.01	0.00	0.00
Total	64,081.19	99.92	0.07	0.00	0.00	0.00

Study Region Average	64,081.19	99.92	0.07	0.00	0.00	0.00

Building Damage by General Occupancy: 50 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	99.07	0.86	0.06	0.01	0.00
Commercial	4,448.34	98.99	0.95	0.06	0.00	0.00
Education	166.95	99.03	0.96	0.01	0.00	0.00
Government	109.51	98.96	1.03	0.01	0.00	0.00
Industrial	3,517.04	98.95	1.02	0.02	0.00	0.00
Religion	182.55	99.19	0.79	0.02	0.00	0.00
Residential	21,054.42	99.20	0.76	0.04	0.00	0.00
Total	29,616.67	99.18	0.77	0.04	0.00	0.00
New Haven						
Agriculture	100.89	99.01	0.91	0.06	0.01	0.00
Commercial	4,211.05	98.95	1.00	0.05	0.00	0.00
Education	262.13	99.00	0.99	0.01	0.00	0.00
Government	206.95	98.91	1.08	0.01	0.00	0.00
Industrial	3,825.70	98.92	1.06	0.02	0.00	0.00
Religion	407.98	99.10	0.88	0.03	0.00	0.00
Residential	25,449.81	98.99	0.93	0.08	0.01	0.00
Total	34,464.52	98.98	0.93	0.08	0.01	0.00
Total	64,081.19	99.08	0.86	0.06	0.00	0.00

Study Region Average	64,081.19	99.08	0.86	0.06	0.00	0.00

Building Damage by General Occupancy: 100 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	94.30	4.62	0.76	0.31	0.01
Commercial	4,448.34	95.45	3.96	0.55	0.05	0.00
Education	166.95	95.92	3.86	0.23	0.00	0.00
Government	109.51	95.78	3.97	0.24	0.00	0.00
Industrial	3,517.04	95.56	3.93	0.41	0.09	0.00
Religion	182.55	96.02	3.78	0.19	0.01	0.00
Residential	21,054.42	94.24	5.33	0.42	0.01	0.00
Total	29,616.67	94.34	5.21	0.43	0.01	0.00
New Haven						
Agriculture	100.89	93.91	4.92	0.83	0.33	0.02
Commercial	4,211.05	94.98	4.42	0.55	0.05	0.00
Education	262.13	95.42	4.29	0.29	0.00	0.00
Government	206.95	95.05	4.60	0.34	0.01	0.00
Industrial	3,825.70	95.03	4.41	0.47	0.09	0.00
Religion	407.98	95.13	4.56	0.29	0.01	0.00
Residential	25,449.81	93.55	5.76	0.66	0.03	0.00
Total	34,464.52	93.68	5.64	0.65	0.03	0.00
Total	64,081.19	93.99	5.44	0.54	0.02	0.00

Study Region Average	64,081.19	93.99	5.44	0.54	0.02	0.00

Building Damage by General Occupancy: 200 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	80.18	14.15	3.72	1.77	0.19
Commercial	4,448.34	84.21	12.13	3.21	0.45	0.00
Education	166.95	85.34	11.96	2.55	0.15	0.00
Government	109.51	85.04	11.96	2.83	0.17	0.00
Industrial	3,517.04	84.59	11.61	3.10	0.65	0.05
Religion	182.55	85.33	12.56	1.99	0.12	0.00
Residential	21,054.42	81.31	16.15	2.37	0.10	0.07
Total	29,616.67	81.55	15.81	2.43	0.14	0.06
New Haven						
Agriculture	100.89	82.32	12.79	3.24	1.50	0.15
Commercial	4,211.05	84.71	11.94	3.01	0.34	0.00
Education	262.13	85.87	11.53	2.47	0.13	0.00
Government	206.95	84.48	12.32	3.03	0.17	0.00
Industrial	3,825.70	85.05	11.41	2.97	0.53	0.04
Religion	407.98	84.81	12.80	2.26	0.13	0.00
Residential	25,449.81	82.34	14.97	2.52	0.13	0.05
Total	34,464.52	82.55	14.70	2.56	0.15	0.04
Total	64,081.19	82.09	15.21	2.50	0.15	0.05

Study Region Average	64,081.19	82.09	15.21	2.50	0.15	0.05

Building Damage by General Occupancy: 500 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%)				
		None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	55.60	26.69	11.18	5.59	0.94
Commercial	4,448.34	60.46	23.66	12.92	2.94	0.02
Education	166.95	61.64	23.48	12.54	2.33	0.00
Government	109.51	60.99	22.87	13.45	2.69	0.00
Industrial	3,517.04	60.76	22.07	13.15	3.75	0.27
Religion	182.55	62.05	25.99	10.38	1.58	0.00
Residential	21,054.42	59.03	30.74	8.53	1.03	0.67
Total	29,616.67	59.14	30.12	8.89	1.22	0.63
New Haven						
Agriculture	100.89	56.69	26.08	10.86	5.46	0.91
Commercial	4,211.05	59.80	23.78	13.40	3.00	0.02
Education	262.13	61.08	23.28	13.05	2.59	0.00
Government	206.95	58.51	23.28	14.98	3.23	0.00
Industrial	3,825.70	59.95	22.24	13.74	3.83	0.24
Religion	407.98	59.61	26.48	11.81	2.10	0.00
Residential	25,449.81	58.70	30.44	9.30	1.01	0.54
Total	34,464.52	58.79	29.83	9.66	1.21	0.50
Total	64,081.19	58.95	29.97	9.30	1.21	0.56

Study Region Average	64,081.19	58.95	29.97	9.30	1.21	0.56

Building Damage by General Occupancy: 1000 - year Event

January 02, 2012

	Square Footage (Thousand. sq.ft)	Damage State Probability (%) None	Minor	Moderate	Severe	Destruction
Connecticut						
Fairfield						
Agriculture	137.85	38.20	31.72	18.01	9.88	2.19
Commercial	4,448.34	40.65	27.17	23.00	9.08	0.10
Education	166.95	40.54	26.74	23.48	9.23	0.00
Government	109.51	38.83	25.45	24.84	10.88	0.00
Industrial	3,517.04	40.41	24.57	23.27	11.00	0.75
Religion	182.55	41.55	31.52	20.47	6.46	0.00
Residential	21,054.42	41.67	37.20	15.60	3.27	2.27
Total	29,616.67	41.56	36.32	16.21	3.81	2.11
New Haven						
Agriculture	100.89	39.71	31.25	17.36	9.55	2.12
Commercial	4,211.05	41.15	27.07	22.64	9.06	0.08
Education	262.13	43.18	26.34	22.07	8.41	0.00
Government	206.95	40.21	25.08	24.09	10.62	0.00
Industrial	3,825.70	41.92	24.66	22.53	10.31	0.57
Religion	407.98	40.92	31.08	20.79	7.21	0.01
Residential	25,449.81	41.56	36.98	16.61	3.07	1.77
Total	34,464.52	41.54	36.07	17.12	3.63	1.64
Total	64,081.19	41.55	36.19	16.69	3.71	1.86

Study Region Average	64,081.19	41.55	36.19	16.69	3.71	1.86

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Debris Summary Report: 10 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	0	0	0	0	0
New Haven	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
Study Region Total	**0**	**0**	**0**	**0**	**0**

Debris Summary Report: 20 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	1	0	56	61	118
New Haven	10	0	61	48	119
Total	**11**	**0**	**117**	**109**	**237**
Study Region Total	**11**	**0**	**117**	**109**	**237**

Debris Summary Report: 50 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	503	0	451	410	1,364
New Haven	931	0	605	420	1,956
Total	**1,434**	**0**	**1,056**	**830**	**3,320**
Study Region Total	**1,434**	**0**	**1,056**	**830**	**3,320**

Debris Summary Report: 100 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	2,280	0	5,049	4,692	12,021
New Haven	4,090	0	4,563	4,521	13,174
Total	**6,370**	**0**	**9,612**	**9,213**	**25,195**
Study Region Total	**6,370**	**0**	**9,612**	**9,213**	**25,195**

Debris Summary Report: 200 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	6,762	5	9,021	8,357	24,145
New Haven	9,939	3	7,273	6,849	24,064
Total	**16,701**	**8**	**16,294**	**15,206**	**48,209**
Study Region Total	**16,701**	**8**	**16,294**	**15,206**	**48,209**

Debris Summary Report: 500 - year Event

January 02, 2012 *All values are in tons.*

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	18,864	88	23,165	21,391	63,508
New Haven	26,367	70	18,720	18,751	63,908
Total	**45,231**	**158**	**41,885**	**40,142**	**127,416**
Study Region Total	**45,231**	**158**	**41,885**	**40,142**	**127,416**

Debris Summary Report: 1000 - year Event

January 02, 2012

All values are in tons.

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Connecticut					
Fairfield	37,818	356	34,813	32,038	105,025
New Haven	48,374	317	29,387	28,619	106,697
Total	**86,192**	**673**	**64,200**	**60,657**	**211,722**
Study Region Total	**86,192**	**673**	**64,200**	**60,657**	**211,722**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Direct Economic Losses For Buildings: Annualized Losses

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	1,263	458	12	0.03	107	17	23	49	1,929
New Haven	1,498	507	13	0.04	133	20	27	78	2,276
Total	**2,761**	**965**	**25**	**0.04**	**240**	**37**	**51**	**127**	**4,205**
Study Region Total	**2,761**	**965**	**25**	**0.04**	**240**	**37**	**51**	**127**	**4,205**

Direct Economic Losses For Buildings: 10 - year Event

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	0	0	0	0.00	0	0	0	0	0
New Haven	0	0	0	0.00	0	0	0	0	0
Total	**0**	**0**	**0**	**0.00**	**0**	**0**	**0**	**0**	**0**
Study Region Total	**0**	**0**	**0**	**0.00**	**0**	**0**	**0**	**0**	**0**

Direct Economic Losses For Buildings: 20 - year Event

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	99	30	0	0.00	0	0	0	0	129
New Haven	242	35	0	0.01	1	0	0	0	278
Total	**341**	**64**	**0**	**0.00**	**2**	**0**	**0**	**0**	**407**
Study Region Total	**341**	**64**	**0**	**0.00**	**2**	**0**	**0**	**0**	**407**

Direct Economic Losses For Buildings: 50 - year Event

January 2, 2012 *All values are in thousands of dollars*

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	4,722	362	1	0.13	72	0	0	73	5,230
New Haven	5,664	548	3	0.14	215	0	0	243	6,671
Total	**10,386**	**910**	**4**	**0.14**	**287**	**0**	**0**	**315**	**11,901**
Study Region Total	**10,386**	**910**	**4**	**0.14**	**287**	**0**	**0**	**315**	**11,901**

Direct Economic Losses For Buildings: 100 - year Event

January 2, 2012 *All values are in thousands of dollars*

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	16,562	1,922	37	0.45	612	111	81	440	19,765
New Haven	21,048	2,519	46	0.53	986	100	144	1,033	25,875
Total	**37,610**	**4,441**	**83**	**0.49**	**1,598**	**210**	**225**	**1,473**	**45,640**
Study Region Total	**37,610**	**4,441**	**83**	**0.49**	**1,598**	**210**	**225**	**1,473**	**45,640**

Direct Economic Losses For Buildings: 200 - year Event

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	44,520	9,919	270	1.21	2,658	630	1,001	1,519	60,517
New Haven	50,099	9,361	253	1.27	3,210	531	955	2,707	67,116
Total	**94,619**	**19,280**	**523**	**1.24**	**5,867**	**1,161**	**1,957**	**4,226**	**127,633**
Study Region Total	**94,619**	**19,280**	**523**	**1.24**	**5,867**	**1,161**	**1,957**	**4,226**	**127,633**

Direct Economic Losses For Buildings: 500 - year Event

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	135,477	47,946	1,276	3.67	13,598	914	1,813	5,855	206,878
New Haven	151,295	47,933	1,452	3.83	15,494	956	1,850	8,771	227,750
Total	**286,772**	**95,879**	**2,728**	**3.75**	**29,091**	**1,870**	**3,663**	**14,626**	**434,628**
Study Region Total	**286,772**	**95,879**	**2,728**	**3.75**	**29,091**	**1,870**	**3,663**	**14,626**	**434,628**

Direct Economic Losses For Buildings: 1000 - year Event

January 2, 2012

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Connecticut									
Fairfield	289,447	124,130	3,290	7.84	31,707	3,374	4,866	13,104	469,917
New Haven	303,435	118,660	3,139	7.69	33,883	3,517	5,022	17,425	485,081
Total	**592,882**	**242,789**	**6,429**	**7.76**	**65,591**	**6,891**	**9,888**	**30,529**	**954,999**
Study Region Total	**592,882**	**242,789**	**6,429**	**7.76**	**65,591**	**6,891**	**9,888**	**30,529**	**954,999**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : VCOG-2

Scenario : Probabilistic

Building Stock Exposure by Building Type

January 02, 2012 — *All values are in thousands of dollars*

	Wood	Masonry	Concrete	Steel	MH	Total
Connecticut						
Fairfield	2,556,690	495,302	148,024	482,145	11,504	3,693,665
New Haven	2,481,543	692,230	167,598	603,406	347	3,945,124
Total	**5,038,233**	**1,187,532**	**315,622**	**1,085,551**	**11,851**	**7,638,789**
Study Region Total	**5,038,233**	**1,187,532**	**315,622**	**1,085,551**	**11,851**	**7,638,789**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : VCOG-2
Scenario : Probabilistic

Building Stock Exposure By General Occupancy

January 02, 2012

All values are in thousands of dollars

	Residential	Commercial	Industrial	Agriculture	Religion	Government	Education	Total
Connecticut								
Fairfield	2,703,083	583,614	327,612	11,555	27,900	18,660	21,237	3,693,661
New Haven	2,837,007	521,089	456,383	8,315	61,334	27,581	33,422	3,945,131
Total	**5,540,090**	**1,104,703**	**783,995**	**19,870**	**89,234**	**46,241**	**54,659**	**7,638,792**
Study Region Total	**5,540,090**	**1,104,703**	**783,995**	**19,870**	**89,234**	**46,241**	**54,659**	**7,638,792**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Emergency Response Center Facility Functionality: 10 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	100.00
Total	**2**	**100.00**
Study Region Total	**2**	**100.00**

Emergency Response Center Facility Functionality: 20 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	100.00
Total	**2**	**100.00**
Study Region Total	**2**	**100.00**

Emergency Response Center Facility Functionality: 50 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	100.00
Total	**2**	**100.00**
Study Region Total	**2**	**100.00**

Emergency Response Center Facility Functionality: 100 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	100.00
Total	**2**	**100.00**
Study Region Total	**2**	**100.00**

Emergency Response Center Facility Functionality: 200 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	0.00
Total	**2**	**0.00**
Study Region Total	**2**	**0.00**

Emergency Response Center Facility Functionality: 500 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	0.00
Total	**2**	**0.00**
Study Region Total	**2**	**0.00**

Emergency Response Center Facility Functionality: 1000 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	2	0.00
Total	**2**	**0.00**
Study Region Total	**2**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Fire Station Facility Functionality: 10 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	100.00
New Haven	7	100.00
Total	**11**	**100.00**
Study Region Total	**11**	**100.00**

Fire Station Facility Functionality: 20 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	100.00
New Haven	7	100.00
Total	**11**	**100.00**
Study Region Total	**11**	**100.00**

Fire Station Facility Functionality: 50 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	100.00
New Haven	7	100.00
Total	**11**	**100.00**
Study Region Total	**11**	**100.00**

Fire Station Facility Functionality: 100 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	100.00
New Haven	7	100.00
Total	**11**	**100.00**
Study Region Total	**11**	**100.00**

Fire Station Facility Functionality: 200 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	0.00
New Haven	7	0.00
Total	**11**	**0.00**
Study Region Total	**11**	**0.00**

Fire Station Facility Functionality: 500 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	0.00
New Haven	7	0.00
Total	**11**	**0.00**
Study Region Total	**11**	**0.00**

Fire Station Facility Functionality: 1000 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	4	0.00
New Haven	7	0.00
Total	**11**	**0.00**
Study Region Total	**11**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Hospital Functionality: 10 - year Event

January 2, 2012

	Total # of Beds	At Day 1 # of Beds	At Day 1 %	At day 3 # of Beds	At day 3 %	At day 7 # of Beds	At day 7 %	At day 30 # of Beds	At day 30 %	At day 90 # of Beds	At day 90 %
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	141	100.0	141	100.0	141	100.0	141	100.0	141	100.0
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**

January 2, 2012

		At Day 1		At day 3		At day 7		At day 30		At day 90	
	Total # of Beds	**# of Beds**	**%**	**# of Beds**	**%**	**# of Beds**	**%**	**# of Beds**	**%**	**# of Beds**	**%**
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	141	100.0	141	100.0	141	100.0	141	100.0	141	100.0
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**

Hospital Functionality: 50 - year Event

January 2, 2012

		At Day 1		At day 3		At day 7		At day 30		At day 90	
	Total # of Beds	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	141	100.0	141	100.0	141	100.0	141	100.0	141	100.0
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**

Hospital Functionality: 100 - year Event

January 2, 2012

		At Day 1		At day 3		At day 7		At day 30		At day 90	
	Total # of Beds	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	0	0.0	141	100.0	141	100.0	141	100.0	141	100.0
Total	**141**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**

Hospital Functionality: 200 - year Event

January 2, 2012

	Total # of Beds	At Day 1 # of Beds	At Day 1 %	At day 3 # of Beds	At day 3 %	At day 7 # of Beds	At day 7 %	At day 30 # of Beds	At day 30 %	At day 90 # of Beds	At day 90 %
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	0	0.0	0	0.0	141	100.0	141	100.0	141	100.0
Total	**141**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**	**141**	**100.0**

Hospital Functionality: 500 - year Event

January 2, 2012

	Total # of Beds	At Day 1 # of Beds	At Day 1 %	At day 3 # of Beds	At day 3 %	At day 7 # of Beds	At day 7 %	At day 30 # of Beds	At day 30 %	At day 90 # of Beds	At day 90 %
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	0	0.0	0	0.0	0	0.0	141	100.0	141	100.0
Total	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**
Total	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**
Study RegionTotal	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**	**141**	**100.0**

Hospital Functionality: 1000 - year Event

January 2, 2012

		At Day 1		At day 3		At day 7		At day 30		At day 90	
	Total # of Beds	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%
Connecticut											
New Haven											
Medium Hospital (50 to 150 Beds)	141	0	0.0	0	0.0	0	0.0	0	0.0	141	100.0
Total	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**
Total	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**
Study RegionTotal	**141**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**0.0**	**141**	**100.0**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Police Station Facility Functionality: 10 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	100.00
New Haven	5	100.00
Total	**6**	**100.00**
Study Region Total	**6**	**100.00**

Police Station Facility Functionality: 20 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	100.00
New Haven	5	100.00
Total	**6**	**100.00**
Study Region Total	**6**	**100.00**

Police Station Facility Functionality: 50 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	100.00
New Haven	5	100.00
Total	**6**	**100.00**
Study Region Total	**6**	**100.00**

Police Station Facility Functionality: 100 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	100.00
New Haven	5	100.00
Total	**6**	**100.00**
Study Region Total	**6**	**100.00**

Police Station Facility Functionality: 200 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	0.00
New Haven	5	0.00
Total	**6**	**0.00**
Study Region Total	**6**	**0.00**

Police Station Facility Functionality: 500 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	0.00
New Haven	5	0.00
Total	**6**	**0.00**
Study Region Total	**6**	**0.00**

Police Station Facility Functionality: 1000 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	1	0.00
New Haven	5	0.00
Total	**6**	**0.00**
Study Region Total	**6**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

School Functionality: 10 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	100.00
New Haven	17	100.00
Total	**26**	**100.00**
Study Region	**26**	**100.00**

School Functionality: 20 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	100.00
New Haven	17	100.00
Total	**26**	**100.00**
Study Region	**26**	**100.00**

School Functionality: 50 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	100.00
New Haven	17	100.00
Total	**26**	**100.00**
Study Region	**26**	**100.00**

School Functionality: 100 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	100.00
New Haven	17	100.00
Total	**26**	**100.00**
Study Region	**26**	**100.00**

School Functionality: 200 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	0.00
New Haven	17	0.00
Total	**26**	**0.00**
Study Region	**26**	**0.00**

School Functionality: 500 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	0.00
New Haven	17	0.00
Total	**26**	**0.00**
Study Region	**26**	**0.00**

School Functionality: 1000 - year Event

January 02, 2012

	Count	Functionality (%)
Connecticut		
Fairfield	9	0.00
New Haven	17	0.00
Total	**26**	**0.00**
Study Region	**26**	**0.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Shelter Summary Report: 10 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	0	0
New Haven	0	0
Total	**0**	**0**
Study Region Total	**0**	**0**

Shelter Summary Report: 20 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	0	0
New Haven	0	0
Total	**0**	**0**
Study Region Total	**0**	**0**

Shelter Summary Report: 50 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	0	0
New Haven	0	0
Total	**0**	**0**
Study Region Total	**0**	**0**

Shelter Summary Report: 100 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	0	0
New Haven	0	0
Total	**0**	**0**
Study Region Total	**0**	**0**

Shelter Summary Report: 200 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	6	1
New Haven	15	2
Total	**21**	**3**
Study Region Total	**21**	**3**

Shelter Summary Report: 500 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	83	12
New Haven	217	51
Total	**300**	**63**
Study Region Total	**300**	**63**

Shelter Summary Report: 1000 - year Event

January 02, 2012

	# of Displaced Households	# of People Needing Short Term Shelter
Connecticut		
Fairfield	449	79
New Haven	782	192
Total	**1,231**	**271**
Study Region Total	**1,231**	**271**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

APPENDIX G
HAZUS DOCUMENTATION FOR HURRICANE WINDS

Quick Assessment Report

January 2, 2012

Study Region : VCOG-2

Scenario : Probabilistic

Regional Statistics

Area (Square Miles)	58
Number of Census Tracts	16
Number of People in the Region	84,500

General Building Stock

Occupancy	*Building Count*	*Dollar Exposure ($ K)*
Residential	28,765	5,540,090
Commercial	1,687	1,104,703
Other	1,046	993,999
Total	31,498	7,638,792

Scenario Results

Number of Residential Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	17	1	0	0	18
50	244	17	1	0	262
100	1,599	158	5	1	1,763
200	4,465	704	33	16	5,218
500	8,797	2,572	294	174	11,836
1000	10,666	4,642	911	576	16,796

Number of Buildings Damaged

Return Period	*Minor*	*Moderate*	*Severe*	*Destruction*	*Total*
10	0	0	0	0	0
20	23	1	0	0	25
50	271	19	1	0	291
100	1,714	172	7	1	1,894
200	4,792	787	46	16	5,642
500	9,440	2,930	382	177	12,929
1000	11,398	5,258	1,169	585	18,410

Shelter Requirements

Return Period	*Displaced Households (#Households)*	*Short Term Shelter (#People)*
10	0	0
20	0	0
50	0	0
100	0	0
200	21	3
500	300	63
1000	1,231	271

Economic Loss (x 1000)

	Property Damage (Capital Stock) Losses		*Business Interruption (Income) Losses*
ReturnPeriod	*Residential*	*Total*	
10	0	0	0
20	405	405	2
50	10,666	11,299	602
100	38,203	42,134	3,507
200	97,303	114,421	13,212
500	303,187	385,379	49,250
1000	644,975	842,100	112,899
Annualized	2,970	3,750	455

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.

Hazus-MH: Hurricane Event Report

Region Name:	VCOG-2
Hurricane Scenario:	Probabilistic 20-year Return Period
Print Date:	Monday, January 02, 2012

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.

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 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 2 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 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 1 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	118	99.82	0	0.18	0	0.00	0	0.00	0	0.00
Commercial	1,683	99.76	4	0.24	0	0.00	0	0.00	0	0.00
Education	49	99.75	0	0.25	0	0.00	0	0.00	0	0.00
Government	44	99.73	0	0.27	0	0.00	0	0.00	0	0.00
Industrial	716	99.74	2	0.26	0	0.00	0	0.00	0	0.00
Religion	117	99.80	0	0.20	0	0.00	0	0.00	0	0.00
Residential	28,747	99.94	17	0.06	1	0.00	0	0.00	0	0.00
Total	**31,473**		**23**		**1**		**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	223	99.68	1	0.32	0	0.00	0	0.00	0	0.00
Masonry	2,720	99.66	9	0.33	0	0.01	0	0.00	0	0.00
MH	285	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	1,229	99.72	3	0.28	0	0.00	0	0.00	0	0.00
Wood	25,528	99.98	5	0.02	1	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 141 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**
EOCs	2	0	0	2
Fire Stations	11	0	0	11
Hospitals	1	0	0	1
Police Stations	6	0	0	6
Schools	26	0	0	26

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 237 tons of debris will be generated. Of the total amount, 109 tons (46%) is Other Tree Debris. Of the remaining 128 tons, Brick/Wood comprises 9% 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 117 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 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 0.4 million dollars, which represents 0.01 % 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	340.51	0.00	0.00	0.00	340.51
	Content	64.43	0.00	0.00	0.00	64.43
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**404.94**	**0.00**	**0.00**	**0.00**	**404.94**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	1.77	0.00	0.00	0.00	1.77
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1.77**	**0.00**	**0.00**	**0.00**	**1.77**
Total						
	Total	**406.72**	**0.00**	**0.00**	**0.00**	**406.72**

Appendix A: County Listing for the Region

Connecticut

- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name: VCOG-2

Hurricane Scenario: Probabilistic 50-year Return Period

Print Date: Monday, January 02, 2012

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 2 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 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 20 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	117	99.04	1	0.89	0	0.06	0	0.01	0	0.00
Commercial	1,670	98.97	16	0.98	1	0.05	0	0.00	0	0.00
Education	49	99.01	0	0.98	0	0.01	0	0.00	0	0.00
Government	44	98.93	0	1.07	0	0.01	0	0.00	0	0.00
Industrial	710	98.93	7	1.04	0	0.02	0	0.00	0	0.00
Religion	116	99.13	1	0.85	0	0.02	0	0.00	0	0.00
Residential	28,503	99.09	244	0.85	17	0.06	1	0.00	0	0.00
Total	**31,207**		**271**		**19**		**1**		**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	221	98.71	3	1.27	0	0.01	0	0.00	0	0.00
Masonry	2,674	97.97	47	1.72	8	0.29	0	0.02	0	0.00
MH	285	99.99	0	0.00	0	0.00	0	0.00	0	0.00
Steel	1,219	98.93	13	1.04	0	0.03	0	0.00	0	0.00
Wood	25,350	99.28	177	0.69	6	0.02	1	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 141 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**
EOCs	2	0	0	2
Fire Stations	11	0	0	11
Hospitals	1	0	0	1
Police Stations	6	0	0	6
Schools	26	0	0	26

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 3,320 tons of debris will be generated. Of the total amount, 830 tons (25%) is Other Tree Debris. Of the remaining 2,490 tons, Brick/Wood comprises 58% 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 57 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 1,056 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 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 11.9 million dollars, which represents 0.16 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 12 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 95% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	9,788.81	347.57	194.08	55.05	10,385.51
	Content	877.29	16.69	15.38	0.33	909.69
	Inventory	0.00	0.36	3.28	0.04	3.68
	Subtotal	**10,666.09**	**364.62**	**212.75**	**55.42**	**11,298.88**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	281.00	4.99	0.62	0.30	286.90
	Rental	315.43	0.00	0.00	0.00	315.43
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**596.43**	**4.99**	**0.62**	**0.30**	**602.33**
Total						
	Total	**11,262.52**	**369.61**	**213.37**	**55.72**	**11,901.22**

Appendix A: County Listing for the Region

Connecticut

- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name:	VCOG-2
Hurricane Scenario:	Probabilistic 100-year Return Period
Print Date:	Monday, January 02, 2012

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 2 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 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 180 buildings will be at least moderately damaged. This is over 1% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy : 100 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	111	94.11	6	4.77	1	0.79	0	0.32	0	0.01
Commercial	1,606	95.19	71	4.21	9	0.55	1	0.05	0	0.00
Education	47	95.62	2	4.11	0	0.27	0	0.00	0	0.00
Government	42	95.30	2	4.38	0	0.31	0	0.00	0	0.00
Industrial	684	95.29	30	4.18	3	0.44	1	0.09	0	0.00
Religion	112	95.44	5	4.30	0	0.26	0	0.01	0	0.00
Residential	27,002	93.87	1,599	5.56	158	0.55	5	0.02	1	0.00
Total	**29,604**		**1,714**		**172**		**7**		**1**	

Table 3: Expected Building Damage by Building Type : 100 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	212	94.80	11	4.81	1	0.39	0	0.00	0	0.00
Masonry	2,508	91.89	164	6.00	54	1.99	3	0.11	0	0.00
MH	284	99.79	0	0.17	0	0.04	0	0.00	0	0.00
Steel	1,177	95.51	49	3.96	6	0.48	1	0.05	0	0.00
Wood	24,070	94.27	1,385	5.42	74	0.29	3	0.01	1	0.00

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) 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**
EOCs	2	0	0	2
Fire Stations	11	0	0	11
Hospitals	1	0	0	0
Police Stations	6	0	0	6
Schools	26	0	0	26

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 25,195 tons of debris will be generated. Of the total amount, 9,213 tons (37%) is Other Tree Debris. Of the remaining 15,982 tons, Brick/Wood comprises 40% 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 255 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 9,612 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 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 45.6 million dollars, which represents 0.60 % 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 46 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 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	34,459.90	1,685.06	1,181.24	283.32	37,609.52
	Content	3,742.65	243.67	418.99	35.75	4,441.06
	Inventory	0.00	5.60	75.86	1.49	82.96
	Subtotal	**38,202.55**	**1,934.33**	**1,676.09**	**320.57**	**42,133.53**
Business Interruption Loss						
	Income	0.00	174.65	6.85	28.88	210.38
	Relocation	1,353.15	184.23	38.39	22.68	1,598.44
	Rental	1,361.75	102.55	6.88	1.84	1,473.02
	Wage	0.00	145.64	11.33	67.91	224.89
	Subtotal	**2,714.90**	**607.07**	**63.46**	**121.31**	**3,506.74**
Total						
	Total	**40,917.45**	**2,541.40**	**1,739.54**	**441.88**	**45,640.27**

Appendix A: County Listing for the Region

Connecticut

- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
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Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name: VCOG-2

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Monday, January 02, 2012

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 2 county(ies) from the following state(s):

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Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

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Occupancy	Exposure ($1000)	Percent of Tot
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Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 850 buildings will be at least moderately damaged. This is over 3% 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 : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	96	81.23	16	13.48	4	3.48	2	1.64	0	0.17
Commercial	1,425	84.49	203	12.03	52	3.10	7	0.39	0	0.00
Education	42	85.65	6	11.70	1	2.51	0	0.14	0	0.00
Government	37	84.67	5	12.20	1	2.96	0	0.17	0	0.00
Industrial	609	84.83	83	11.51	22	3.03	4	0.59	0	0.04
Religion	99	84.99	15	12.72	3	2.17	0	0.12	0	0.00
Residential	23,547	81.86	4,465	15.52	704	2.45	33	0.12	16	0.06
Total	**25,856**		**4,792**		**787**		**46**		**16**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building	None		Minor		Moderate		Severe		Destruction	
Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	187	83.65	29	12.73	8	3.48	0	0.14	0	0.00
Masonry	2,174	79.67	373	13.65	168	6.17	13	0.47	1	0.03
MH	280	98.31	3	1.18	1	0.42	0	0.01	0	0.08
Steel	1,052	85.38	135	10.97	39	3.19	6	0.45	0	0.00
Wood	21,011	82.29	4,026	15.77	457	1.79	25	0.10	14	0.06

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) 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**
EOCs	2	0	0	0
Fire Stations	11	0	0	0
Hospitals	1	0	0	0
Police Stations	6	0	0	0
Schools	26	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 48,209 tons of debris will be generated. Of the total amount, 15,206 tons (32%) is Other Tree Debris. Of the remaining 33,003 tons, Brick/Wood comprises 51% 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 668 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 16,294 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 21 households to be displaced due to the hurricane. Of these, 3 people (out of a total population of 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 127.6 million dollars, which represents 1.67 % 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 128 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 82% 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	82,734.12	5,890.04	4,942.55	1,051.95	94,618.66
	Content	14,568.72	1,527.63	2,912.85	270.40	19,279.61
	Inventory	0.00	35.79	477.03	9.72	522.53
	Subtotal	**97,302.84**	**7,453.47**	**8,332.43**	**1,332.07**	**114,420.80**
Business Interruption Loss						
	Income	0.00	954.95	81.73	124.54	1,161.23
	Relocation	4,252.68	1,083.30	345.26	186.10	5,867.35
	Rental	3,528.01	617.32	64.90	16.22	4,226.44
	Wage	0.00	899.03	107.88	950.00	1,956.91
	Subtotal	**7,780.69**	**3,554.61**	**599.77**	**1,276.86**	**13,211.93**
Total						
	Total	**105,083.53**	**11,008.08**	**8,932.20**	**2,608.93**	**127,632.73**

Appendix A: County Listing for the Region

Connecticut

- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name: VCOG-2

Hurricane Scenario: Probabilistic 200-year Return Period

Print Date: Monday, January 02, 2012

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 2 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 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 850 buildings will be at least moderately damaged. This is over 3% 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 : 200 - year Event

	None		Minor		Moderate		Severe		Destruction	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	96	81.23	16	13.48	4	3.48	2	1.64	0	0.17
Commercial	1,425	84.49	203	12.03	52	3.10	7	0.39	0	0.00
Education	42	85.65	6	11.70	1	2.51	0	0.14	0	0.00
Government	37	84.67	5	12.20	1	2.96	0	0.17	0	0.00
Industrial	609	84.83	83	11.51	22	3.03	4	0.59	0	0.04
Religion	99	84.99	15	12.72	3	2.17	0	0.12	0	0.00
Residential	23,547	81.86	4,465	15.52	704	2.45	33	0.12	16	0.06
Total	**25,856**		**4,792**		**787**		**46**		**16**	

Table 3: Expected Building Damage by Building Type : 200 - year Event

Building	None		Minor		Moderate		Severe		Destruction	
Type	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	187	83.65	29	12.73	8	3.48	0	0.14	0	0.00
Masonry	2,174	79.67	373	13.65	168	6.17	13	0.47	1	0.03
MH	280	98.31	3	1.18	1	0.42	0	0.01	0	0.08
Steel	1,052	85.38	135	10.97	39	3.19	6	0.45	0	0.00
Wood	21,011	82.29	4,026	15.77	457	1.79	25	0.10	14	0.06

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) 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

Classification	Total	# Facilities: Probability of at Least Moderate Damage > 50%	# Facilities: Probability of Complete Damage > 50%	# Facilities: Expected Loss of Use < 1 day
EOCs	2	0	0	0
Fire Stations	11	0	0	0
Hospitals	1	0	0	0
Police Stations	6	0	0	0
Schools	26	0	0	0

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 48,209 tons of debris will be generated. Of the total amount, 15,206 tons (32%) is Other Tree Debris. Of the remaining 33,003 tons, Brick/Wood comprises 51% 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 668 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 16,294 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 21 households to be displaced due to the hurricane. Of these, 3 people (out of a total population of 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 127.6 million dollars, which represents 1.67 % 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 128 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 82% 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	82,734.12	5,890.04	4,942.55	1,051.95	94,618.66
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	Subtotal	**7,780.69**	**3,554.61**	**599.77**	**1,276.86**	**13,211.93**
Total						
	Total	**105,083.53**	**11,008.08**	**8,932.20**	**2,608.93**	**127,632.73**

Appendix A: County Listing for the Region

Connecticut
- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars) Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name: VCOG-2

Hurricane Scenario: Probabilistic 500-year Return Period

Print Date: Monday, January 02, 2012

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 2 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 58.40 square miles and contains 16 census tracts. There are over 33 thousand households in the region and has a total population of 84,500 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,639 million dollars (2006 dollars). Approximately 91% of the buildings (and 73% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 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 3,489 buildings will be at least moderately damaged. This is over 11% of the total number of buildings in the region. There are an estimated 177 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	66	56.14	31	26.39	13	11.02	7	5.53	1	0.92
Commercial	1,014	60.10	400	23.72	222	13.18	50	2.98	0	0.02
Education	30	61.31	11	23.36	6	12.84	1	2.48	0	0.00
Government	26	59.35	10	23.14	6	14.46	1	3.05	0	0.00
Industrial	433	60.34	159	22.16	97	13.45	27	3.79	2	0.26
Religion	71	60.44	31	26.32	13	11.32	2	1.92	0	0.00
Residential	16,929	58.85	8,797	30.58	2,572	8.94	294	1.02	174	0.60
Total	**18,569**		**9,440**		**2,930**		**382**		**177**	

Table 3: Expected Building Damage by Building Type : 500 - year Event

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	130	57.97	51	22.83	37	16.51	6	2.68	0	0.00
Masonry	1,542	56.51	660	24.19	460	16.85	60	2.18	7	0.27
MH	263	92.45	12	4.05	8	2.66	0	0.16	2	0.68
Steel	751	60.96	259	21.00	176	14.31	46	3.70	0	0.03
Wood	15,109	59.17	8,093	31.70	1,929	7.55	241	0.95	161	0.63

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use. After one week, 0.00% 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**
EOCs	2	0	0	0
Fire Stations	11	0	0	0
Hospitals	1	0	0	0
Police Stations	6	0	0	0
Schools	26	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 127,416 tons of debris will be generated. Of the total amount, 40,142 tons (32%) is Other Tree Debris. Of the remaining 87,274 tons, Brick/Wood comprises 52% 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 1816 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 41,885 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 300 households to be displaced due to the hurricane. Of these, 63 people (out of a total population of 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 434.6 million dollars, which represents 5.69 % 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 435 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 77% 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	235,933.53	23,981.73	22,461.99	4,394.95	286,772.19
	Content	67,253.51	9,983.27	16,815.87	1,825.99	95,878.63
	Inventory	0.00	220.23	2,467.32	40.30	2,727.85
	Subtotal	**303,187.03**	**34,185.23**	**41,745.18**	**6,261.24**	**385,378.68**
Business Interruption Loss						
	Income	4.00	1,378.66	312.12	175.36	1,870.13
	Relocation	21,759.07	4,701.65	1,731.37	899.36	29,091.45
	Rental	11,589.81	2,639.92	309.69	86.08	14,625.51
	Wage	9.44	1,451.48	431.48	1,770.11	3,662.51
	Subtotal	**33,362.32**	**10,171.71**	**2,784.66**	**2,930.91**	**49,249.60**
Total						
	Total	**336,549.35**	**44,356.94**	**44,529.84**	**9,192.15**	**434,628.28**

Appendix A: County Listing for the Region

Connecticut
- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
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Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

Hazus-MH: Hurricane Event Report

Region Name: VCOG-2

Hurricane Scenario: Probabilistic 1000-year Return Period

Print Date: Monday, January 02, 2012

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Note:
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Building Inventory

General Building Stock

Hazus estimates that there are 31,498 buildings in the region which have an aggregate total replacement value of 7,639 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	5,540,090	72.5%
Commercial	1,104,703	14.5%
Industrial	783,995	10.3%
Agricultural	19,870	0.3%
Religious	89,234	1.2%
Government	46,241	0.6%
Education	54,659	0.7%
Total	**7,638,792**	**100.0%**

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name:	Probabilistic
Type:	Probabilistic

Building Damage

General Building Stock Damage

Hazus estimates that about 7,012 buildings will be at least moderately damaged. This is over 22% of the total number of buildings in the region. There are an estimated 585 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	46	38.94	37	31.49	21	17.69	11	9.72	3	2.16
Commercial	690	40.92	457	27.12	385	22.80	153	9.07	2	0.09
Education	21	42.10	13	26.50	11	22.64	4	8.74	0	0.00
Government	17	39.74	11	25.20	11	24.35	5	10.71	0	0.00
Industrial	296	41.19	177	24.62	164	22.89	76	10.64	5	0.66
Religion	48	41.13	37	31.23	24	20.68	8	6.95	0	0.01
Residential	11,969	41.61	10,666	37.08	4,642	16.14	911	3.17	576	2.00
Total	**13,088**		**11,398**		**5,258**		**1,169**		**585**	

Table 3: Expected Building Damage by Building Type : 1000 - year Event

	None		Minor		Moderate		Severe		Destruction	
Building Type	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	84	37.58	53	23.57	64	28.67	23	10.18	0	0.00
Masonry	1,069	39.16	759	27.80	723	26.50	157	5.75	22	0.79
MH	241	84.47	18	6.30	17	6.10	2	0.73	7	2.40
Steel	513	41.63	280	22.73	299	24.25	139	11.28	1	0.11
Wood	10,668	41.78	9,913	38.82	3,661	14.34	756	2.96	535	2.10

Essential Facility Damage

Before the hurricane, the region had 141 hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (only 0.00%) are available for use. After one week, 0.00% of the beds will be in service. By 30 days, 0.00% 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**
EOCs	2	0	0	0
Fire Stations	11	0	0	0
Hospitals	1	0	0	0
Police Stations	6	0	0	0
Schools	26	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 211,722 tons of debris will be generated. Of the total amount, 60,657 tons (29%) is Other Tree Debris. Of the remaining 151,065 tons, Brick/Wood comprises 57% 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 3475 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 64,200 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 1,231 households to be displaced due to the hurricane. Of these, 271 people (out of a total population of 84,500) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 955.0 million dollars, which represents 12.50 % 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 955 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 75% 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	476,463.41	56,352.55	50,095.74	9,970.29	592,881.98
	Content	168,511.66	28,387.65	40,872.77	5,017.43	242,789.50
	Inventory	0.00	596.96	5,750.16	81.41	6,428.54
	Subtotal	**644,975.07**	**85,337.16**	**96,718.67**	**15,069.12**	**842,100.02**
Business Interruption Loss						
	Income	97.82	5,694.29	854.97	243.61	6,890.69
	Relocation	49,332.82	10,587.56	3,667.36	2,002.77	65,590.51
	Rental	23,417.49	6,216.25	693.52	201.86	30,529.12
	Wage	230.37	6,137.90	1,241.15	2,278.83	9,888.25
	Subtotal	**73,078.49**	**28,636.00**	**6,457.00**	**4,727.07**	**112,898.57**
Total						
	Total	**718,053.56**	**113,973.16**	**103,175.67**	**19,796.20**	**954,998.60**

Appendix A: County Listing for the Region

Connecticut

- Fairfield
- New Haven

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Connecticut				
Fairfield	38,101	2,703,083	990,578	3,693,661
New Haven	46,399	2,837,007	1,108,124	3,945,131
Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**
Study Region Total	**84,500**	**5,540,090**	**2,098,702**	**7,638,792**

APPENDIX H
HAZUS DOCUMENTATION FOR EARTHQUAKES

Hazus-MH: Earthquake Event Report

Region Name: VCOG

Earthquake Scenario: East Haddam - 6.4

Print Date: March 18, 2012

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 2 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 58.38 square miles and contains 16 census tracts. There are over 33 thousand households in the region which has a total population of 84,500 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,638 (millions of dollars). Approximately 91.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,086 and 306 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 31 thousand buildings in the region which have an aggregate total replacement value of 7,638 (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 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 20 dams identified within the region. Of these, 8 of the dams are classified as 'high hazard'. The inventory also includes 21 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 2,392.00 (millions of dollars). This inventory includes over 83 kilometers of highways, 65 bridges, 1,576 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	65	1,513.10
	Segments	27	535.00
	Tunnels	0	0.00
		Subtotal	**2,048.10**
Railways	Bridges	2	0.20
	Facilities	0	0.00
	Segments	19	35.40
	Tunnels	0	0.00
		Subtotal	**35.60**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	2.50
		Subtotal	**2.50**
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	**2,086.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	15.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**15.80**
Waste Water	Distribution Lines	NA	9.50
	Facilities	4	306.40
	Pipelines	0	0.00
		Subtotal	**315.80**
Natural Gas	Distribution Lines	NA	6.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**6.30**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	3	0.30
		Subtotal	**0.30**
		Total	**338.20**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	East Haddam - 6.4
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-72.40
Latitude of Epicenter	41.50
Earthquake Magnitude	6.40
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Building Damage

Hazus estimates that about 1,552 buildings will be at least moderately damaged. This is over 5.00 % of the buildings in the region. There are an estimated 28 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	82	0.31	21	0.56	12	0.91	3	1.26	0	1.14
Commercial	1,130	4.32	293	7.69	208	15.93	49	22.14	7	24.83
Education	33	0.13	8	0.22	6	0.47	1	0.59	0	0.79
Government	28	0.11	8	0.20	6	0.49	1	0.66	0	0.82
Industrial	467	1.79	124	3.24	100	7.69	24	10.61	3	12.25
Other Residential	5,042	19.29	874	22.94	430	33.02	84	37.93	11	37.89
Religion	87	0.33	17	0.44	10	0.79	2	1.11	0	1.29
Single Family	19,266	73.72	2,465	64.70	530	40.70	57	25.69	6	20.99
Total	26,136		3,809		1,303		222		28	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	22,318	85.39	2830	74.30	531	40.76	35	15.80	1	3.61
Steel	879	3.36	252	6.62	236	18.13	53	23.98	8	29.44
Concrete	262	1.00	74	1.94	68	5.22	13	5.66	1	4.78
Precast	57	0.22	12	0.31	13	0.99	5	2.03	0	0.56
RM	601	2.30	81	2.12	72	5.55	19	8.67	0	0.88
URM	1,841	7.04	493	12.93	320	24.58	89	40.21	17	59.08
MH	179	0.69	68	1.78	62	4.77	8	3.65	0	1.65
Total	26,136		3,809		1,303		222		28	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 141 hospital beds available for use. On the day of the earthquake, the model estimates that only 88 hospital beds (63.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 82.00% of the beds will be back in service. By 30 days, 95.00% 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	26	0	0	26
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	11	0	0	11

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	27	0	0	27	27
	Bridges	65	0	0	65	65
	Tunnels	0	0	0	0	0
Railways	Segments	19	0	0	19	19
	Bridges	2	0	0	2	2
	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	2	0	0	2	2
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	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	3	0	0	3	3

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	788	45	11
Waste Water	473	22	6
Natural Gas	315	8	2
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	33,104	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 0.06 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 49.00% 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 2,200 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 162 households to be displaced due to the earthquake. Of these, 95 people (out of a total population of 84,500) 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	1	0	0	0
	Other-Residential	17	3	0	1
	Single Family	11	1	0	0
	Total	**29**	**4**	**0**	**1**
2 PM	Commercial	24	4	0	1
	Commuting	0	0	0	0
	Educational	8	1	0	0
	Hotels	0	0	0	0
	Industrial	8	1	0	0
	Other-Residential	3	1	0	0
	Single Family	2	0	0	0
	Total	**45**	**8**	**1**	**2**
5 PM	Commercial	21	4	0	1
	Commuting	1	1	1	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	5	1	0	0
	Other-Residential	7	1	0	0
	Single Family	4	1	0	0
	Total	**38**	**7**	**2**	**2**

Economic Loss

The total economic loss estimated for the earthquake is 223.07 (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 168.89 (millions of dollars); 24 % 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 46 % 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	1.23	7.48	0.80	0.65	10.16
	Capital-Related	0.00	0.51	6.66	0.59	0.07	7.83
	Rental	0.73	3.26	3.93	0.41	0.16	8.49
	Relocation	2.61	2.31	5.71	1.96	1.21	13.79
	Subtotal	**3.34**	**7.31**	**23.79**	**3.76**	**2.08**	**40.28**
Capital Stock Losses							
	Structural	5.75	4.29	7.25	5.25	1.33	23.87
	Non_Structural	26.45	17.69	15.57	12.03	2.98	74.72
	Content	8.44	4.23	6.83	7.70	1.39	28.58
	Inventory	0.00	0.00	0.16	1.26	0.02	1.44
	Subtotal	**40.64**	**26.20**	**29.82**	**26.24**	**5.71**	**128.61**
	Total	**43.98**	**33.52**	**53.61**	**29.99**	**7.79**	**168.89**

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	535.04	$0.00	0.00
	Bridges	1,513.09	$45.20	2.99
	Tunnels	0.00	$0.00	0.00
	Subtotal	**2048.10**	**45.20**	
Railways	Segments	35.42	$0.00	0.00
	Bridges	0.16	$0.00	0.19
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**35.60**	**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	2.51	$0.20	7.91
	Subtotal	**2.50**	**0.20**	
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	**2086.20**	**45.40**	

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	15.80	$0.20	1.28
	Subtotal	**15.77**	**$0.20**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	306.40	$8.43	2.75
	Distribution Lines	9.50	$0.10	1.07
	Subtotal	**315.82**	**$8.53**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	6.30	$0.03	0.55
	Subtotal	**6.31**	**$0.03**	
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	0.30	$0.01	2.52
	Subtotal	**0.35**	**$0.01**	
	Total	**338.24**	**$8.78**	

Table 14. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of $)

LOSS		Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06
Second Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-0.18
Third Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.24
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.24
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.24
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(5)	-0.24

Appendix A: County Listing for the Region

Fairfield,CT

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Fairfield	38,101	2,703	990	3,693
	New Haven	46,399	2,837	1,108	3,945
Total State		**84,500**	**5,540**	**2,098**	**7,638**
Total Region		**84,500**	**5,540**	**2,098**	**7,638**

Hazus-MH: Earthquake Event Report

Region Name: VCOG-2

Earthquake Scenario: Haddam

Print Date: January 18, 2012

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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The earthquake loss estimates provided in this report was based on a region that includes 2 county(ies) from the following state(s):

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Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 58.38 square miles and contains 16 census tracts. There are over 33 thousand households in the region which has a total population of 84,500 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,638 (millions of dollars). Approximately 91.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,086 and 306 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 31 thousand buildings in the region which have an aggregate total replacement value of 7,638 (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 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 20 dams identified within the region. Of these, 8 of the dams are classified as 'high hazard'. The inventory also includes 21 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 2,392.00 (millions of dollars). This inventory includes over 83 kilometers of highways, 65 bridges, 1,576 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	65	1,513.10
	Segments	27	535.00
	Tunnels	0	0.00
		Subtotal	**2,048.10**
Railways	Bridges	2	0.20
	Facilities	0	0.00
	Segments	19	35.40
	Tunnels	0	0.00
		Subtotal	**35.60**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	2.50
		Subtotal	**2.50**
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	**2,086.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	15.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**15.80**
Waste Water	Distribution Lines	NA	9.50
	Facilities	4	306.40
	Pipelines	0	0.00
		Subtotal	**315.80**
Natural Gas	Distribution Lines	NA	6.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**6.30**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	3	0.30
		Subtotal	**0.30**
		Total	**338.20**

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	CEUS Event

Building Damage

Hazus estimates that about 429 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 4 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	106	0.36	8	0.55	3	0.74	0	0.87	0	0.58
Commercial	1,507	5.10	121	7.95	50	13.32	8	16.29	1	14.49
Education	44	0.15	3	0.22	1	0.36	0	0.41	0	0.44
Government	40	0.13	3	0.20	1	0.34	0	0.37	0	0.30
Industrial	647	2.19	47	3.10	20	5.39	3	6.03	0	4.52
Other Residential	5,867	19.85	404	26.61	146	38.97	22	43.40	2	48.71
Religion	104	0.35	8	0.54	4	0.95	1	1.30	0	1.49
Single Family	21,233	71.86	925	60.83	150	39.93	16	31.32	1	29.46
Total	**29,549**		**1,520**		**375**		**50**		**4**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	24,567	83.14	1019	67.01	123	32.90	7	13.61	0	0.00
Steel	1,310	4.43	81	5.34	34	8.97	4	7.43	0	2.78
Concrete	377	1.28	28	1.86	11	3.06	1	1.61	0	0.59
Precast	73	0.25	7	0.45	5	1.41	1	2.41	0	0.41
RM	701	2.37	41	2.71	26	6.97	5	9.01	0	0.06
URM	2,260	7.65	306	20.14	156	41.70	32	64.47	4	95.66
MH	261	0.88	38	2.48	19	4.99	1	1.46	0	0.51
Total	**29,549**		**1,520**		**375**		**50**		**4**	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 141 hospital beds available for use. On the day of the earthquake, the model estimates that only 110 hospital beds (79.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 91.00% of the beds will be back in service. By 30 days, 98.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	1
Schools	26	0	0	26
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	11	0	0	11

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	27	0	0	27	27
	Bridges	65	0	0	65	65
	Tunnels	0	0	0	0	0
Railways	Segments	19	0	0	19	19
	Bridges	2	0	0	2	2
	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	2	0	0	2	2
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	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	3	0	0	3	3

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	788	2	0
Waste Water	473	1	0
Natural Gas	315	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	33,104	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 0.02 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 68.00% 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 600 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 43 households to be displaced due to the earthquake. Of these, 25 people (out of a total population of 84,500) 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	5	1	0	0
	Single Family	3	0	0	0
	Total	**9**	**1**	**0**	**0**
2 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	2	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**10**	**1**	**0**	**0**
5 PM	Commercial	4	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	1	0	0	0
	Total	**9**	**1**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 60.68 (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 52.78 (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 53 % 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	0.23	1.51	0.13	0.15	2.03
	Capital-Related	0.00	0.10	1.30	0.09	0.02	1.50
	Rental	0.21	0.98	0.89	0.07	0.03	2.18
	Relocation	0.73	0.71	1.18	0.34	0.26	3.22
	Subtotal	**0.94**	**2.02**	**4.88**	**0.63**	**0.46**	**8.93**
Capital Stock Losses							
	Structural	1.79	1.30	1.48	0.87	0.30	5.74
	Non_Structural	9.73	6.51	4.55	3.97	0.89	25.65
	Content	3.80	1.88	2.74	2.92	0.57	11.91
	Inventory	0.00	0.00	0.06	0.48	0.01	0.55
	Subtotal	**15.32**	**9.68**	**8.84**	**8.24**	**1.77**	**43.85**
	Total	**16.26**	**11.70**	**13.72**	**8.87**	**2.23**	**52.78**

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	535.04	$0.00	0.00
	Bridges	1,513.09	$0.29	0.02
	Tunnels	0.00	$0.00	0.00
	Subtotal	**2048.10**	**0.30**	
Railways	Segments	35.42	$0.00	0.00
	Bridges	0.16	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**35.60**	**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	2.51	$0.18	7.35
	Subtotal	**2.50**	**0.20**	
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	**2086.20**	**0.50**	

Table 13: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	15.80	$0.01	0.05
	Subtotal	**15.77**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	306.40	$7.41	2.42
	Distribution Lines	9.50	$0.00	0.04
	Subtotal	**315.82**	**$7.41**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	6.30	$0.00	0.02
	Subtotal	**6.31**	**$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	0.30	$0.01	2.17
	Subtotal	**0.35**	**$0.01**	
	Total	**338.24**	**$7.43**	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

LOSS		Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.02
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.07
Fourth Year			
	Employment Impact	0	0.00
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Hazus-MH: Earthquake Event Report

Region Name: VCOG-2

Earthquake Scenario: Portland

Print Date: January 18, 2012

Totals only reflect data for those census tracts/blocks included in the user's study region.

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Highway	Bridges	65	1,513.10
	Segments	27	535.00
	Tunnels	0	0.00
		Subtotal	**2,048.10**
Railways	Bridges	2	0.20
	Facilities	0	0.00
	Segments	19	35.40
	Tunnels	0	0.00
		Subtotal	**35.60**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	2.50
		Subtotal	**2.50**
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	**2,086.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	15.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**15.80**
Waste Water	Distribution Lines	NA	9.50
	Facilities	4	306.40
	Pipelines	0	0.00
		Subtotal	**315.80**
Natural Gas	Distribution Lines	NA	6.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**6.30**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	3	0.30
		Subtotal	**0.30**
		Total	**338.20**

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	CEUS Event

Building Damage

Building Damage

Hazus estimates that about 373 buildings will be at least moderately damaged. This is over 1.00 % of the buildings in the region. There are an estimated 3 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	108	0.36	8	0.56	2	0.75	0	0.88	0	0.58
Commercial	1,525	5.12	110	8.17	44	13.54	7	16.28	1	14.36
Education	45	0.15	3	0.22	1	0.37	0	0.41	0	0.43
Government	40	0.13	3	0.20	1	0.34	0	0.37	0	0.30
Industrial	655	2.20	43	3.18	18	5.43	3	5.98	0	4.44
Other Residential	5,927	19.91	365	27.04	129	39.44	19	43.29	2	48.79
Religion	106	0.35	8	0.56	3	0.98	1	1.31	0	1.50
Single Family	21,372	71.77	810	60.06	128	39.16	14	31.48	1	29.59
Total	**29,776**		**1,348**		**326**		**43**		**4**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	24,722	83.02	886	65.70	102	31.28	6	13.34	0	0.00
Steel	1,323	4.44	73	5.45	29	8.93	3	7.25	0	2.53
Concrete	381	1.28	25	1.89	10	2.99	1	1.50	0	0.58
Precast	75	0.25	6	0.47	5	1.46	1	2.42	0	0.37
RM	708	2.38	38	2.81	23	7.11	4	8.93	0	0.00
URM	2,301	7.73	285	21.16	142	43.39	28	65.30	4	96.17
MH	268	0.90	34	2.52	16	4.84	1	1.26	0	0.35
Total	**29,776**		**1,348**		**326**		**43**		**4**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 141 hospital beds available for use. On the day of the earthquake, the model estimates that only 113 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	26	0	0	26
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	11	0	0	11

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: Expected Damage to the Transportation Systems

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	27	0	0	27	27
	Bridges	65	0	0	65	65
	Tunnels	0	0	0	0	0
Railways	Segments	19	0	0	19	19
	Bridges	2	0	0	2	2
	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	2	0	0	2	2
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	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	3	0	0	3	3

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	788	2	0
Waste Water	473	1	0
Natural Gas	315	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	33,104	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 0.01 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 520 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 37 households to be displaced due to the earthquake. Of these, 22 people (out of a total population of 84,500) 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	5	1	0	0
	Single Family	3	0	0	0
	Total	**8**	**1**	**0**	**0**
2 PM	Commercial	4	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**8**	**1**	**0**	**0**
5 PM	Commercial	4	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	1	0	0	0
	Total	**8**	**1**	**0**	**0**

Economic Loss

The total economic loss estimated for the earthquake is 51.03 (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 44.62 (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 53 % 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	0.20	1.32	0.11	0.13	1.76
	Capital-Related	0.00	0.08	1.13	0.08	0.02	1.31
	Rental	0.18	0.86	0.78	0.06	0.03	1.91
	Relocation	0.62	0.62	1.03	0.29	0.23	2.80
	Subtotal	**0.80**	**1.76**	**4.25**	**0.55**	**0.41**	**7.78**
Capital Stock Losses							
	Structural	1.55	1.13	1.29	0.76	0.27	5.01
	Non_Structural	8.18	5.47	3.79	3.35	0.76	21.55
	Content	3.12	1.54	2.24	2.46	0.47	9.83
	Inventory	0.00	0.00	0.05	0.40	0.01	0.46
	Subtotal	**12.86**	**8.14**	**7.38**	**6.97**	**1.50**	**36.85**
	Total	**13.66**	**9.90**	**11.63**	**7.52**	**1.91**	**44.62**

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	535.04	$0.00	0.00
	Bridges	1,513.09	$0.23	0.02
	Tunnels	0.00	$0.00	0.00
	Subtotal	**2048.10**	**0.20**	
Railways	Segments	35.42	$0.00	0.00
	Bridges	0.16	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**35.60**	**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	2.51	$0.16	6.41
	Subtotal	**2.50**	**0.20**	
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	**2086.20**	**0.40**	

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	15.80	$0.01	0.04
	Subtotal	**15.77**	**$0.01**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	306.40	$6.00	1.96
	Distribution Lines	9.50	$0.00	0.04
	Subtotal	**315.82**	**$6.00**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	6.30	$0.00	0.02
	Subtotal	**6.31**	**$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	0.30	$0.01	1.88
	Subtotal	**0.35**	**$0.01**	
	Total	**338.24**	**$6.02**	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.02
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.05
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.06

Appendix A: County Listing for the Region

Fairfield,CT

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Fairfield	38,101	2,703	990	3,693
	New Haven	46,399	2,837	1,108	3,945
Total State		**84,500**	**5,540**	**2,098**	**7,638**
Total Region		**84,500**	**5,540**	**2,098**	**7,638**

Hazus-MH: Earthquake Event Report

Region Name: VCOG

Earthquake Scenario: Stamford 5.7

Print Date: March 18, 2012

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 2 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 58.38 square miles and contains 16 census tracts. There are over 33 thousand households in the region which has a total population of 84,500 people (2002 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 31 thousand buildings in the region with a total building replacement value (excluding contents) of 7,638 (millions of dollars). Approximately 91.00 % of the buildings (and 73.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 2,086 and 306 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

Hazus estimates that there are 31 thousand buildings in the region which have an aggregate total replacement value of 7,638 (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 141 beds. There are 26 schools, 11 fire stations, 6 police stations and 2 emergency operation facilities. With respect to high potential loss facilities (HPL), there are 20 dams identified within the region. Of these, 8 of the dams are classified as 'high hazard'. The inventory also includes 21 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 2,392.00 (millions of dollars). This inventory includes over 83 kilometers of highways, 65 bridges, 1,576 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# Locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	65	1,513.10
	Segments	27	535.00
	Tunnels	0	0.00
		Subtotal	**2,048.10**
Railways	Bridges	2	0.20
	Facilities	0	0.00
	Segments	19	35.40
	Tunnels	0	0.00
		Subtotal	**35.60**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	2.50
		Subtotal	**2.50**
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	**2,086.20**

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	15.80
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**15.80**
Waste Water	Distribution Lines	NA	9.50
	Facilities	4	306.40
	Pipelines	0	0.00
		Subtotal	**315.80**
Natural Gas	Distribution Lines	NA	6.30
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**6.30**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	0	0.00
		Subtotal	**0.00**
Communication	Facilities	3	0.30
		Subtotal	**0.30**
		Total	**338.20**

Earthquake Scenario

Hazus uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Stamford 5.7
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-73.60
Latitude of Epicenter	41.15
Earthquake Magnitude	5.70
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	Central & East US (CEUS 2008)

Building Damage

Hazus estimates that about 778 buildings will be at least moderately damaged. This is over 2.00 % of the buildings in the region. There are an estimated 9 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	97	0.34	14	0.59	6	0.90	1	1.19	0	0.97
Commercial	1,367	4.83	196	8.21	103	15.28	18	19.46	2	20.59
Education	40	0.14	5	0.22	3	0.41	0	0.45	0	0.59
Government	36	0.13	5	0.20	3	0.39	0	0.42	0	0.45
Industrial	579	2.04	83	3.47	48	7.05	8	8.40	1	8.72
Other Residential	5,635	19.89	543	22.68	225	33.33	35	37.29	4	39.22
Religion	99	0.35	11	0.47	6	0.82	1	1.14	0	1.37
Single Family	20,474	72.28	1,535	64.15	283	41.83	30	31.63	3	28.09
Total	**28,327**		**2,393**		**676**		**93**		**9**	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	23,764	83.89	1686	70.47	250	37.04	15	15.64	0	0.11
Steel	1,152	4.07	162	6.79	99	14.65	14	14.83	1	14.97
Concrete	342	1.21	46	1.93	27	3.95	3	2.80	0	1.88
Precast	68	0.24	9	0.37	8	1.15	2	2.24	0	0.45
RM	677	2.39	52	2.18	37	5.43	7	7.72	0	0.47
URM	2,113	7.46	378	15.79	212	31.33	49	52.85	7	80.42
MH	211	0.75	59	2.48	44	6.46	4	3.93	0	1.70
Total	**28,327**		**2,393**		**676**		**93**		**9**	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 141 hospital beds available for use. On the day of the earthquake, the model estimates that only 104 hospital beds (74.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 89.00% 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	26	0	0	26
EOCs	2	0	0	2
PoliceStations	6	0	0	6
FireStations	11	0	0	11

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	27	0	0	27	27
	Bridges	65	0	0	65	65
	Tunnels	0	0	0	0	0
Railways	Segments	19	0	0	19	19
	Bridges	2	0	0	2	2
	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	2	0	0	2	2
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	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	3	0	0	3	3

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	788	16	4
Waste Water	473	8	2
Natural Gas	315	3	1
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	33,104	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 0.03 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 60.00% 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 1,000 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 65 households to be displaced due to the earthquake. Of these, 38 people (out of a total population of 84,500) 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	8	1	0	0
	Single Family	6	1	0	0
	Total	**15**	**2**	**0**	**0**
2 PM	Commercial	13	2	0	0
	Commuting	0	0	0	0
	Educational	3	1	0	0
	Hotels	0	0	0	0
	Industrial	4	1	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**22**	**3**	**0**	**1**
5 PM	Commercial	10	2	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	3	0	0	0
	Single Family	2	0	0	0
	Total	**18**	**3**	**0**	**1**

Economic Loss

The total economic loss estimated for the earthquake is 93.07 (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 81.87 (millions of dollars); 22 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 49 % 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	0.46	3.32	0.30	0.28	4.36
	Capital-Related	0.00	0.19	2.95	0.21	0.03	3.37
	Rental	0.39	1.49	1.93	0.15	0.05	4.02
	Relocation	1.39	1.06	2.69	0.74	0.48	6.37
	Subtotal	**1.79**	**3.20**	**10.89**	**1.41**	**0.84**	**18.12**
Capital Stock Losses							
	Structural	3.34	1.96	3.36	1.85	0.56	11.07
	Non_Structural	15.41	7.82	7.91	5.02	1.28	37.44
	Content	4.95	1.84	3.81	3.32	0.65	14.57
	Inventory	0.00	0.00	0.08	0.57	0.01	0.67
	Subtotal	**23.70**	**11.62**	**15.16**	**10.76**	**2.51**	**63.75**
	Total	**25.48**	**14.82**	**26.05**	**12.17**	**3.35**	**81.87**

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	535.04	$0.00	0.00
	Bridges	1,513.09	$6.74	0.45
	Tunnels	0.00	$0.00	0.00
	Subtotal	**2048.10**	**6.70**	
Railways	Segments	35.42	$0.00	0.00
	Bridges	0.16	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**35.60**	**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	2.51	$0.13	5.21
	Subtotal	**2.50**	**0.10**	
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	**2086.20**	**6.90**	

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	15.80	$0.07	0.45
	Subtotal	**15.77**	**$0.07**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	306.40	$4.20	1.37
	Distribution Lines	9.50	$0.04	0.37
	Subtotal	**315.82**	**$4.23**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	6.30	$0.01	0.19
	Subtotal	**6.31**	**$0.01**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Communication	Facilities	0.30	$0.01	1.48
	Subtotal	**0.35**	**$0.01**	
	Total	**338.24**	**$4.32**	

Table 14. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

LOSS		Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.03
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.09
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.12
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.12
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.12
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.12

Appendix A: County Listing for the Region

Fairfield,CT

New Haven,CT

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Connecticut					
	Fairfield	38,101	2,703	990	3,693
	New Haven	46,399	2,837	1,108	3,945
Total State		**84,500**	**5,540**	**2,098**	**7,638**
Total Region		**84,500**	**5,540**	**2,098**	**7,638**

APPENDIX I
ANNUAL WORKSHEET

Progress Report

Progress Report Period: ________________ to ________________
(date) (date)

Project Title: ______________________ Project ID#: ______________

Responsible Agency: ______________________

Address: ______________________

City/County: ______________________

Contact Person: ______________________ Title: ______________

Phone #(s): ______________ email address: ______________

List Supporting Agencies and Contacts:

____

____

____

Total Project Cost: ______________________

Anticipated Cost Overrun/Underrun: ______________________

Date of Project Approval: ______________ Start date of the project: ______________

Anticipated completion date: ______________________

Description of the Project (include a description of each phase, if applicable, and the time frame for completing each phase): ______________________

____

____

Milestones	**Complete**	**Projected Date of Completion**

Plan Goal(s)/Objective(s) Addressed:

Goal: ______________________________

Objective: ______________________________

Indicator of Success (e.g., losses avoided as a result of the acquisition program):

In most cases, you will list losses avoided as the indicator. In cases where it is difficult to quantify the benefits in dollar amounts, you will use other indicators, such as the number of people who now know about mitigation or who are taking mitigation actions to reduce their vulnerability to hazards.

____

____

Status (Please check pertinent information and provide explanations for items with an asterisk. For completed or canceled projects, see Worksheet #2 — to complete a project evaluation):

Project Status

- ☐ Project on schedule
- ☐ Project completed
- ☐ Project delayed*

*explain: ______________________________

____

- ☐ Project canceled

Project Cost Status

- ☐ Cost unchanged
- ☐ Cost overrun*

*explain: ______________________________

____

- ☐ Cost underrun*

*explain: ______________________________

____

Summary of progress on project for this report:

A. What was accomplished during this reporting period?

____

____

____

____

B. What obstacles, problems, or delays did you encounter, if any?

____

____

____

C. How was each problem resolved?

____

____

____

Next Steps: What is/are the next step(s) to be accomplished over the next reporting period?

Other comments: