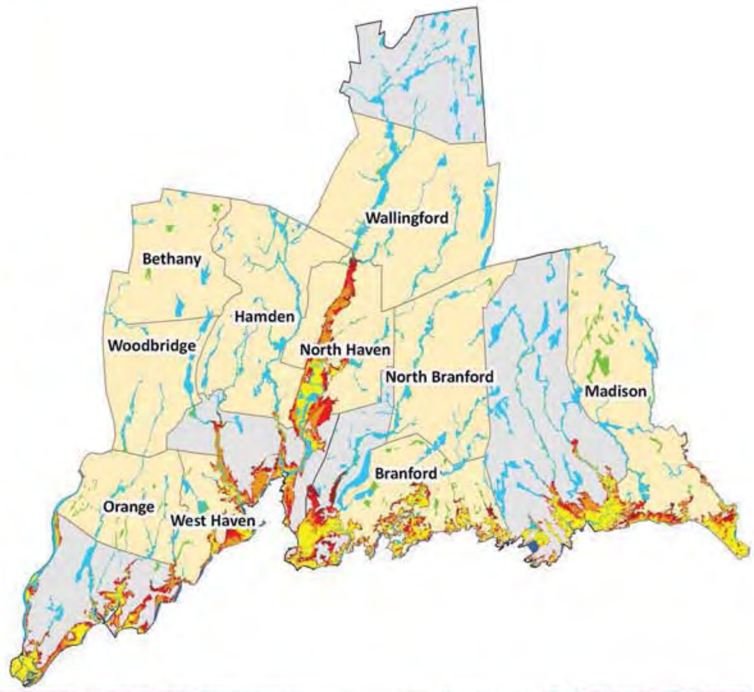
SCRCOG SOUTH CENTRAL REGIONAL COUNCIL OF GOVERNMENTS
Planning for Our Region's Future

SOUTH CENTRAL REGION MULTI-JURISDICTION HAZARD MITIGATION PLAN



Final

April 24, 2014

SCRCOG JAMIE CAPLAN CONSULTING LLC Emergency Management Services AECOM

Participating Jurisdictions

- ✓ Town of Bethany
- ✓ Town of Branford
- ✓ Town of Hamden
- ✓ Town of Madison
- ✓ Town of North Branford
- ✓ Town of North Haven
- ✓ Town of Orange
- ✓ Town of Wallingford
- ✓ City of West Haven
- ✓ Town of Woodbridge

Support Provided By:

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Acronyms

ALE	Annualized Loss Estimate
APA	American Planning Association
ASDSO	Association of Dam Safety Officials
BFE	Base Flood Elevation
CEDS	Comprehensive Economic Development Strategy
CL&P	Connecticut Light & Power
CRS	Community Rating System
DEEP	CT Department of Energy and Environmental Protection
DFIRM	Digital Flood Insurance Rate Map
DOT	Department of Transportation
DPW	Department of Public Works
EF Scale	Enhanced Fujita Scale
EMPG	Emergency Management Performance Grants
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance Program
GIS	Geographic Information Systems
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
IPCC	Intergovernmental Panel on Climate Change
JCC	Jamie Caplan Consulting LLC
LOMR	Letter of Map Revision
LRTP	Long Range Transportation Plan
MPH	Miles Per Hour
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NOAA	National Oceanic and Atmospheric Administration
NPDP	National Performance of Dams Program
NPG	National Preparedness Goal
NRCS	Natural Resources Conservation Service
NSSL	National Severe Storms Laboratory

NYCEM	New York City Area Consortium for Earthquake Loss Mitigation
PDM	Pre-Disaster Mitigation Program
PDSI	Palmer Drought Severity Index
POCD	Plan of Conservation and Development
PRI	Priority Risk Index
RPC	Regional Planning Commission
RWA	Regional Water Authority
SCRCOG	South Central Regional Council of Governments
STEAP	Small Town Economic Assistance Program
TNC	The Nature Conservancy

CHAPTER 1. INTRODUCTION

The Federal Emergency Management Agency (FEMA) defines mitigation as "the effort to reduce loss of life and property by lessening the impact of disasters. Mitigation is taking actions now – before the next disaster – to reduce human and financial consequences later (analyzing risk, reducing risk, insuring against risk.)"[1]

The intent of mitigation planning is to maintain a process that leads to hazard mitigation actions. Mitigation plans identify the natural hazards that impact communities, identify actions to reduce losses from those hazards, and establish a coordinated process to implement the plan.[2]

The Disaster Mitigation Act of 2000 (DMA 2000) amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 322 of the Act makes pre- and post-disaster mitigation funding available for states, territories, Indian tribal governments, universities and local governments who have an approved mitigation plan. Governments with approved mitigation plans in place are eligible and ready to receive federal funds.

The South Central Regional Council of Governments (SCRCOG) was awarded a FEMA Hazard Mitigation Planning grant administered by the Connecticut Department of Energy and Environmental Protection (CT DEEP) to develop a Multi-Jurisdiction Hazard Mitigation Plan for Bethany, Branford, Hamden, Madison, North Branford, North Haven, Orange, Wallingford, West Haven and Woodbridge. The five additional jurisdictions in the Region (East Haven, Guilford, Meriden, Milford and New Haven) have completed or are currently working on their own hazard mitigation plans. SCRCOG hired a consulting team led by Jamie Caplan Consulting, LLC (JCC) with support from AECOM to develop the Plan.

The significance of the South Central Region Multi-Jurisdiction Hazard Mitigation Plan is that it provides the Region with a comprehensive mitigation strategy for prioritizing projects, programs and activities that will save lives and reduce losses from impacts of natural disasters. Participating in a multi-jurisdiction plan was a way for the ten jurisdictions to achieve economies of scale. This Plan defines responsibilities and analyzes local capacities and capabilities to manage mitigation projects. It also fulfills FEMA's requirement for a mitigation planning process that first, ensures federal assistance to these ten South Central Connecticut jurisdictions and second, allows the local governments to compete for millions of dollars of mitigation project assistance annually. This Multi-Jurisdiction Hazard Mitigation Plan defines risk and vulnerability in a systematic manner, and analyzes the vulnerability of critical structures with respect to mapped known natural hazard areas. It also provides a framework for informed decision-making regarding prioritization of mitigation projects that will ensure both the protection of life and property and cost-effective use of taxpayer's funds.

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[1] http://www.fema.gov/what-mitigation#1

[2] 44 CFR §201.1(b)

SCRCOG staff took the leadership with the planning process, which eased the burden of a single jurisdiction having to assume all of the planning work. They will assume this leadership role for future updates of the South Central Region Multi-Jurisdiction Hazard Mitigation Plan. FEMA requires that the jurisdictions update this Plan every five years to remain eligible for non-emergency public assistance from FEMA in the form of grants.

South Central Regional Council of Governments

The South Central Regional Council of Governments (SCRCOG) provides a platform for inter-municipal coordination, cooperation and decision-making. SCRCOG is made up of fifteen jurisdictions: Bethany, Branford, East Haven, Guilford, Hamden, Madison, Meriden, Milford, New Haven, North Branford, North Haven, Orange, Wallingford, West Haven, and Woodbridge. Over the years, SCRCOG has primarily addressed issues of transportation and land use planning. However, in recent years, the SCRCOG has taken on such additional issues as foreclosure prevention and pre-disaster natural hazard mitigation planning.

The SCRCOG region covers approximately 570,000 people, or 1/6th of the state's population. SCRCOG has a staff of six employed in its offices in North Haven.

In 1948, a few jurisdictions in the SCRCOG region were the first to take advantage of the opportunity afforded by recently enacted legislation to voluntarily form the Regional Planning Authority of the South Central Region. By 1960, the authority was serving all fifteen towns in the Region. In 1985, the South Central Regional Council of Governments was established with the approval of each legislative body from the fifteen jurisdictions. Today, the fifteen mayors and first selectmen of the SCRCOG member cities and towns meet monthly to promote regional collaboration and to address issues of regional importance.

2014 Multi-Jurisdiction Hazard Mitigation Plan Goals

The purpose of the South Central Region Multi-Jurisdiction Hazard Mitigation Plan is to provide the region with a comprehensive examination of all natural hazards affecting the region and to provide a framework for informed decision-making regarding the selection of cost-effective mitigation actions. These mitigation actions, when implemented, will reduce the region's risk and vulnerability from natural hazards. The Plan also documents the mitigation planning process that is required by the DMA 2000.

This Plan is the result of a collaborative effort between many stakeholders representing the region, including SCRCOG staff, the governments of the ten participating jurisdictions and The Nature Conservancy. Throughout the development of the Plan, the Advisory Committee, a formal committee with at least one representative from each of the participating jurisdictions, provided leadership. The Advisory Committee reviewed mitigation goals, reviewed research regarding natural hazard risk and vulnerability assessments and identified and prioritized mitigation actions. They also prepared a mitigation implementation strategy with recommendations designed to save lives and reduce losses from future disasters caused by natural hazards.

The mission of the South Central Region Multi-Jurisdiction Hazard Mitigation Plan is to: reduce or eliminate risk to people and property from natural hazards.

2014 Multi-Jurisdiction Hazard Mitigation Plan Mission

Reduce or eliminate risk to people and property from natural hazards.

The Jamie Caplan Consulting team, SCRCOG staff and the Advisory Committee adhered to the following guiding principles in the plan's development.

Guiding Principles for Plan Development[3]

- Focus on the mitigation strategy. The mitigation strategy is the plan's primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions.
- Process is as important as the plan itself. In mitigation planning, as with most other planning efforts, the plan is only as good as the process and people involved in its development. The plan should also serve as the written record, or documentation, of the planning process.
- This is your community's plan. To have value, the plan must represent the current needs and values of the community and be useful for local officials and stakeholders. Develop the mitigation plan in a way that best serves your community's purpose and people.

The theme throughout the planning process was:

Jurisdictions are individual entities with specific characteristics/risks that need to be addressed.

With this theme in mind, the planning process included the development of a Public Outreach Strategy, eight Advisory Committee meetings, ten Municipality meetings and four Public Workshops. Significant effort was made throughout the planning process to capture the specific risks and mitigation actions for each jurisdiction as well as to examine the region as a whole.

[3] Local Mitigation Planning Handbook, FEMA March 2013, p.I-2.

The Advisory Committee identified the following twelve hazards to profile:

- Coastal Erosion
- Dam Failure
- Drought
- Earthquake
- Extreme Temperatures
- Flood
- Hurricane/Tropical Storm
- Sea Level Rise
- Severe Thunderstorm
- Severe Winter Storm/Nor'easter
- Tornado
- Wildfire

Following the hazard identification, a risk analysis was conducted to determine vulnerability for each participating jurisdiction. Included in the risk analysis were community assets, vulnerable assets, potential impacts, loss estimates and problem statements. This approach enabled the theme of "jurisdictions are individual entities with specific risks" to be examined. The problem statements at the end of each jurisdiction's risk analysis bridged the gap to capabilities and mitigation actions by identifying hazards and geographic areas of concern as well as vulnerable community assets.

The Advisory Committee developed five goal categories and associated goal statements for the region as represented in **Table 1.1** below.

Table 1.1 Mitigation Plan Goals

Goal Categories	Mitigation Plan Goals
Community Planning	1. Reduce the impact of natural hazards by integrating natural hazard mitigation policies and practices into local community planning.
Flood Hazards	2. Minimize flood hazards in the region by maintaining continued compliance with the National Flood Insurance Program, adopting higher regulatory standards for new floodplain development, and implementing flood mitigation projects for existing flood prone structures.
Trees	3. Limit the impact of fallen trees due to natural hazards by collaborating with electric utility companies and property owners (private and public) to cut limbs and remove hazardous trees that pose threats to buildings, infrastructure and utility lifelines.
Regional Collaboration	4. Build capacity for natural hazard mitigation and climate adaptation at the local level through regional collaboration.
Public Awareness and Preparedness	5. Increase public awareness and preparedness for natural hazards by implementing community-based public education programs across the region.

After the regional goals were developed, SCRCOG staff and each jurisdiction developed their own mitigation actions. The Advisory Committee then came together to develop an implementation and plan maintenance process.

Authority

The SCRCOG Board and each of the ten jurisdictions participating in this Hazard Mitigation Plan have adopted the South Central Region Multi-Jurisdiction Hazard Mitigation Plan. The adoption notices are included in Appendix L. The Plan was developed in accordance with current state and federal regulations governing hazard mitigation plans. The contractors, SCRCOG staff and the Advisory Committee used FEMA's Local Mitigation Planning Handbook, March 2013, and the Local Mitigation Plan Review Guide, October 2011, as references for this plan.

Document Overview

Below is a summary of the Hazard Mitigation Plan chapters including the appendices. The FEMA guidelines and requirements for each portion of this Plan are included in their respective chapters. The planning process closely adhered to FEMA guidelines and to the intent of these guidelines.

Chapter 2: Planning Area Profile

The Planning Area Profile chapter describes the demographics, geography, climate, transportation and land use of the region. It then goes into detail about each of the participating jurisdictions. To gather the jurisdiction specific information, the Planning Team conducted research including meeting with each jurisdiction, reviewing the town's website and their Plan of Conservation and Development. This chapter describes the characteristics of the region.

Chapter 3: Planning Process

The Planning Process chapter documents the methods and approach of the hazard mitigation planning process. The chapter summarizes the eight Advisory Committee meetings; the public workshops and the public outreach activities. This chapter guides a reader through the process of generating this Plan and reflects the open and inclusive public involvement process.

Chapter 4: Risk Assessment

The Risk Assessment chapter includes three main sections: hazard identification, hazard analysis and risk analysis. Best available data, including geographic information systems (GIS) and Hazus-MH, were used for this analysis. The chapter includes a sub-section for each of the ten participating jurisdictions emphasizing their unique risks. Finally, each jurisdiction section concludes with Problem Statements related to primary hazards of concern, geographic areas of concern and vulnerable community assets. The Problem Statements served as a stepping-stone for developing the mitigation actions presented in Chapter 6.

Chapter 5: Capability Assessment

The Capability Assessment looks at each jurisdiction's ability to mitigate risk prior to and post-disaster. This chapter aims to answer two questions:

1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs?[4]
2. Does the Plan address each jurisdiction's participation in the National Flood Insurance Program (NFIP) and continued compliance with NFIP requirements, as appropriate?[5]

The combination of the information contained in the Risk Assessment and the Capability Assessment leads to the analysis in the Mitigation Strategy chapter.

Chapter 6: Mitigation Strategy

This chapter provides a blueprint for reducing losses identified in the Risk Assessment. The chapter presents the overall hazard mitigation goals and objectives and then identifies mitigation actions in priority order for each of the participating jurisdictions. Where applicable, funding sources are identified, as are responsible persons or departments.

Chapter 7: Plan Implementation and Maintenance

The Plan Implementation and Maintenance chapter establishes a system and mechanism for periodically monitoring, evaluating and updating the Hazard Mitigation Plan.

Appendices

The Appendices include documentation regarding the planning process, such as Advisory Committee meeting presentations and Public Participation Survey results. In addition, resources such as the Toolkit for Floodplain Mapping and the Project Fact Sheet are available. The jurisdiction resolutions for participation are included, as are the adoption letters.

[4] 44 CFR 201.6(c)(3)

[5] 44 CFR 201.6(c)(3)(ii)

CHAPTER 2. PLANNING AREA PROFILE

The South Central Region is one of fourteen planning regions in the State of Connecticut. Located within New Haven County in Southern Connecticut, the South Central Region is comprised of the following fifteen jurisdictions: Bethany, Branford, East Haven, Guilford, Hamden, Madison, Meriden, Milford, New Haven, North Branford, North Haven, Orange, Wallingford, West Haven and Woodbridge. These fifteen jurisdictions make up the South Central Regional Council of Governments (SCRCOG). SCRCOG brings together local governments to coordinate land use and transportation on a regional basis. This Multi-Jurisdiction Hazard Mitigation Plan covers ten out of the fifteen SCRCOG jurisdictions (referred to as the "planning area"). The additional five jurisdictions in the SCRCOG region are either covered or are in the process of being covered by their own hazard mitigation plan.

Demographics

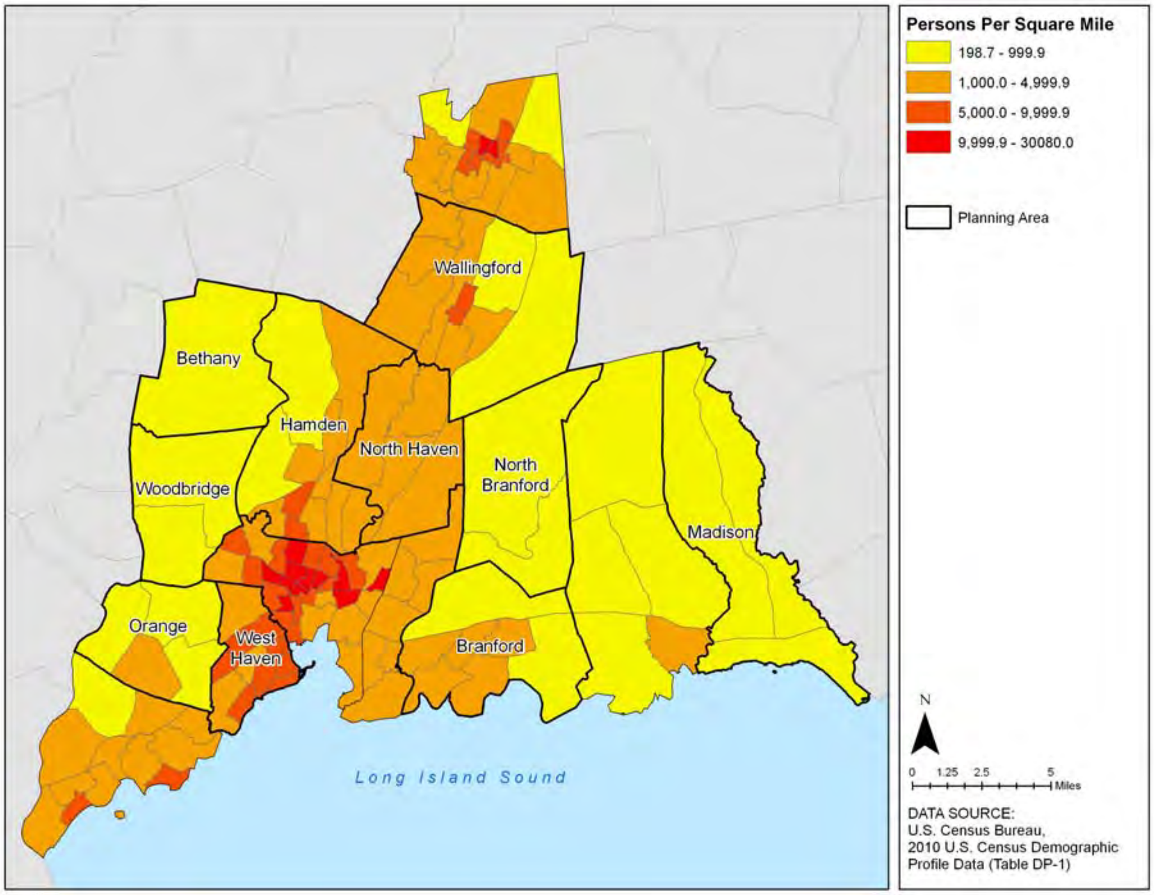
As of the 2010 United States Census, the total population of the planning area is 274,963 (**Table 2.2**), or approximately half of the population of the South Central Region (570,001).[6] The most populated jurisdiction in the planning area is the Town of Hamden, with 60,960 residents, while the least populated is Bethany, with 5,563 residents.

Table 2.2 Population Distribution by Jurisdiction, 2010

Jurisdiction	Population
Bethany	5,563
Branford	28,026
Hamden	60,960
Madison	18,269
North Branford	14,407
North Haven	24,093
Orange	13,956
Wallingford	45,135
West Haven	55,564
Woodbridge	8,990
Total	**274,963**

[6] U.S. Census Bureau, 2010 U.S. Census Demographic Profile Data (Table DP-1).

The South Central Region, which is 369 square miles, is fairly dense with an average population density of 1,544 people per square mile (based on 2010 U.S. Census data). As depicted in **Map 2.0**, the population density varies by jurisdiction with the densely populated census tracts following the major transportation corridors (depicted in **Map 2.2**).



MAP 2.0 Population Density by Census Tract, 2010

It is evident in the population pyramid for Connecticut (**Figure 2.1**) that the largest population segment is within the baby boomer generation. Baby boomers are defined as those born between 1946 and 1964.[7] Overall, the general age structure of the planning area (**Figure 2.2**) mirrors that of the State of Connecticut. In both the planning area and the State of Connecticut, the female population dominates the 85 and over age group, which is consistent with the historical trend of females having a higher life expectancy than males in the United States.[8]

[7] Connecticut Commission on Aging (2011). Aging Issues Fact Sheet (May 2011). Retrieved on July 8, 2013 from http://www.cga.ct.gov/coa/pdfs/Fact Sheets/Aging Issues Fact Sheet 5-16-11.pdf.

[8] U.S. Census Bureau (2012). Expectation of Life at Birth and Projections. *The 2012 Statistical Abstract*. Retrieved on May 15, 2012 from http://www.census.gov/compendia/statab/2012/tables/12s0104.pdf.

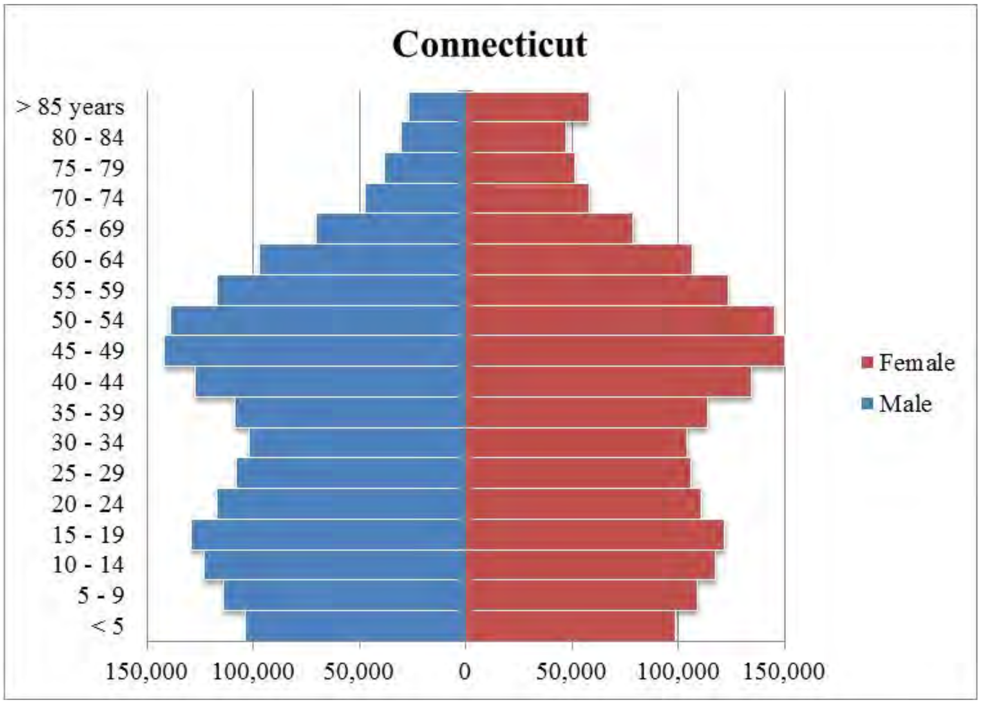


Figure 2.1 Population Distribution by Age in State, 2010[9]

Figure 2.2 Population Distribution by Age in Planning Area, 2010[10]

[9] U.S. Census Bureau, 2010 U.S Census Demographic Profile Data (Table DP-1).

[10] U.S. Census Bureau, 2010 U.S Census Demographic Profile Data (Table DP-1).

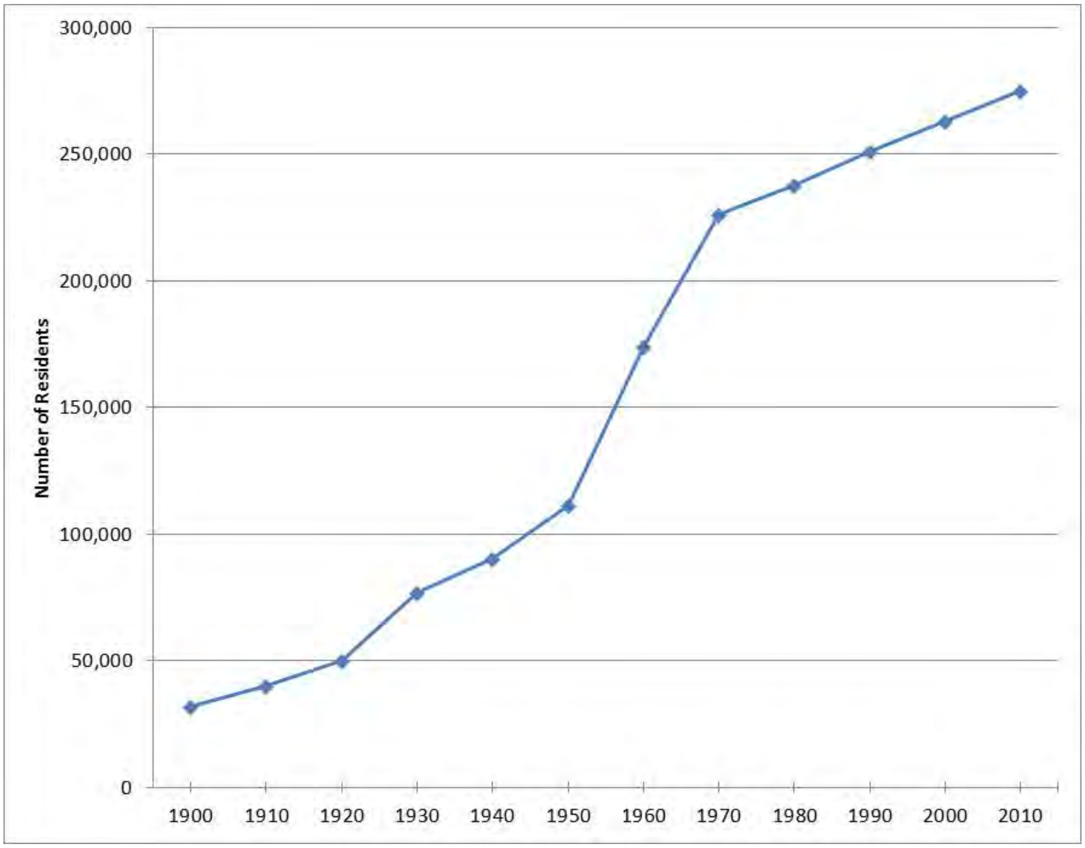


Figure 2.3 Population Growth in Planning Area, 1900–2010[11]

Population growth has remained rather constant since the 1970 U.S. Census, with increases of around 5% between decennial census years (**Figure 2.3**). The largest increase in population occurred between 1950 and 1960 (over 56%). **Figure 2.4** shows the population change in the planning area between 2000 and 2010. Since 2000, the population of nine of the ten jurisdictions increased. The largest increase occurred in Hamden (4,047), while the only jurisdiction that experienced a decrease in population was Branford (-657). The population of Woodbridge remained stable during this time period.

[11] U.S. Census Bureau. Decennial Census, 1990-2010.

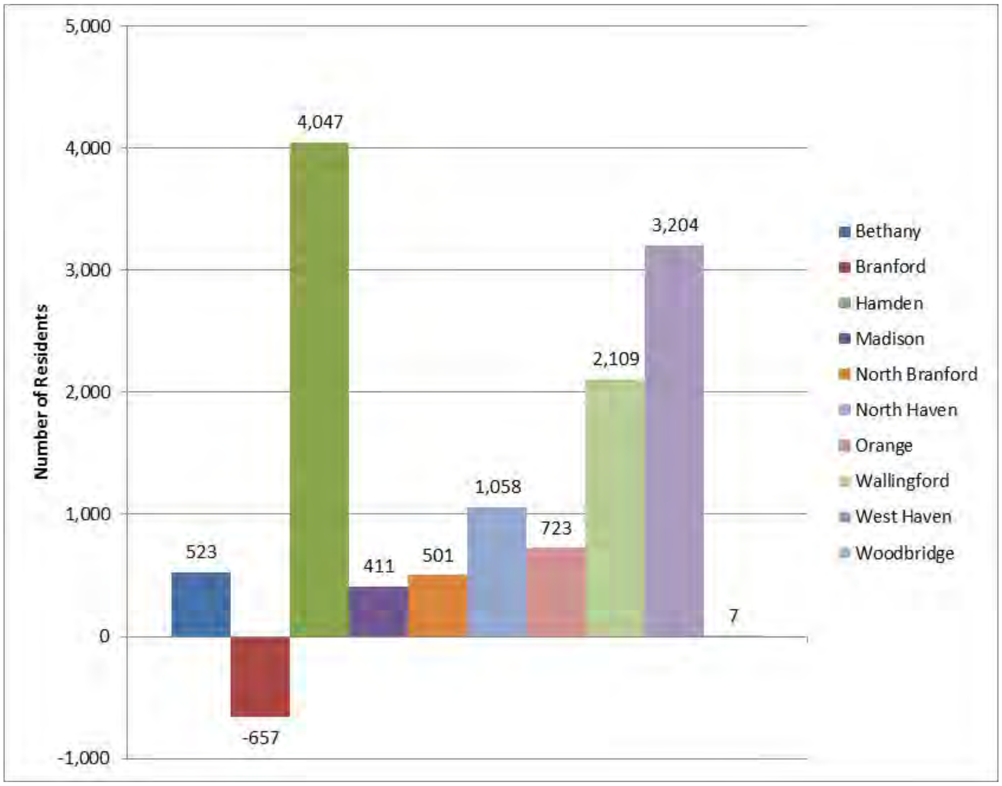


Figure 2.4 Population Change by Jurisdiction, 2000-2010[12]

The following statistics apply to the entire South Central Region, not just the ten jurisdictions that make up the planning area.

In 2010, the region had a median household income of $64,653[13] and the unemployment rate that same year peaked at nine and one-half percent.[14] The following year, the region experienced a drop in unemployment rate to just over eight percent.[15] Close to forty-one percent of the region's residents have attained a bachelor's degree or higher.[16] The State of Connecticut ranks fourth in the nation with 34.7% of the population over the age of 25 having a bachelor's degree or higher.[17] Recent estimates indicate the region contains 14,685 occupied residences. [18]

[12] U.S. Census Bureau, 2010 U.S. Census Demographic Profile Data (Table DP-1).

[13] Connecticut Department of Labor, Labor Force Monthly Data w/ Annual Averages by Town 2000-2011.

[14] U.S. Census Bureau, 2007-2011 American Community Survey.

[15] U.S. Census Bureau, 2007-2011 American Community Survey.

[16] U.S. Census Bureau, 2007-2011 American Community Survey.

[17] http://www.rexdevelopment.org/images/stories/pdfs/rexbrochurejune2011.pdf.

[18] U.S. Census Bureau, 2007-2011 American Community Survey.

Geography

The South Central Region is bordered by the Long Island Sound on the south. The southernmost part of the planning area includes the towns of Branford, Madison, Orange and West Haven. These towns are situated among the Coastal Lowlands, a narrow strip of level shore that runs along the Long Island Sound. The coastline of the Long Island Sound is dotted with many small coves and inlets and varies from sections of sandy beach to rocky bluffs to saltwater marshes.[19] Towns in the Coastal Lowlands have elevations at or near sea level. The towns of Bethany, Hamden, North Branford, North Haven, Wallingford and Woodbridge are located in the Central Lowlands, an area characterized by a gently to moderately sloping landscape of nutrient-rich farming soil.[20] The South Central Region rests mainly on the well-drained Connecticut Valley Lowlands soil that has been formed by glacial stratified drift, sediment that was deposited as a result of glacial melt water streams.[21]

Map 2.1 shows the South Central Region's three major rivers: the Housatonic, the Hammonasset, and the Quinnipiac Rivers. The Housatonic River flows from western Massachusetts south to Connecticut and into Long Island Sound. Many people use the Housatonic River for canoeing and other water activities. The Housatonic River estuary produces one-third of seed oysters, which are a vital part of Connecticut's commercial shellfish industry.[22] The Quinnipiac River bisects the State of Connecticut in a north-south direction and forms the Central Lowlands region.[23] The Quinnipiac River Watershed extends into Wallingford and North Haven in the planning area. The Quinnipiac River flows thirty-eight miles from its headwaters in Plainville, CT to its mouth in New Haven.[24] The Hammonasset River defines a portion of the region's southeastern boundary. The Hammonasset River travels about twenty-one miles from Durham, CT to Long Island Sound near Hammonasset Beach State Park in Madison, CT. All three rivers empty into the Long Island Sound.[25]

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[19] Connecticut Department of Energy & Environmental Protection (2011). *Connecticut Statewide Comprehensive Outdoor Recreation Plan, 2011-2016*, p. 1-2.

[20] Connecticut Department of Energy & Environmental Protection (2011). *Connecticut Statewide Comprehensive Outdoor Recreation Plan, 2011-2016*, p. 3.

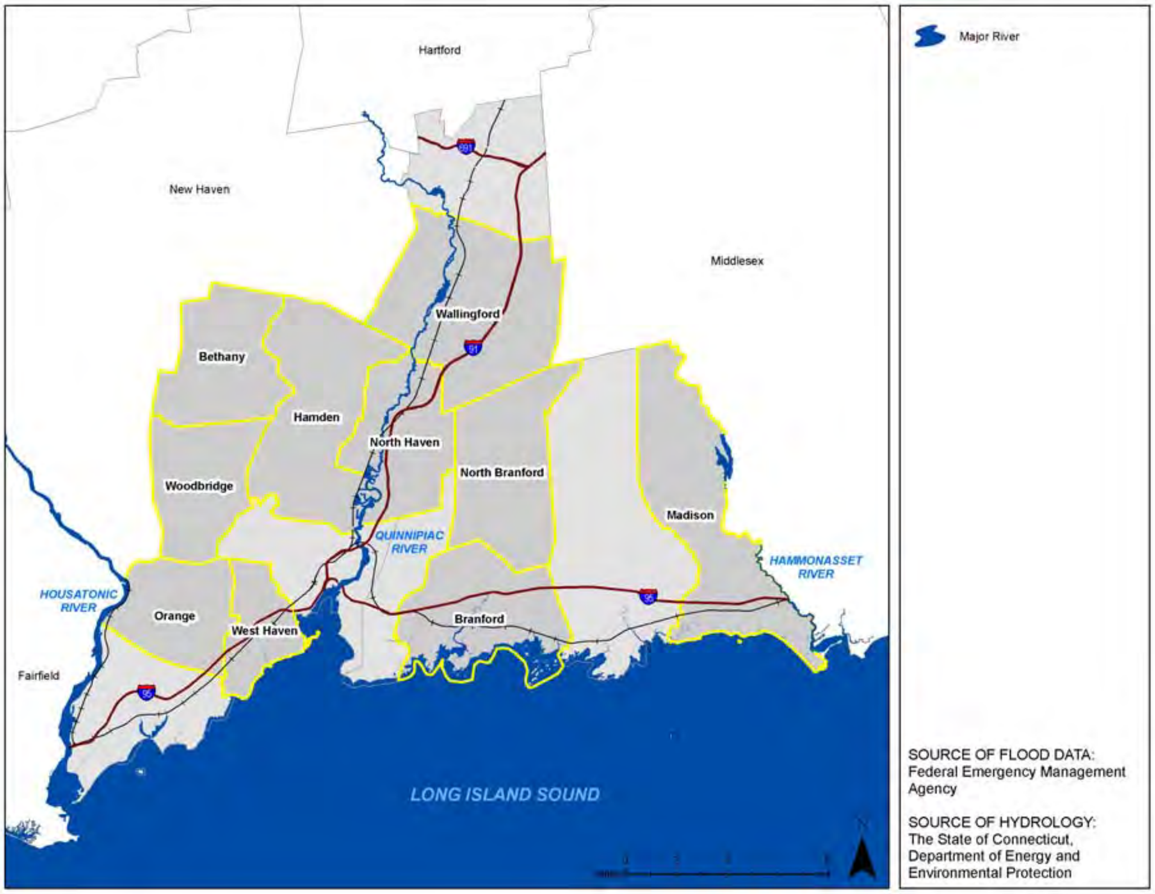
[21] "Glaciers and Glaciation", Stephen A. Nelson, Tulane University, Oct 2003, http://www.tulane.edu/~sanelson/geol111/glaciers.htm.

[22] http://www.housatonicriverguide.com/about/.

[23] "Geographical Features of Connecticut", Connecticut Diary US, http://www.connecticutdiary.us/Geography/.

[24] http://www.ct.gov/deep/cwp/view.asp?a=2716&q=438090.

[25] FEMA Flood Insurance Study, New Haven County, CT., December 17, 2010.



MAP 2.1 Rivers in SCRCOG Region

Overall, the physical characteristics of the region range from marshland to farmland to urban areas. Much of the coastal lands, including areas within floodplains, have developed into densely populated areas of commerce, industry and residence.[26] The Long Island Sound also supports the region's growing commercial and recreational interests, including shell fishing, sport fishing, boating and swimming. As one of the largest estuaries in the United States,[27] the Long Island Sound is also home to a diversity of marine animal and plant life. Considerable efforts have been made by the State of Connecticut and its coastal jurisdictions to protect the Sound's tidal wetlands as an irreplaceable natural resource.[28]

Many organizations, such as the Nature Conservancy, are working to protect the Long Island Sound and the waterways that feed it. The Nature Conservancy developed the Coastal Resilience Tool, which is on its website. This tool allows local decision-makers and scientists to help prepare for sea level rise and storm surge by mapping its potential impact areas. The State of Connecticut has made a commitment to protecting and restoring the Sound. Millions of dollars have been allocated to address the issues of pollution and damage to tidal wetlands. For more information regarding work by the State of Connecticut, visit the CT Department of Energy and Environmental Protection (DEEP) agency website. Commissioner Daniel C. Etsy, CT DEEP, outlined a list of challenges the state faces to protect the Long Island Sound on February 13, 2013 in a Task Force Meeting.[29] The challenges were listed in the following four categories:

1. Regulatory jurisdiction: DEEP vs. local permitting
2. Planning for a changing climate
3. Rebuilding with resilience: Reducing risk in vulnerable areas
4. Connecticut Resiliency Center

Climate

The South Central Region has relatively mild winters and warm summers. Average temperatures for midsummer are between 63˚F (daily low) and 84˚F (daily high). Midwinter temperatures range from 18˚F (daily low) to 35˚F (daily high). The average annual precipitation is about forty-seven inches. The region experiences westerly winds and is subject to cyclonic disturbances—twenty to thirty mile per hour winds that are often accompanied by heavy rain—that follow the prevailing west to southwest winds. The region is also affected by northward moving coastal storms that can reach hurricane intensity during the summer and fall seasons.[30]

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[26] FEMA Flood Insurance Study, New Haven County, CT., December 17, 2010.

[27] Connecticut Department of Energy & Environmental Protection (2011). *Connecticut Statewide Comprehensive Outdoor Recreation Plan, 2011-2016*, p. 11.

[28] Connecticut Department of Energy & Environmental Protection. "Living on the Shore Tidal Wetlands." Accessed on July 9. 2013 from http://www.ct.gov/dep/cwp/view.asp?A=2705&Q=323808.

[29] http://www.ct.gov/deep/lib/deep/long_island_sound/shorelinepreservation/shorelinetaskforcetestimony_02-13-2013.pdf.

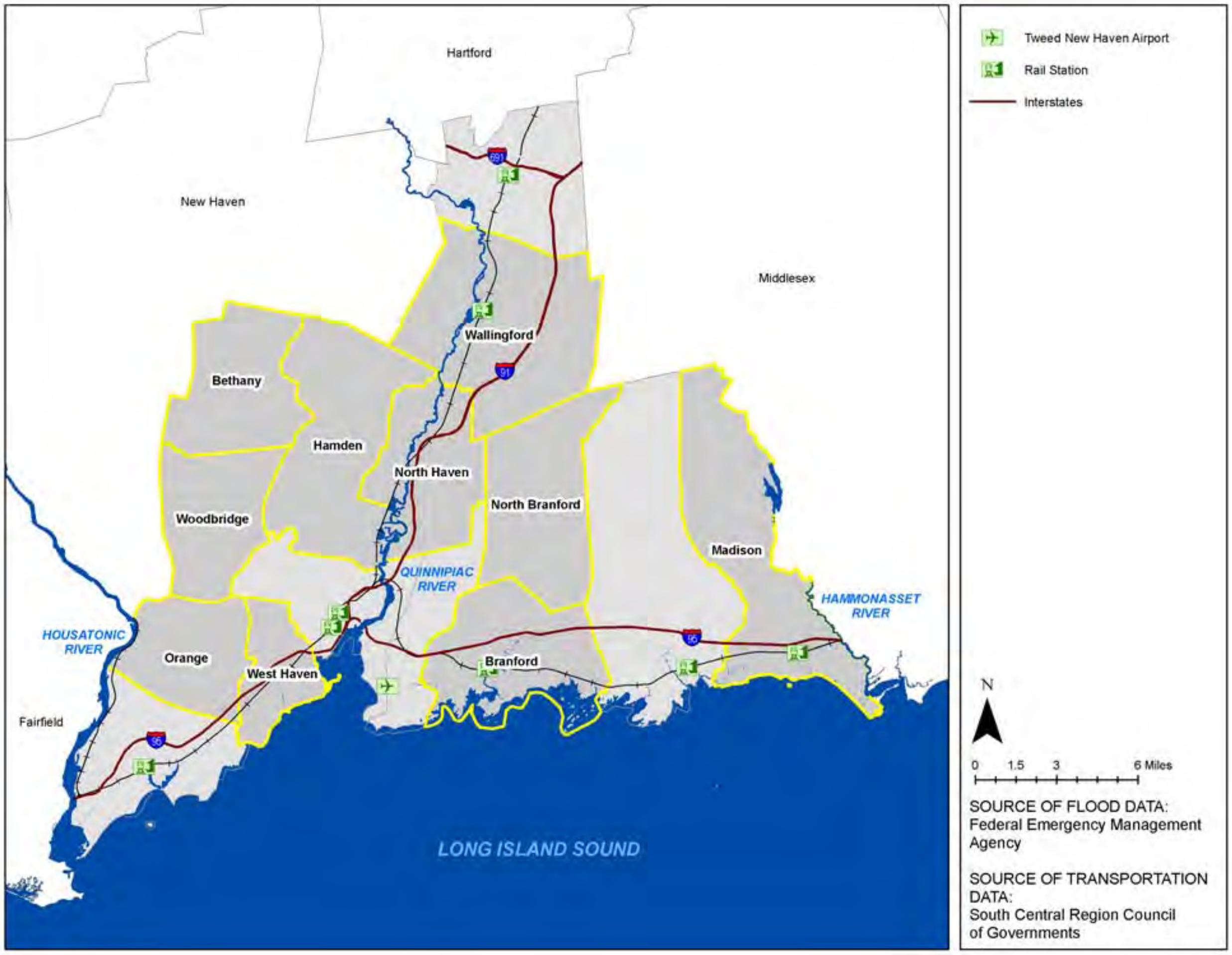
[30] FEMA Flood Insurance Study, New Haven County, CT, December 17, 2010.

The coastal communities in the planning area – West Haven, Branford and Madison – are located on Long Island Sound. The inland communities in the planning area are Orange, Woodbridge, Bethany, Hamden, North Haven, Wallingford and North Branford. On average, the coastal communities receive less rainfall and less snowfall than the inland communities. The average high and low temperatures tend to be approximately the same for the coastal communities as the inland communities.

Transportation Network

The South Central Region has a well-developed transportation network. It is centrally located just thirty-nine miles from Hartford, eighty-nine miles from New York City and one hundred twenty-eight miles from Boston. Its transportation resources include railways, waterways, roads and natural gas pipelines. Among these are two major interstate highways (I-91 and I-95), Tweed New Haven Regional Airport, which serves one hundred thirty destinations around the globe, a major rail hub serving Amtrak, Metro-North, and Shoreline East and the Port of New Haven, which is the State's largest deep-water port.[31] **Map 2.2** shows the location of the major transportation corridors in the region.

[31] Regional Economic Xcelleration, http://www.rexdevelopment.org/.



MAP 2.2 Transportation Arteries in the Planning Area

The presence of many heavily used transportation modes makes coordination and planning necessary. SCRCOG hosts monthly meetings to facilitate interagency communication and cooperation regarding transportation between their member jurisdictions and state and federal agencies. As the metropolitan planning organization, SCRCOG develops the regional Long Range Transportation Plan (LRTP), which "addresses broad goals for the transportation needs of the region." The latest LRTP, which covers the years 2011-2040, lists the following major goals: travel options, transportation funding, policy guidance, regional solutions, linking land use with transportation, aging infrastructure, economic vitality, congestion management process, preservation of existing transportation resources and climate change. The LRTP does not address natural hazards but it does seek to address climate change in terms of reducing the emission of greenhouse gasses. Environmental permitting for transportation rests primarily at the state level; however, the LRTP mentions that review by "jurisdictions will provide the potential for local input to the state permitting process, working toward the goal of a better environmental outcome for every transportation project."[32]

[32] http://www.scrcog.org/documents/LRTP_April272011approved.pdf. p.8.

Land Use and Development

FEMA Requirement §201.6(c)(2)(ii)(C)

Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

The South Central Region updated its Plan of Conservation and Development (POCD) in 2008 (amended in July 2009). The POCD "provides a general regional policy guide for conservation and development that balances higher density development in the region's existing employment, transportation, and housing corridors with context-sensitive reinvestment in historic town centers and villages while also protecting the open spaces, forests, and agricultural lands that contribute to the region's high quality of life and sense of place."[33]

The 2008 update to the POCD coincided with updates to both the region's Long Range Transportation Plan (LRTP) and Comprehensive Economic Development Strategy (CEDS) being completed by the region's economic development arm, the Regional Growth Partnership (now REX Development). The CEDS is an action plan for the region's economy that identifies strengths and weaknesses in the economy, provides a concrete plan for creating jobs, prioritizes infrastructure needs, and identifies strategies for improving quality of life. This timing provided the region with the unique opportunity to discuss transportation, economic development and land use comprehensively.

In the South Central Region, there is a strong connection between transportation and development patterns. SCRCOG jurisdictions are continually working to balance development and their transportation needs in a way that promotes the region's broader long-term goals.[34] The region directs development toward areas that:

- Are good places to live and work
- Maintain and improve the quality of life
- Sustain economic growth
- Build a strong sense of community
- Reinvest in urban centers
- Develop on lands which have existing supportive infrastructure (i.e., existing public utilities and road network).

[33] http://www.scrcog.org/documents/AmendedPOCDfinal21July2009.pdf.

[34] "South Central Regional Long Range Transportation Plan 2011-2040: Framing the Region's transportation programs and investments", South Central Regional Council of Governments, April 27, 2007.

Additionally, regional land use and development trends strongly consider the preservation of open space and prime farmland as well as maintaining safe streets, a healthy environment and travel options for its citizens.[35]

Jurisdiction Specifics

Bethany

According to the Town website, "Bethany was first settled in 1717 but it was not until May 1832 before Bethany separated from Woodbridge to become incorporated as a town."[36] Bethany is located between New Haven and Waterbury on State Routes 63 and 69. Bethany meets the criteria for "rural" established in the State Plan of Conservation and Development.[37] A Board of Selectman, Town Meeting and Board of Finance govern the Town of Bethany. The Tennessee Gas Pipeline Company operates a natural gas transmission pipeline that runs through the southeast corner of town.[38] The high amount of forested land in Bethany presents a major concern for blocked roadways and damaged property by fallen trees during major storms.

Picture 2.1 Derrylyn Gorski, First Selectwoman of the Town of Bethany

Demographics

The Town of Bethany is a sparsely populated agricultural community situated in the northwest corner of the region. It covers twenty-one square miles and is home to 5,563 residents[39] and many small businesses. According to recent data, there are nearly 1,916 occupied housing units, a six percent unemployment rate and the median household income is $106,579. Over forty-nine percent of the Town's residents have attained a four year college degree or higher.[40]

Geography and Water

The Town encompasses many forested areas. Residents appreciate the outdoors and enjoy horseback riding, which explains their investment in working to preserve the Town's many open spaces as natural sanctuaries and sites of historic significance. Bethany also has several reservoirs and a major waterway, the Naugatuck River, which runs north to south just one mile from the western border. The river is flood prone, but the Town has sufficiently sized culverts and a dam that helps alleviate flooding concerns. One of the Land Use Goals in Bethany is "to protect Bethany's role in the region as a public water supply watershed."[41]

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[35] "South Central Regional Long Range Transportation Plan 2011-2040: Framing the Region's transportation programs and investments", South Central Regional Council of Governments, April 27, 2007, p.9.

[36] http://www.bethany-ct.com/community/com_AboutBethany.asp.

[37] Town of Bethany, Town Plan of Conservation and Development, January 1, 1999.

[38] National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

[39] U.S. Census Bureau, 2010.

[40] U.S. Census Bureau, 2007-2011 American Community Survey.

[41] Town of Bethany, Town Plan of Conservation and Development, January 1, 1999.

Transportation
Bethany does not have any major transportation arteries running through the Town however; it is located fairly close to State Route 8.

Land Use and Development
The Town of Bethany is located outside of the region's main commercial corridor. The western half of Bethany is considered to be a suburban residential area, while the remainder of the Town is considered to be a rural residential area and has a higher incidence of agricultural land use. The rural residential area is also an area for regional water supply. Both rural and suburban residential areas with larger lot sizes can be out of range for access to public utilities.[42] The residents of Bethany have no municipal water or sewer service and rely on wells as a source for both grey water and potable water.

Branford

The area of land now known as Branford was purchased from the Mattabesech Indians in 1638. It was originally called "Totoket" and later became Branford.[43] Branford is a twenty-two square mile coastal community located on Long Island Sound between the towns of East Haven and Guilford. A Board of Selectman, Town Meeting and Board of Finance govern the Town of Branford.

Picture 2.2 Janice Plaziak, Branford Town Engineer

Branford also has several taxing districts, which are listed below:

- The Castle Rock Tax District
- The Civic Association of Short Beach
- The Eastern Indian Neck Association
- The Granite Bay Association
- The Greens District Tax District
- Linden Shore District
- Pine Orchard Association
- Stonegate Tax District
- The Stony Creek Association
- Sylvan Point Tax District
- The Plymouth Colony Association
- Johnson's Point District
- Turtle Bay Tax District

Demographics
According to recent data, Branford has a year-round population of 28,026,[44] 12,414 occupied housing units, a median household income of $71,314 and almost forty-three percent of its

[42] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 17-18.

[43] http://www.branford-ct.gov/History/History%20Intro.htm.

[44] U.S. Census Bureau, 2010.

residents have attained a bachelor's degree or higher. The Town has an unemployment rate of just over seven percent.[45]

Geography and Water

The Town of Branford offers a diversity of settings from quaint seaside villages to heavy industrial and commercial districts to densely wooded areas and farmlands. A unique feature of Branford is the Thimble Islands, an archipelago of small bedrock islands located in the Long Island Sound at the southeast corner of Branford. There are a total of about one hundred homes on the islands, mostly occupied during only the summer months. Branford is susceptible to flooding during high tides and rain events.

Transportation

The Tweed New Haven Regional Airport is three miles west of Town and the Shoreline East Rail Service has a stop in Branford.

Land Use and Development

Land use in Branford varies from suburban areas with single-family home lots up to 40,000 ft^2 to multi-family dwellings located along the shoreline to commercial mixed-use areas to areas of industry.[46] As a community with twenty miles of coastline, rivers and reservoirs, storm-related and high tide flooding are major concerns for residents.

Hamden

The Town of Hamden is located to the west of North Haven and borders Bethany and Woodbridge. Prior to 1786 when Hamden was incorporated, it was part of New Haven. Hamden has a Mayor and Council form of government. In 1798, Eli Whitney, inventor of the cotton gin, introduced the United States to modern-day mass production while building arms for the military at a mill site in Hamden. The old factory is now the Eli Whitney Museum. Today, the Town continues to support many small businesses, as well as some light industry. Quinnipiac University is in Hamden. The Farmington Canal passes through the Town; historically the canal was used for ship travel going north from New Haven. Currently the right-of-the way for the canal is being used as a walking and bicycle trail.

Picture 2.3 Carl Amento (center), Executive Director of SCRCOG with Bob Brinton (right), Town Engineer, Town of Hamden, and Craig Cesare (left), Director of Public Works, Town of Hamden

[45] U.S. Census Bureau, 2007-2011 American Community Survey.

[46] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 17-18.

Demographics

Latest available data shows Hamden as having a total population of 60,960[47] with 23,247 occupied housing units and a median household income of $67,955. Just over forty-one percent of residents have attained a bachelor's degree or higher while the unemployment rate is about eight percent.[48] Many New Haven commuters live in Hamden.

Geography and Water

The thirty-three square mile town of Hamden is nicknamed "The Land of the Sleeping Giant." The "Sleeping Giant" refers to Mount Carmel, a narrow ridge of the larger traprock mountain range that extends south from the Long Island Sound and north through the Connecticut River Valley and all the way through Massachusetts and into Vermont. The town features the Mill River, Lake Whitney, the Quinnipiac River, many small streams, reservoirs and an old defunct canal. The main watersheds in Hamden are the Mill River Watershed, the Quinnipiac River Watershed, the Wintergreen Brook Watershed and the Willow Brook Watershed. The Mill River Watershed is the largest and its entire length is considered to be in the 100-year floodplain.[49] The northernmost section of the Town lies at the foot of Mount Carmel and because of the rugged and densely forested landscape, much of this area has remained rural – and a good portion is preserved and managed as a State Park. In contrast, the southern end of town is much more developed and has a rich history of industry and development.

Transportation

In addition to Interstate Highway 91, Wilbur Cross Parkway runs through the Town and serves as a connection to both Hartford and New York City.

Land Use

Much of Hamden's developed land is considered suburban residential with single-family homes on 10,000 feet to 40,000 feet lots. Homes are located in relative close proximity to the main commercial corridors and have access to public utilities.[50] The Town's major concerns are flooding in areas around the rivers, reservoirs and the canal bed. In the Sleeping Giant area, there is a concern for structural damages and interruption to transportation from fallen trees, as well as an increased risk of wildfire during drought periods.

Madison

Madison was known originally as East Guilford until it was incorporated in 1826. This coastal town is located in the southeastern corner of the region. A Board of Selectman governs Madison. The Town has several sites and buildings listed on the National Register of Historic Places and the Town Hall houses valuable historical documents.

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[47] U.S. Census Bureau, 2010.

[48] U.S. Census Bureau, 2007-2011 American Community Survey.

[49] Hamden Plan of Conservation and Development, September 1, 2004, p. 26.

[50] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 17-18.

Demographics

According to recent data, Madison has a population of 18,269[51] with 6,739 occupied housing units. The median household income is $106,609, unemployment rate is approximately six percent and about sixty-two percent of residents have obtained a bachelor's degree or higher.[52] Madison also has a relatively sizeable vulnerable population with many transient persons, several group homes and three senior housing areas.

Geography and Water

The Town is thirty-six square miles and occupies a central location along the Long Island Sound shoreline. Madison also lays claim to the State's longest public beach, Hammonasset Beach State Park, a popular tourist destination in summer months. Madison Center is the main location for businesses and town services.

Picture 2.4 Madison Town Offices

Transportation

Interstate 95 and U.S. Route 1, as well as the Shoreline East Rail line, travel through Madison Center at the southern end of the Town.

Land Use

Except along the shore and south of Interstate 95, Madison is mainly a rural residential area, with homes situated on lots that exceed 80,000 ft^2.[53] The western side of town is less protected from coastal erosion. In the past, hurricanes and severe storms have destroyed homes and roads, leveled sea walls and disabled power lines. Ice storms present a large concern as do severe rain and winter storms. Urban flooding is a major concern as is coastal erosion and sea level rise.

The Town's Plan of Conservation and Development calls for efforts toward "encouraging or requiring buildings to be built as far back as possible from eroding shorelines and vulnerable beach areas."[54] It also recommends that all building near the shoreline not cause additional flooding or impact the shoreline negatively. The plan makes a distinction between preservation (to protect from harm) and conservation (to save from loss) when considering resources and land use. For instance, the plan names preserving wetlands and Coastal "V" flood areas; it names conserving Coastal "A" flood area and the public water supply watershed areas.[55]

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[51] U.S. Census Bureau, 2010.

[52] U.S. Census Bureau, 2007-2011 American Community Survey.

[53] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 17-18.

[54] Madison Plan of Conservation and Development, 2000, p.70.

[55] Madison Plan of Conservation and Development, 2000, p.44.

North Branford

North Branford was originally part of Branford and was purchased in 1638 for "twelve coats made in the English fashion."[56] North Branford was incorporated in 1831[57] and is located just to the east of the City of New Haven in the central portion of the South Central Region. North Branford has a Town Manager-Council form of government.

Demographics

Current data shows a population of 14,407[58] with 5,596 occupied housing units, a median household income of $78,720 and nearly thirty-five percent of residents have attained a bachelor's degree or higher. The town has an unemployment rate of about seven percent.[59]

Geography and Water

The Totoket Mountain, a continuation of the Traprock Ridge that cuts through Hamden, dominates much of its twenty-five square miles. At the southern end of North Branford lies a suburban community surrounded by farmland. The town is unique in that it has retained much of its agricultural landscape despite its close proximity to New Haven.

Picture 2.5 Kurt Weiss, Town Engineer of the Town of North Branford

Transportation

Unlike many of the other jurisdictions in the Region, no interstate highways or railways cut through North Branford.[60] A section of the Algonquin Gas Transmission Company natural gas pipeline bisects the lower portion of Town from east to west.[61]

Land Use

A former mill Town, since the 1950s, North Branford has largely transformed into a residential Town, and a bedroom community for New Haven. However, Tilcon occupies a sizeable tract of land for gravel production.[62] Lake Gaillard, a man-made reservoir built on the north end of the Town, is the major water supply source for the South Central Connecticut Regional Water Authority (SCCRWA). Approximately five thousand residents are served by Lake Gaillard.[63] The SCCRWA owns about 34.9% of land in North Branford.[64]

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[56] http://www.nbranford.lioninc.org/histnbr.htm.

[57] http://connecticuthistory.org/towns-page/north-branford/.

[58] U.S. Census Bureau, 2010.

[59] U.S. Census Bureau, 2007-2011 American Community Survey.

[60] Town of North Branford, Plan of Conservation and Development, December 21, 2009. p.20.

[61] National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

[62] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 18.

[63] "North Branford Plan of Conservation and Development", December 21, 2009.

[64] Town of North Branford, Plan of Conservation and Development, December 21, 2009, p. 57.

North Haven

North Haven became an incorporated town in 1786. The twenty-one square mile town of North Haven is located northeast of the City of New Haven, just ten miles from the city center and twenty-seven miles south of Hartford. A Board of Selectman governs the Town of North Haven.

Demographics

Current data shows a population of 24,093[65] with 8,954 occupied housing units, a median household income of $81,789 and about thirty-seven percent of residents have attained a bachelor's degree or higher. There is an unemployment rate of over seven percent.[66] The convenience of major transportation routes allows North Haven businesses to provide many jobs to residents and commuters alike. North Haven is home to forty businesses assessed at over $1 million, five industrial parks, two colleges and a variety of housing.

Geography and Water

The Town is home to an excellent parks system, including the Quinnipiac River State Park and a portion of the Quinnipiac River Marsh Wildlife Area.[67] The Quinnipiac River runs north to south right through the middle of town and helps to create some of the natural divisions seen in North Haven. Portions of land along the river are broad and flat and stretch east into the neighboring Town of North Branford. Westward, the flat river valley reaches the ridge in the Town of Hamden.[68] The SCCRWA serves 89% of the Town's population[69].

Transportation

Interstate Highway 91 and State Highway 15 bisect the Town. The Algonquin Gas Transmission Company operates a natural gas transmission pipeline that bisects North Haven from north to south, veering off to the eastern corner of town.[70] North Haven has rail currently going through the Town and will have a Train Station in the future as part of the proposed New Haven-Hartford-Springfield Commuter Rail.

Land Use

Once a farming community, today very little agricultural land remains since the rapid residential and commercial land development that ensued after the interstate system was built. There is a large industrial presence along Interstates 95 and 91. East of Interstate 91 is predominantly a suburban residential area.[71] As was revealed in a 2012 municipal meeting, urban flooding is the biggest concern in North Haven. Although the northwest areas of Town are on higher ground safe from flood damage, areas within the river valley are at risk. Major risk areas include residences, businesses and other commercial properties as well as State Highway 15. In 1982, the Quinnipiac River flood submerged some homes, businesses and roadways under 4 feet of water. Some

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65 U.S. Census Bureau, 2010.

66 U.S. Census Bureau, 2007-2011 American Community Survey.

67 The Town of North Haven, Connecticut Official Website, http://www.town.north-haven.ct.us/.

68 "Town of North Haven Plan of Conservation and Development", April 15, 2005, p. 78.

69 Town of North Haven Plan of Conservation and Development, April 15, 2005, p.67.

70 National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

71 South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 18.

commercial properties regularly (up to two times per year) experience one to two inches of floodwater. The Town is also at risk for damage from downed trees and inadequate storm water management.

Orange

The Town of Orange was incorporated in 1822. It had previously been a part of North Milford and West Haven.[72] Orange is located seven miles to the west of New Haven and 45 miles from Hartford. A Board of Selectman governs the Town of Orange.

Demographics

Current data shows a population of 13,956[73] with 4,928 occupied housing units, a median household income of $104,335 and fifty-five percent of residents have attained a bachelor's degree or higher. Orange has an unemployment rate of just over six percent.[74]

Geography and Water

As an open and well-planned residential community, Orange residents prioritize stewardship for the environment and protecting their natural resources. The Town's seventeen square miles of tree-lined rolling hills are bordered on the west by the Housatonic River and traversed by Interstate Highway 95, State Highway 15 and U.S. Route 1.

Transportation

The Iroquois Gas Corporation operates a natural gas transmission pipeline that runs along the Housatonic River.[75] In a 2012 municipal meeting it was revealed that 2012 Hurricane Sandy felled forty trees and more common periodic heavy rains caused flooding on U.S. Route 1, a major thoroughfare for the Region.

Land Use

Overall, the residential density of Orange can be categorized as suburban residential with single-family homes on lots 40,000 ft^2 – 80,000 ft^2.[76] Orange is home to several structures that are listed on the National Register of Historic Places including the Col. Asa Platt House and the Henry F. Miller House. It is also home to the national headquarters for both Pez Candy, Inc. and the United Illuminating Company. The Town is subject periodically to damages from downed trees, river and lake flooding, ice storms and hurricanes.

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[72] http://www.orangehistory.org.

[73] U.S. Census Bureau, 2010.

[74] U.S. Census Bureau, 2007-2011 American Community Survey.

[75] National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

[76] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 18.

Wallingford

Wallingford was incorporated in 1670. A separate Borough of Wallingford was incorporated in 1853 but on June 3, 1957 the Borough and the Town voted to consolidate effective January 1, 1958. The present Town Charter created a Mayor-Council form of government in 1962.

Demographics

Current data shows a population of 45,135[77] with 17,506 occupied housing units, a median household income of $72,540 and nearly thirty-three percent of residents have attained a bachelor's degree or higher. Wallingford has an unemployment rate of nearly eight percent.[78]

Geography and Water

Wallingford stretches across a forty square mile area and is located fourteen miles north of New Haven and less than thirty miles from Hartford. It straddles the Quinnipiac River in the northernmost portion of the South Central Region. In 1989 Wallingford built a new sewer treatment plant that was projected to meet the demand of flows for at least twenty years. Wallingford has municipally operated Water, Sewer and Electricity.

Transportation

Interstate Highway 91 and State Highway 15 also traverse the town. The Algonquin Gas Transmission Company operates a natural gas transmission pipeline that transverses the southwest corner of town.[79] The Amtrak railway services the town.

Land Use

Wallingford is a residential community with some industrial and commercial sites. In recent decades the Town has transitioned from heavy manufacturing to high tech industry. Pharmaceutical manufacturer Bristol-Meyer's Squibb operates a research and development facility in one of Wallingford's five industrial parks.[80] Wallingford's land use varies from rural residential to suburban residential with small lot single-family homes to areas of industrial use along Interstate 91. Wallingford also serves as a site for the regional water supply.[81] The Town is home to several historically significant buildings, including the oldest brick home in the State, the John Barker House, and the Samuel Simpson House, built by notable architect Henry Austin.[82] Wallingford has experienced damage from river flooding caused by hurricanes, tropical storms and heavy rains. Ice and snowstorms have contributed to damages as well.

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[77] U.S. Census Bureau, 2010.

[78] U.S. Census Bureau, 2007-2011 American Community Survey.

[79] National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

[80] The Town of Wallingford Connecticut Official Website, http://www.town.wallingford.ct.us/Content/History_and_Description.asp.

[81] South Central Regional Council of Governments, "South Central Region Plan of Conservation and Development", June 2008, Amended July 2009, p 17-18.

[82] The Town of Wallingford Connecticut Official Website, http://www.town.wallingford.ct.us/Content/Points_of_Interest.asp.

West Haven

The independent Town of West Haven, established in 1921, previously was part of the Town of Orange. West Haven was incorporated as a City in 1959.[83] The City of West Haven has Mayor-Council form of government.

Demographics

Though shipping and other industry have left, West Haven has retained its combination of working and middle class residential neighborhoods and remains a bedroom community for New Haven commuters. The Town is also home to the University of New Haven. Recent data shows a population of 55,564[84] with 21,535 occupied housing units, a median household income of $53,057 and twenty-three percent of residents have attained a bachelor's degree or higher. West Haven has an unemployment rate of almost ten percent. [85]

Geography and Water

Picture 2.6 Municipality Meeting in West Haven Town Hall

The eleven square mile City of West Haven is unique among the jurisdictions in the Region because more than half of its geographic boundary is river, sound, or harbor. The City is bordered on the south by the Long Island Sound, on the east by the New Haven Harbor, on the northeast by the West River and on the southwest by the Oyster River. The City's Plan of Conservation and Development mentions that a significant portion of West Haven's coastal area is in a "coastal hazard area," specifically the area "east of Front Street and between Clifton Street and Mix Avenue near the West River."[86]

As a result, West Haven is particularly vulnerable to damages caused by flooding, severe storms and hurricanes.

Transportation

It is located less than five miles west and south of New Haven and is traversed by both Interstate 95 and U.S. Route 1. Metro-North Railroad and Amtrak operate rail service that run through town. In 2013 West Haven opened a Train Station on the Metro North Commuter Rail Line.

Land Use

It is home to three and a half miles of publicly accessible beaches, which is one quarter of the public beaches in the State. Along the shoreline and the Sandy Point Estuary, many rare species of birds can be spotted. The City is also home to several buildings that are listed on the National Register of Historic Places and has a rich history.

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[83] http://www.westhavenhistory.org

[84] U.S. Census Bureau, 2010.

[85] U.S. Census Bureau, 2007-2011 American Community Survey.

[86] City of West Haven, Plan of Conservation and Development, February 2004, p.38.

Woodbridge

The Town of Woodbridge became an independent parish in 1739. It had been part of New Haven and Milford. A Board of Selectman and Board of Finance govern Woodbridge. The Town has "five residential districts, two commercial/industrial districts, two professional office districts and a park district."[87]

Demographics

Recent data shows a population of 8,990[88] with 3,334 occupied housing units, a median household income of $129,583 and nearly sixty-seven percent of residents have attained bachelor's degree or higher. Woodbridge has an unemployment rate of about five percent.[89]

Geography and Water

Picture 2.7 Woodbridge Town Hall

The Town of Woodbridge is on the western border of the South Central Region. The Town is located six miles northwest of New Haven and forty miles from Hartford. It is a suburban community seated upon nineteen square miles of rolling green countryside. The western portion of Woodbridge is typically hilly while the eastern end has come to be known as "The Flats" for its level terrain. According to the Town's Plan of Conservation and Development 2005, "steep slopes, poor soil drainage and wetlands have influenced the development of Woodbridge. These features require that septic and well systems be carefully planned and constructed."[90] The natural water system in the Town includes an extensive wetland system that provides recharging for private wells, public water supply for reservoirs and flood damage control by acting as storage basins. Beyond the natural water system, "five hundred eighty-five households, schools, businesses, and fire water sources receive water from the SCCRWA. The SCCRWA also manages 1,325 acres of forestland surrounding the reservoirs as public water supply watershed."[91]

Transportation

Unlike other jurisdictions in the region, Woodbridge has no interstate highways within town limits. The Tennessee Gas Pipeline Company operates a natural gas transmission pipeline that runs through Woodbridge from the northeast corner to the southeast corner of Town.[92]

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[87] Town of Woodbridge, Plan of Conservation and Development, 2005, p.15.

[88] U.S. Census Bureau, 2010.

[89] U.S. Census Bureau, 2007-2011 American Community Survey.

[90] Town of Woodbridge, Plan of Conservation and Development, 2005, p.11.

[91] Town of Woodbridge, Plan of Conservation and Development, 2005, p.11.

[92] National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration, https://www.npms.phmsa.dot.gov/.

Land Use

The Town supports a thriving business community and offers plenty of outdoor recreation at numerous parks and an extensive network of trails.[93] A very sizeable West Rock Ridge State Park serves as the entire eastern border of the Town, and Woodbridge is dotted with many small rivers, lakes and ponds. In a 2012 municipal meeting, residents of Woodbridge explained having experienced damages as a result of flood, wildfire, and downed trees and expressed vulnerability during severe storms, hurricanes and wildfires especially in the expansive parkland areas along the eastern border of the Town.

[93] The Town of Woodbridge Connecticut Official Website, http://www.woodbridgect.org/.

CHAPTER 3. THE PLANNING PROCESS

Overview of Planning Process

The planning process was developed in full compliance with the current planning requirements of the Federal Emergency Management Agency (FEMA) per the following rules and regulations:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000
- Code of Federal Regulations – Title 44, Chapter 1, Part 201 (§201.6: Local Mitigation Plans)
- FEMA's Local Mitigation Plan Review Guide (dated October 1, 2011)

FEMA Requirement §201.6(c)(1)
[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

In addition, the plan was prepared in a manner that maximizes credit points under the National Flood Insurance Program's Community Rating System (CRS) for participating jurisdictions. The JCC Team utilized FEMA's 2012 draft version of the *CRS Coordinator's Manual* and its own internal planning crosswalk to ensure that the plan is consistent with CRS requirements for floodplain management planning (Activity 510). While only the Town of Hamden has participated in the CRS, this will enable it and other jurisdictions in the South Central Region to receive credit should they decide to join the program in the future.

The theme throughout the planning process was: **Jurisdictions are individual entities with specific characteristics/risks that need to be addressed.**

This Multi-Jurisdiction Hazard Mitigation Plan eases the burden of keeping these communities safe by identifying and communicating hazard risks, developing actions to reduce or eliminate those risks, and making each jurisdiction eligible for FEMA mitigation program funding. In addition, the mitigation planning process educated key stakeholders within each jurisdiction and strengthened partnerships between these stakeholders and SCRCOG staff.

Figure 3.3 Project Timeline

Planning Team

The SCRCOG Mitigation Planning Team consisted of three SCRCOG staff members and a consulting team. Carl Amento, Executive Director, Eugene Livshits, Regional Planner and Christopher Rappa, Sustainability Planner were the SCRCOG representatives. Jamie Caplan and Jamie Caplan Consulting LLC (JCC) led the consulting team. JCC partnered with AECOM to complete the project.

Outreach Strategy

FEMA Requirement §201.6(b)
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters…

The JCC Team coordinated with the SCRCOG staff in the development of an outreach strategy that successfully generated public interest, solicited citizen input, and engaged additional partners in the planning process. Communication among the key project stakeholders was an essential component of reaching project success.

One of the first project tasks was to develop a formal public outreach strategy. It can be found in its entirety in Appendix B. The six categories of the public outreach strategy were outlined as follows:

1. Form the Advisory Committee and institute an Advisory Committee meeting schedule.
2. Organize and hold ten individual Municipality Meetings.
3. Encourage public participation through the development of the project webpage, municipality surveys and public questionnaires, host regional public workshops, distribute a Project Fact Sheet and utilize news media resources.
4. Develop a Toolkit for Floodplain Mapping.
5. Involve additional stakeholders.
6. Provide ample opportunity for stakeholder involvement in the plan adoption.

Advisory Committee

Prior to the JCC Team being hired, SCRCOG staff had formed an Advisory Committee, as shown in **Table 3.3**, with representatives from each of the ten participating jurisdictions. The Advisory Committee was involved in the process of choosing the consulting team. At the conclusion of the consultant selection process the Advisory Committee was expanded to include additional stakeholders. They have participated fully throughout the planning process and are tasked with plan implementation. The five SCRCOG jurisdictions that already have mitigation plans in place were invited to participate in all meetings. The SCRCOG would like to update the mitigation plan with all fifteen-member jurisdictions in the future.

The table below shows the names and associated jurisdictions for each of the Advisory Committee members. These were the active members for the ten participating jurisdictions. The five jurisdictions that are in the SCRCOG region but already have mitigation plans were involved in Advisory Committee meetings but were not considered Advisory Committee members.

Table 3.3 Advisory Committee Members

Jurisdiction	Committee Member	Position
Bethany	Clark Hurlburt	Deputy EMD / CERT Coordinator
Branford	Janice Plaziak	Town Engineer
Hamden	Robert Brinton	Town Engineer
Madison	Michael Ott	Town Engineer
	David Anderson	Town Planner
North Branford	Kurt Weiss	Town Engineer
North Haven	Jonathan Bodwell	Town Engineer
Orange	Fred Palmer	Emergency Management Director
Wallingford	Peter Struble	Fire Chief
West Haven	Abdul Quadir	City Engineer
Woodbridge	Warren Connors	Operations Manager

The Advisory Committee met at the SCRCOG offices eight times throughout the project in order to provide input to the JCC Team throughout all phases of the project and to provide feedback on all project deliverables. Each of these meetings is outlined in detail in the following pages. In addition, the committee participated in two surveys, assisted with data collection, identified stakeholders in each participating jurisdiction, organized Municipality meetings, assisted with regional workshops, submitted mitigation action implementation worksheets and reviewed the draft mitigation plan.

Advisory Committee Meetings

The JCC Team facilitated a series of eight meetings with the Advisory Committee to ensure continuous involvement of local staff and stakeholders in the development of the plan. The meetings were strategically scheduled throughout the length of the project to gain valuable input from the Advisory Committee and to keep them apprised of project progress. All jurisdictions included in the SCRCOG, including those five jurisdictions not being represented in this multi-jurisdictional plan, were invited to participate in all Advisory Committee meetings. Appendix D includes all Advisory Committee Meeting sign-in sheets, agendas and PowerPoint

Picture 3.1 Advisory Committee Kick-off Meeting

presentations. All Advisory Committee Meetings were held at the SCRCOG offices located at 127 Washington Avenue, North Haven, CT.

Summaries of the Advisory Committee Meetings, listed as Meetings 1-8, are below.

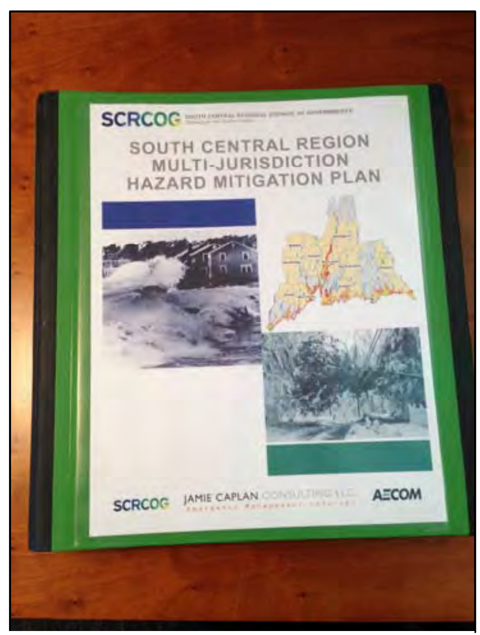
Meeting 1

The Project Kick-off Meeting was held on August 14, 2012. The primary purpose of this meeting was to review the planning process in detail, describe individual roles and responsibilities, and begin initial data collection efforts. Specifically the following critical issues were addressed:

- A general review and discussion of the JCC Team's final Project Work Plan, reviewing any immediate issues, concerns or particular revisions necessary to reflect hazard risks, community development, progress in local mitigation efforts and/or local priorities;
- Discussion of additional members for the Mitigation Planning Advisory Committee, which included representatives from each of the participating jurisdictions to help guide plan development;
- It was highly recommended that SCRCOG staff appoint a Project Liaison who would serve as the primary point of contact throughout the project. They named Eugene Livshits as the SCRCOG Hazard Mitigation Plan Project Manager.
- The development of a public outreach strategy;
- The identification of any data, plans, policies, programs, studies, reports and/or technical information for review and incorporation into the mitigation planning process;
- The identification and involvement of regulatory agencies and other relevant stakeholders that may affect planning efforts and/or be able to provide support in the planning process;
- A regular meeting schedule for the advisory committee; and
- The identification of any potential barriers to timely task completion and the means to overcome such barriers.

Specific collaborations arose at the meeting. Adam Whelchel of The Nature Conservancy (TNC) was invited by SCRCOG staff to participate as a stakeholder. TNC has a concurrent project in Connecticut using their Coastal Resiliency Tool. Fire Chief Struble of Wallingford, an instructor at the University of New Haven, suggested the opportunity to involve his students in the plan development/maintenance process. Some additional questions arose at the meeting:

- How do we involve our citizens in the planning process?
- Can a description of the benefits of FEMA's CRS program be provided to us?
- Can your team (JCC) help us with getting communities to join the CRS program?
- How does this project relate to the ongoing coastal flood study FEMA is doing?



Picture 3.2 Advisory Committee Project Binders

Each of these questions was answered in future Advisory Committee Meetings.

Meeting 2

The second Advisory Committee meeting was held on September 12, 2012. At this meeting the JCC Team's final Project Work Plan and Public Outreach Strategy were presented and discussed. In addition, a Project Binder was distributed to all Advisory Committee members and the Project Website was introduced. The purpose of the binder was to organize all materials distributed at meetings and to keep members of each jurisdiction engaged in this multi-jurisdictional effort. The Project Website and the Project Binder each offer a transparent view into the planning process and enable all stakeholders to participate fully.

The JCC Team facilitated interactive, consensus building exercises with the Advisory Committee to begin hazard identification and data collection efforts, as well as to identify some preliminary goals or objectives for the plan. The exercise, "mayor for a day," used a hypothetical scenario to glean information about each jurisdiction's mitigation objectives. Each jurisdiction representative assumed the hypothetical role of a mayor who has just been awarded a $20 million hazard mitigation grant. Then each participant was asked to prioritize hazards for mitigation projects, where at least fifty percent of funds must be dedicated to the same hazard. Results were quickly tallied and indicated that the hazards receiving the highest spending in mitigation project budgeting were flooding and hurricane/tropical storm. Complete results were reviewed at the October 10, 2012 meeting.

Town officials shared potential public outreach strategies including:

- Janice Plaziak, Branford's Town Engineer, suggested establishing a link from town websites to the SCRCOG website.
- Local public access TV channels were identified as a medium for public outreach.
- The importance of having representatives from relevant departments (planning, engineering/public works, emergency management, fire, police, schools, conservation/recreation) at the municipal meetings. The Advisory Committee determined that the ideal maximum for the number of people to invite to this meeting is around 20, to keep things manageable.

Several comments on mitigation goals were made as well:

- A representative from the City of New Haven asked how their plan would be incorporated into the regional plan. Eugene Livshits, SCRCOG Hazard Mitigation Plan Project Manager, responded by saying that he envisions all fifteen jurisdictions of the Region eventually coming together to be covered under one Plan.

Picture 3.3 "Mayor for a Day" Exercise

Picture 3.4 Adam Whelchel, Nature Conservancy Presenting

Meeting 3

The third Advisory Committee meeting was held on October 10, 2012. The purpose of this meeting was to review the results of the hazard identification process, to review community assets and essential facilities, and to continue the data collection effort in support of both the risk and capability assessments. A public opinion survey was distributed and discussed and examples of the State's mitigation goals and objectives were discussed. The results from the previous meeting's "mayor for a day" exercise were presented.

Additionally, guest speaker Adam Whelchel, Ph.D. of The Nature Conservancy presented the Coastal Resilience Program, a Connecticut-based program designed to help citizens and the environment adapt to the hazards and impacts associated with coastal changes. Dr. Whelchel's presentation can be found in Appendix D.

Meeting 4

The fourth Advisory Committee meeting was held on December 5, 2012. The purpose of this meeting was to review the individual Municipality meetings, hazard identification and analysis, and to discuss any impact from Hurricane Sandy. Themes that emerged in the Municipality meetings were shared with the Advisory Committee. Details on these findings can be found below under the section titled Municipality Meetings. Town officials were given the opportunity to share how Hurricane Sandy affected their jurisdiction in terms of damages, response and recovery. They were encouraged to share any mitigation success stories and to communicate any mitigation actions that could be implemented to reduce any future damages.

- Fire Chief Struble of Wallingford expressed feeling spared from any major impact from Hurricane Sandy.

Picture 3.5 Risk Analysis Branch Chief Mike Goetz (seated far right) presenting to Advisory Committee

- Janice Plaziak, Branford's Town Engineer, stated that there was no significant damaging wave action, but there was widespread and deep flooding.
- Clark Hurlburt, Bethany's representative from Bethany suggested working with the Zoning Board of Appeals to request a zone change variance for elevating structures.

Meeting 5

The fifth Advisory Committee meeting was held on February 13, 2013. The JCC Team gave presentations of the final Risk Assessment and Capability Assessment findings. Completed Capability Assessment data tables were distributed for a final review by representatives from each of the ten jurisdictions. The results of the public questionnaire were also presented and discussed (see below under **Public Preparedness Questionnaire)**. Complete results can be found in Appendix F.

Special guest speaker Mike Goetz, FEMA Risk Analysis Branch Chief, discussed the FEMA Risk MAP program. The overall process of FEMA's flood mapping program, especially flood mapping in Connecticut, was discussed in detail. Information was given regarding the upcoming availability of updated maps and future opportunities to discuss the results of the new maps.

- Janice Plaziak, Branford's Town Engineer, requested that FEMA send discovery reports to the SCRCOG towns regarding the mapped riverine areas in the region.
- Questions were raised concerning how citizens become informed about the new maps and whether they are eligible for reduced flood rates if they apply before the new maps are put into effect.
- Milford, CT and Old Saybrook, CT were suggested as having effectively implemented mitigation actions for flooding through the use of new FEMA maps, the CRS Program incentives and increasing regulations concerning base flood elevation (BFE) levels.

Impacts to the Region from the February 2013 Nor'easter were briefly discussed. Branford reported having six roof collapses and the State of Connecticut overall reported having at least sixteen roof collapses. Record setting snowfall for the Region was recorded.

Meeting 6

The sixth Advisory Committee meeting was held on April 10, 2013. The final analysis of the Risk Assessment was presented. Darrin Punchard explained that AECOM was in the process of reviewing the editorial and GIS updates and that up to this point in time Hazus-MH Annualized Loss Estimates had been included for coastal and riverine flooding, hurricanes and earthquakes. He also explained that storm surge analysis for Connecticut was not possible due to the presence of leading zeroes in the 2010 census data.

Picture 3.6 Mitigation Actions Exercise April 10, 2013

Jamie Caplan reviewed a draft of the Regional Profile and encouraged Advisory Committee members to look over their copies and to give feedback regarding the accuracy and/or relevance of information. The Safe Growth Questionnaire analysis, a part of the Capability Assessment Survey was discussed. Jamie Caplan pointed out that all participating towns make no mention of hazard mitigation in their community planning documents (e.g., Plan of Conservation and Development). During the group discussion it was recommended that towns consider hazard mitigation during town development and planning activities.

Adam Whelchel of The Nature Conservancy presented on Coastal Resiliency. He discussed his current work with other towns in Connecticut (including Bridgeport, Guilford and Old Saybrook) and outlined the steps involved in developing resiliency—Awareness, Risk, Choices, and Action. He also provided information regarding some valuable tools that are available through The Nature Conservancy that would help communities to assess and map current and future impacts of development given the likelihood of sea-level rise and specific natural hazards. See Adam Whelchel's presentation in its entirety in Appendix D.

Lastly, Jamie Caplan and Darrin Punchard facilitated an exercise to help determine regional themes for mitigation actions and to help identify any potential gaps in mitigation efforts. Advisory Committee members were asked to respond to two questions: 1) *what will it take for the South Central Region to become disaster resistant?* And 2) *what specific mitigation actions should my community take to become safer from natural hazards?* In general, participant responses showed a consensus among the Region with regard to developing goal statements. For example, many town representatives recognized the need for mitigating flood risk through improved storm water management efforts. The results of this exercise in their entirety can be found in Appendix J.

- Janice Plaziak, Branford's Town Engineer, expressed concern for lack of connection between the Town Emergency Manager and the day-to-day town operations. She said that there is a need for better coordination between all "disciplines." She suggested that towns run simulations of hazard events to improve coordination efforts.
- Fire Chief Struble of Wallingford said that it would be a "bold statement" to towns to appoint Emergency Managers that are effective managers in terms of coordination of all departments.
- Chief Struble also suggested engaging the CEOs (i.e., First Selectman and Town Mayors) in a discussion that would outline the responsibilities of an Emergency Manager, since the responsibilities are not clearly defined.

Meeting 7

The seventh Advisory Committee meeting was held on June 27, 2013. The meeting focused on reviewing a draft of the Mitigation Strategy, and making key decisions on plan implementation and the plan maintenance process.

Picture 3.7 Advisory Committee Discussing Public Involvement

The meeting began with a brief presentation from Brian Ambrette, Master's Student at Yale who is completing an internship with The Nature Conservancy. He distributed a paper, which is located in Appendix D, titled "Municipal Zoning Options for Adaptation to Sea Level Rise in Connecticut." His paper was well received by the Advisory Committee and was posted to the project webpage for further review and distribution.

The Project Workshops obviously inspired a large number of citizens, especially in the coastal jurisdictions, to participate in the mitigation planning process. It also was obvious that citizen groups do not know who is responsible for applying for mitigation funding, they do not know what is available or how to effectively communicate with their local jurisdiction. Many Advisory Committee members expressed being overwhelmed with the prospect of locating and applying for mitigation grant funding. Eugene Livshits, SCRCOG stepped forward and said the SCRCOG will subscribe to a grant finding website and communicate results to their membership. In terms of locating Hurricane Sandy funding, Adam Whelchel recommended reviewing the Community Recovery Resource Guide, Connecticut 2013, FEMA 4807-DR-CT.

The Advisory Committee reviewed the mitigation strategy and agreed with the Plan Mission Statement and five Mitigation Plan Goals. The SCRCOG mitigation actions were discussed. The Advisory Committee is definitely looking for SCRCOG staff to continue to provide regional leadership in terms of mitigation implementation and may look to SCRCOG staff for assistance with the Community Rating System (CRS). The Advisory Committee agreed to spend the next two weeks reviewing their mitigation actions and making additions and changes if necessary. They also agreed to put the mitigation actions submitted by community groups in Branford and Madison in Appendix J instead of in the mitigation strategy chapter. These actions are already reflected in those included in the Mitigation Strategy Chapter. The community group's actions are more detailed information and therefore, the appendix seems like an appropriate place for them.

Finally, Jamie Caplan reviewed the schedule for completing the plan and having it reviewed by CT DEEP and FEMA. The Advisory Committee was unclear who is responsible for adopting the plan in each jurisdiction. Eugene Livshits planned to check with CT DEEP and then get back in touch with Advisory Committee members. In terms of the length of time for CT DEEP and FEMA to review the plan it was mentioned by the project managers that forty-five days is standard. Jamie reviewed the process of implementation and maintenance with the group. The Advisory Committee agreed to participate in regular meetings hosted by SCRCOG staff until the plan is approved and adopted. They agreed to meet after that on an as-needed basis. This information is reflected in Chapter 7: Plan Implementation and Maintenance.

SCRCOG
SOUTH CENTRAL REGIONAL COUNCIL OF GOVERNMENTS

South Central Region Multi-Jurisdiction Hazard Mitigation Plan: Fact Sheet

10 Diverse Municipalities, 1 Multi-Jurisdiction Hazard Mitigation Plan

The South Central Regional Council of Governments (SCRCOG) has been awarded a grant from the Connecticut Department of Energy and Environmental Protection to develop a Multi-Jurisdiction Hazard Mitigation Plan for Bethany, Branford, Hamden, Madison, North Branford, North Haven, Orange, Wallingford, West Haven and Woodbridge. The five additional municipalities in the Region (East Haven, Guilford, Meriden, Milford, and New Haven) have completed or are currently working on their own hazard mitigation plans but have been invited to participate in the development of the Regional Plan. SCRCOG has hired a consulting team led by Jamie Caplan Consulting, LLC with support from AECOM to develop the Plan.

The planning process will adhere to Federal Emergency Management Agency (FEMA) standards and requirements for local hazard mitigation plans. The Plan will address possible natural hazards such as flood, wind, earthquake, and winter storms. The purpose of the Plan is to reduce the Region's vulnerability to natural hazards and provide a comprehensive approach to mitigate any potential inter-jurisdictional hazards. The Hazard Mitigation Plan is a prerequisite for the Region's municipalities to apply for federal and state grants to implement the identified mitigation projects.

The Multi-Jurisdiction Hazard Mitigation Plan prepared through this project will ease the burden of keeping these communities safe and resilient by identifying and communicating hazard risks, developing actions to reduce or eliminate those risks, and making each municipality eligible for FEMA mitigation program funding before and after the next disaster strikes.

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards.

Meeting 8

The eighth Advisory Committee meeting was held on September 11, 2013. The purpose of this meeting was to review the final draft of the plan and to prepare for local plan adoption.

Project Fact Sheet

A double-sided, one page Project Fact Sheet was developed for the purposes of describing the project and soliciting public involvement. Promoting the Project Website, Public Opinion Survey and Regional Workshops was a key focus of

Picture 3.8 Project Fact Sheet

the Fact Sheet. The Fact Sheet was available in print and in digital form on the Project Webpage. Hard copies were printed by SCRCOG staff and distributed in regional and municipal offices, and public buildings such as libraries and town halls. The Project Fact Sheet is in Appendix C in its entirety. A snapshot of page one is shown in Picture 3.8.

Municipality Meetings

FEMA Requirement §201.6(b)(2)

[The planning process shall include] an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process.

In an effort to include as many jurisdiction specific stakeholders as possible, the Planning Team held ten Municipality meetings. The date of each meeting is shown in **Table 3.4**. These meetings were organized by the Advisory Committee and usually took place in the City/Town Hall or Police Station. The JCC Team met with these stakeholders in order to ensure that each jurisdiction had the opportunity to participate fully in the mitigation planning process. Municipality meetings were scheduled between October 15, 2012 and December 17, 2012.

Table 3.4 Municipality Meeting Dates

Jurisdiction	Date Of Meeting
Bethany	10/16/2012
Branford	10/16/2012
Hamden	10/18/2012
Madison	10/15/2012
North Branford	11/28/2012
North Haven	12/06/2012
Orange	12/17/2012
Wallingford	10/17/2012
West Haven	10/25/2012
Woodbridge	10/18/2012

The meetings were attended by JCC project leaders, Jamie Caplan and Darrin Punchard, SCRCOG staff and representatives of the participating towns including, but not limited to planners, developers, engineers, operations managers, emergency managers, town clerks, school officials and personnel from fire and police departments. The Municipality meeting sign-in sheets are located in Appendix E.

The purpose of these meetings was to provide an overview of the goals, benefits and processes involved with creating a multi-jurisdictional hazard mitigation plan. In addition, it was an opportunity for the Planning Team to gather local data for the Capability Assessment and the Risk Assessment. To gather this information the Planning Team distributed the PowerPoint presentation (included in Appendix E) and conducted the meetings in a casual style that encouraged conversation. Darrin Punchard, Deputy Project Manager, used a Risk Assessment Questionnaire (included in Appendix K) to document conversation related to the risk assessment and to ensure all necessary topics were discussed.

Picture 3.9 Deputy Project Manager Darrin Punchard and Hamden Fire Chief David Berardesca Identifying Hazard Locations

Jamie Caplan, Project Manager, used a similar technique to capture information relevant to the Capability Assessment. Jamie also distributed a Capability Assessment Questionnaire to the Advisory Committee members for completion. Each of these questionnaires is included in Appendix I.

Some common themes emerged from the Municipality meetings. For example, many towns feel that their capacity to shelter citizens during a disaster is limited and downed trees, flooding and power outages seem to be the most common risks associated with natural hazards. Common questions arose from town officials including how to obtain funding for dam removal, historic site preservation and can generators be purchased with federal grant funding? Significant town specific information regarding community assets and capabilities was collected at each meeting as well. The following are some examples of these findings:

- It was found that while the Town of **Bethany** has no grant writer and funding is limited they do have a newly renovated Fire Headquarters that serves as the Emergency Operations Center (EOC) and an old airplane hangar that may serve as a shelter in the future.
- In **Branford**, it was noted that some shelters exist in flood areas. They are working with The Nature Conservancy on issues emerging from sea-level rise and coastal erosion.
- **Hamden** has at least five mitigation projects in mind already, including filling-in an old canal bed to prevent flooding in the Greenway Trail area. They also experienced severe transportation problems as a result of Hurricane Irene when nearly 200 trees came down.
- The Town of **Madison** was able to provide a lot of information for the risk analysis, including exact locations and details of previous occurrences of natural hazards. They are considering hazard mitigation projects such as beach dune restorations and improvements to communications.
- **North Branford** lacks the personnel and other technical resources to adequately strategize and prepare for natural hazards, i.e. no GIS capabilities. However, during natural hazard emergency response they do engage in mutual aid with neighboring towns.
- **North Haven** was able to provide a lot of information for the risk analysis chapter of the plan, including exact locations and other details of previous occurrences of natural hazards. They have given considerable thought to the allocation of hazard mitigation funding, including projects such as dredging of the Muddy River and bringing in generators to pump stations.

Picture 3.10 Bethany Municipality Meeting

- The Town of **Orange** has some excellent emergency response capabilities, such as many municipal buildings equipped with generators, a back-up EOC and a large shelter. They expressed an interest in increasing public outreach efforts as a potential mitigation project.
- The Town of **Wallingford** operates its own public utility company, which it sees as a great community asset. They have built a non-engineered berm to protect one residential area from flooding and have elevated some structures. Town officials see protecting the town from riverine flooding as a high priority.
- Officials from **West Haven** were able to provide the details of specific past hazard occurrences, such as impassable roadway flooding at the Morgan Lane Underpass that resulted in the drowning of an individual. They have given considerable thought to the allocation of hazard mitigation funding, including projects that address coastal erosion and the transfer station located in a floodplain.
- The Town of **Woodbridge** has GIS capabilities and a part-time grant writer. They engage in some community outreach as well. One hazard mitigation project already underway is the dam removal of the Pond Lily Dam at Pond Lily in New Haven. This is a Habitat Restoration project and flood mitigation project. The Connecticut Fund for the Environment has assumed leadership of the project.

  The West River Restoration and Flood Mitigation Committee was formed to mitigate flooding of the West River. This committee advocated for the replacement of the Merritt Avenue Bridge.

Public Participation

FEMA Requirement §201.6(b)(1)
[The planning process shall include] an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval.

Several opportunities were offered throughout the planning process for the public to participate in the mitigation plan. These included:

- Visiting the SCRCOG Mitigation Planning webpage,
- Participating in the online Public Preparedness Questionnaire,
- Attending Public Workshops and Participating in the Workshop Questionnaire, and
- Reviewing and commenting on the Draft Mitigation Plan.

SCRCOG Website

SCRCOG had recently updated their website and it was determined early on in the planning process that utilizing this website as a "home base" for the planning process made sense. Content for the website was developed by the Project Team and sent to Christopher Rappa at SCRCOG for review and posting.

Picture 3.11 Screenshot of Project Website

The content included a brief introduction to the planning process and a project timeline. In addition, meeting announcements, agendas and PowerPoint presentations were posted. Also, a Resources section was developed. Some of the resources posted included general mitigation planning and mitigation project idea documents by FEMA, links to the Community Rating System (CRS) website and dam removal resources.

Public Preparedness Questionnaire

In an effort to ensure public participation, the *Natural Hazard Mitigation Plan Public Opinion Survey* was developed. The questionnaire was drafted on SurveyMonkey and a link was posted on the SCRCOG project webpage. The survey was live from October 2012 through January 2013. Complete survey results can be found in Appendix F. Outreach for survey participation included introducing it to the Advisory Committee and introducing it at Municipality Meetings. The Planning Team emphasized that Advisory Committee members and town officials should complete the survey and should do their best to encourage participation by their constituents. To bolster participation, some town officials issued press releases to the local media. Related news articles and press releases can be found in Appendix F.

Picture 3.12 October 9, 2013 News Article Soliciting Community Participation in Public Preparedness Survey

Two hundred fifty people participated in the survey, including representatives from each of the 15 towns in the Region. The vast majority of those who participated reside in Madison (38.5%), Branford (27.8%), Wallingford (10.7%) and Hamden (9.8%) respectively. Two percent or less of participants reside in one of the remaining towns in the Region including North Branford (2%), North Haven (2%), Woodbridge (2%), West Haven (1.5%), Orange (1%), Bethany (.05%). Demographically speaking, survey respondents were equally divided between males and females and almost all were at least thirty years of age or older. Over seventy percent of respondents have acquired a four year educational degree or higher and seventy-nine percent has an annual household income that exceeds $70,000. Of those who participated in the survey, an overwhelming majority (72%) has resided in South Central Connecticut for twenty or more years and almost eighty-six percent of participants have lived in the Region for ten or more years. Not surprisingly, almost ninety-five percent of those surveyed own their own home, most of which (90%) are single-family homes.

Overall, the survey sought to understand the concerns that citizens might have about the impact of natural hazards and the most effective strategy toward implementing a regional hazard mitigation plan. For example: In Question 4, participants were asked to evaluate community assets according to their susceptibility or vulnerability to natural hazards. Assets were broadly categorized as People, Economic, Infrastructure, Cultural/Historic, Environmental and Governance. Respondents were asked to rank asset vulnerability from 1 (most vulnerable) to 6 (least vulnerable). Forty-three percent felt that People were the most vulnerable community asset while thirty-four percent felt that Infrastructure was the most vulnerable asset. Twenty-seven percent of participants found Economic assets to be most vulnerable. Governance assets (40%), Cultural/Historic assets (38%) and Environmental assets (27%) all were considered the least or mildly vulnerable to natural hazards.

In Question 5, participants were asked to prioritize community assets by ranking them from Very Important to Not Important. The assets, which ranked highest in importance, were Fire/Police (74%), Hospitals (69%), Major Bridges (64%) and Schools (50%). The assets that ranked Somewhat Important were Small Businesses (47%), Major Employers (45%), Elder Care Facilities (39%), Museum/Historic Buildings (38%) and City Hall/Courthouses (37%). Participants felt Neutral about the importance of Colleges/Universities (36%) and Parks (35%) as community assets.

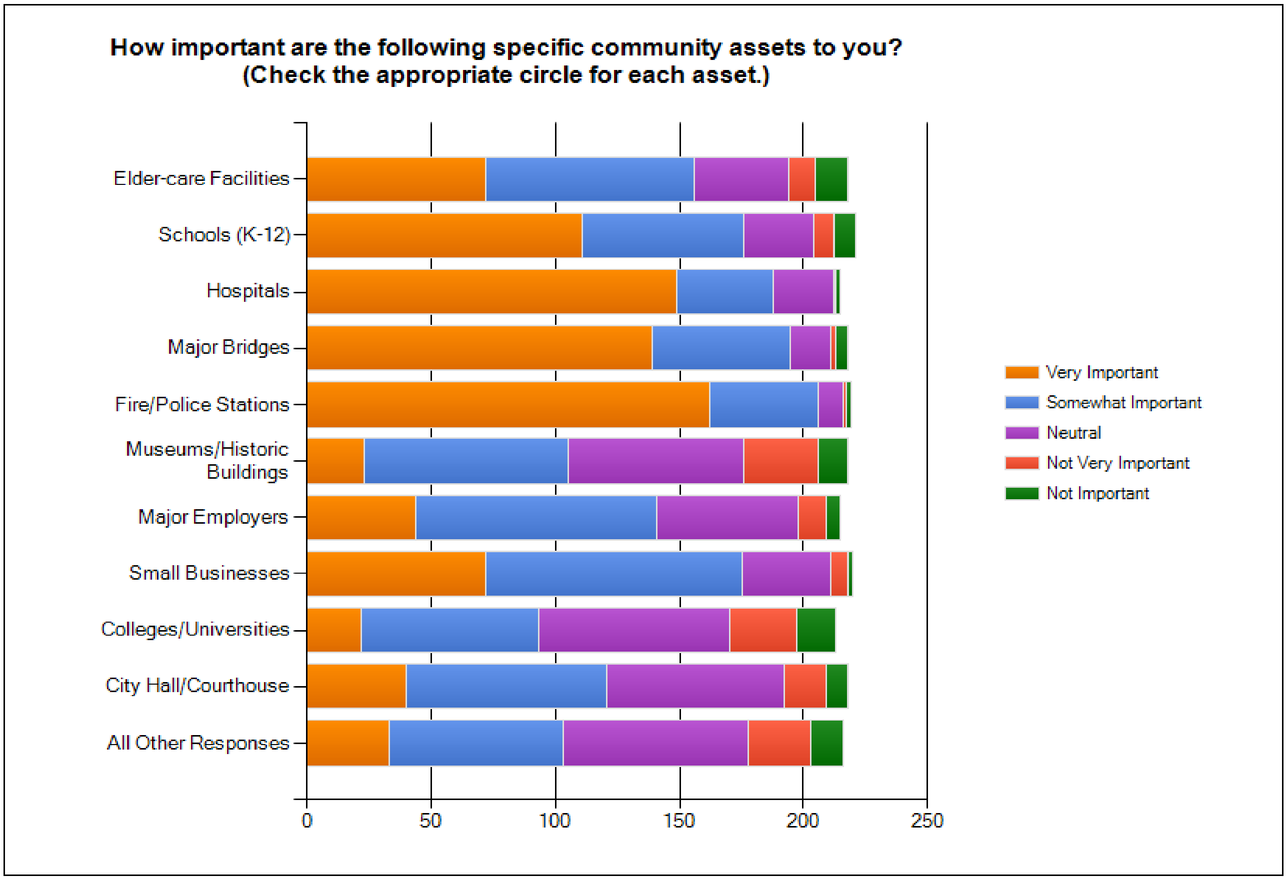


Figure 3.2 Public Questionnaire Question 5 Results

In Question 6, participants were asked to comment on the importance of specific natural disaster planning strategies. Eight distinct methods of planning for natural hazards were listed and respondents were asked to rank each activity as Very Important, Somewhat Important, Neutral, Not Very Important or Not Important. According to participants, the three most important planning strategies included Protecting Critical Facilities (91%), Protecting and Reducing Damage to Utilities (77%) and Strengthening Emergency Services (65%). The remaining five strategies, which included Protecting Private Property, Preventing Development in Hazard Areas, Enhancing the Function of Natural Features, Protecting Historical and Cultural Landmarks and Promoting Cooperation Among Public Agencies, Citizens, Non-profit Organizations and Businesses all were ranked as Very Important by less than forty-nine percent of respondents. Given the above eight choices, survey participants felt that when planning for the impact of natural hazards in their communities, Protecting Historical and Cultural Landmarks was the least important action.

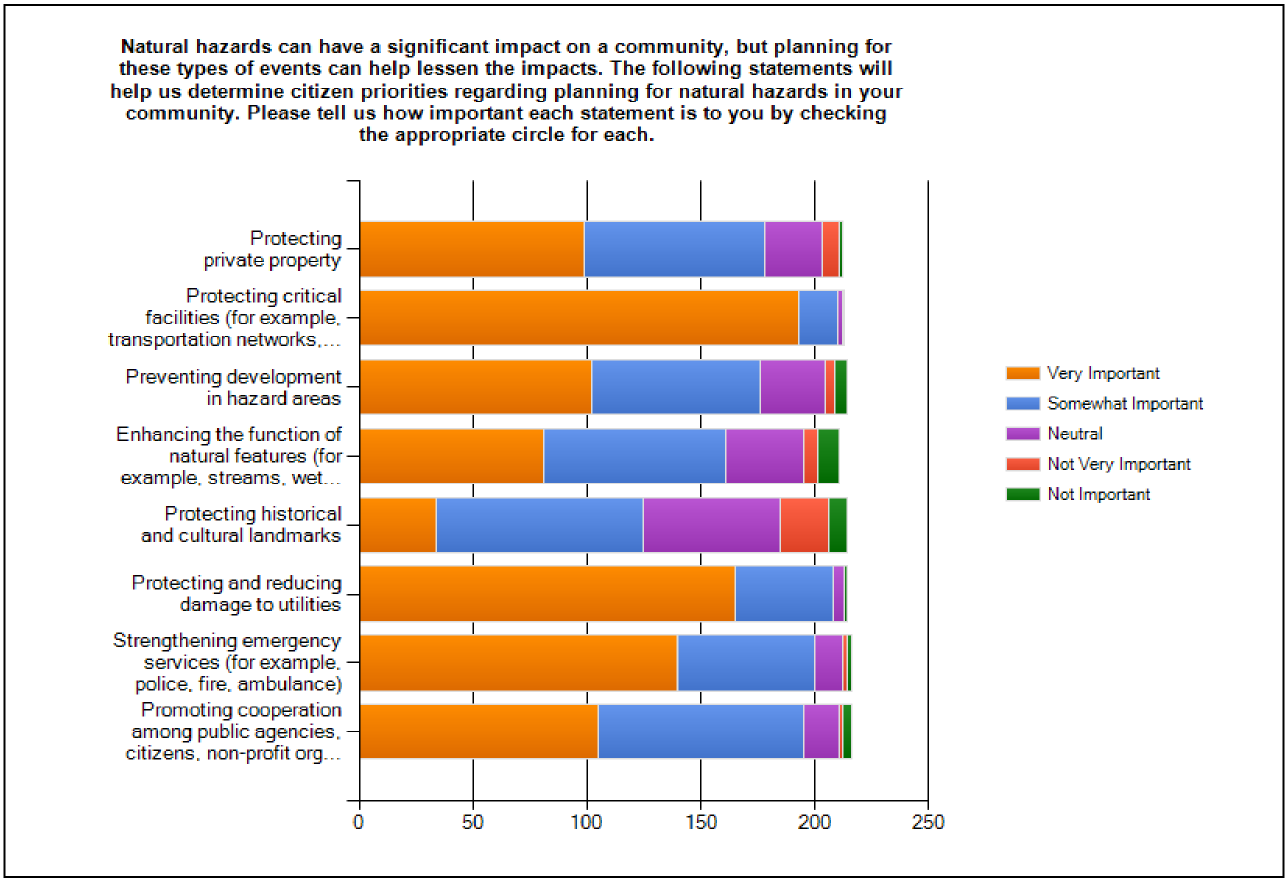


Figure 3.3 Public Questionnaire Question 6 Results

Question 7 gave citizens the opportunity to offer specific suggestions regarding the steps that local government should take to reduce or eliminate the risk of future natural hazard damages in individual neighborhoods. The responses are too many in number to list here; however, Table 3.5 shows the number of responses given under each category of risk reduction.

Table 3.5 Public Questionnaire Question 7 Response

Category of Risk Reduction	Number of Responses
Prevention	31
Property Protection	6
Natural Resource Protection	46
Structural Projects	31
Emergency Services	19
Public Education and Awareness	25

Many of the Natural Resource actions included the maintenance or removal of trees that, if felled during a storm, could cause damage to structures or utilities. In this same category, respondents suggested dredging waterways, repairing seawalls and improving stormwater management systems to alleviate damages caused by flooding. Suggested structural projects included the removal of dams, the elevation of structures or the burying of power lines. Emergency Services related responses called for improved methods of communications to citizens as well as better evacuation and post-disaster planning (i.e. accessible information about shelter locations). Prevention related responses included various suggestions for improving zoning, planning and wetlands regulations. Suggestions regarding Public Education, in general, were to simply increase the amount and frequency of public education on preparedness strategies in times of natural hazards.

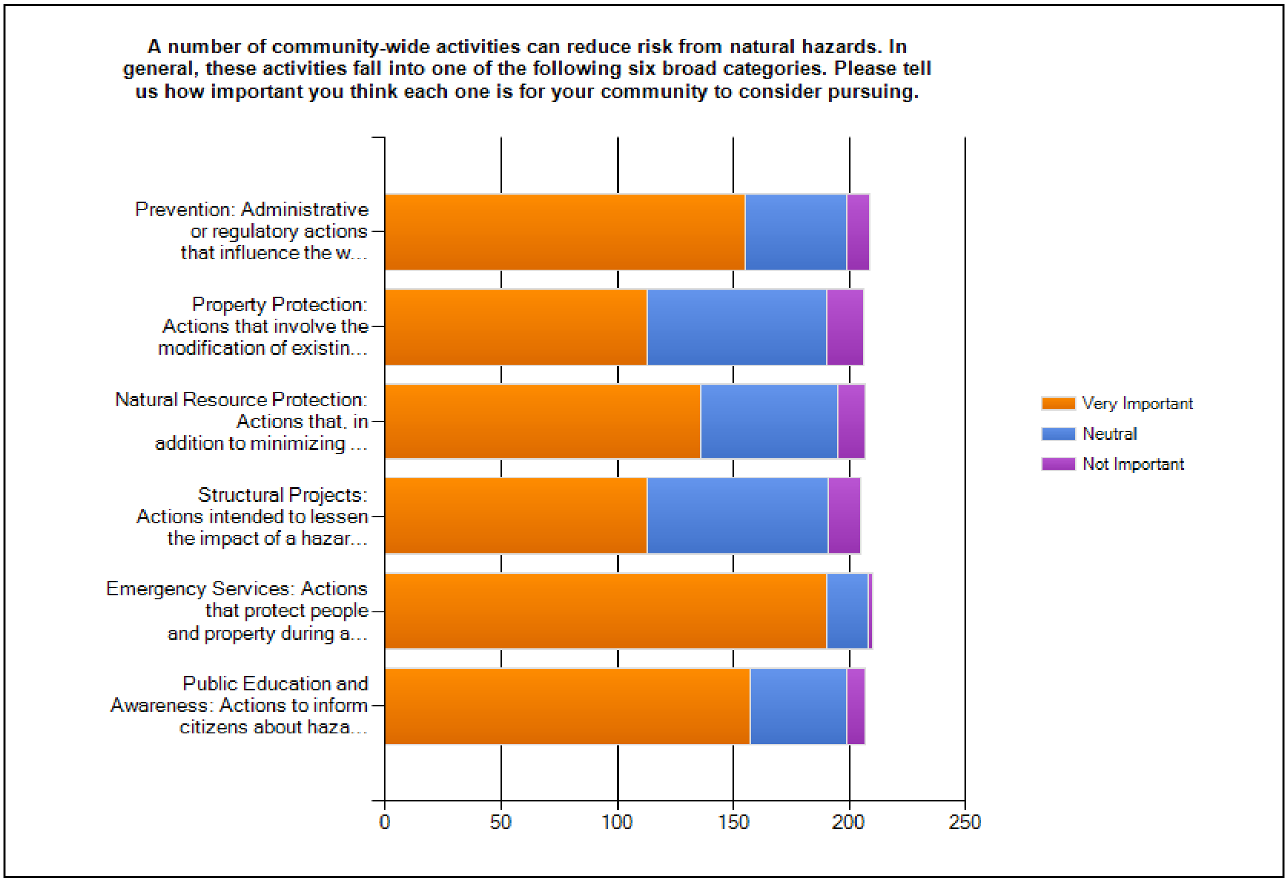


Figure 3.4 Public Questionnaire Question 8 Results

In Question 8, the survey sought to determine opinions about which category of mitigation actions or projects should be pursued in order to reduce community risk from natural hazards. The actions considered were categorized as follows: Prevention, Property Protection, Natural Resource Protection, Structural Projects, Emergency Services and Public Education and Awareness. Participants were asked to rank each category of risk reduction actions as Very Important, Neutral or Not Important. According to survey results, at least fifty-five percent of respondents felt that all six categories of risk reduction activities are Very Important. The actions that ranked as the highest priority were those related to Emergency Services (91%), Public Education and Awareness (76%) and Prevention (74%).

The consulting team made the point to the Advisory Committee on several occasions that they should definitely consider public education and awareness mitigation actions because they are frequently the easiest and most cost-effective actions to implement. However, they are frequently overlooked. The responses to Question 8 in the survey prove that the resident participants are certainly interested in additional education.

Regional Public Workshops

The SCRCOG hosted four public workshops as part of the Public Outreach process. The workshops were held at the point in the planning process when the Risk Assessment and Capability Assessment were completed and the Mitigation Actions were being developed. Each of the Public Workshops was advertised via a public notice, which is shown in **Figure 3.5**. Media notices were distributed with the following news media sources:

- *The Advisor*
- *Connecticut Post*
- *Connecticut Public Broadcasting Network*
- *East Haven Courier*
- *FOX Connecticut*
- *Guilford Courier*
- *The Hamden Journal*
- *Inner City News*
- *La Voz Hispana de Connecticut*
- *Miford-Orange Bulletin*
- *New Haven Advocate*
- *New Haven Independent*
- *New Haven Register*
- *Northeast Minority News*
- *North Haven Courier*
- *Orange Patch*
- *Post Chronicle*
- *Shoreline Times*
- *The Sound*
- *The Source*
- *Totokett Times*
- *Wallingford Government Channel*
- *West Haven Voice*
- *WFSB Channel 3*
- *WNHU 88.7 FM*
- *WQUN 1220 AM*
- *WTIC NewsTalk 1080*
- *WTNH Channel 8*
- *WYBC 94.3 FM*
- *Yale Daily News*

Legal notices were published in the following newspapers:

- *La Voz Hispana de Connecticut*
- *New Haven Register*
- *Northeast Minority News*

In addition, many of the Advisory Committee members listed the workshops on their town websites. A copy of the media release, the sign-in sheets and example PowerPoint presentations are all listed in Appendix G.

PUBLIC WORKSHOPS

Draft South Central Region Hazard Mitigation Plan for

Bethany, Branford, Hamden, Madison, North Branford, North Haven,

Orange, Wallingford, West Haven and Woodbridge

The South Central Regional Council of Governments (SCRCOG) is hosting four public workshops to review and discuss the Draft South Central Region Hazard Mitigation Plan. The purpose of the plan is to reduce the Region's vulnerability to natural hazards. These workshops are an opportunity for the public to hear a presentation of the Draft Plan and to ask questions and provide feedback.

The Public Workshops will be held:

April 29, 2013 at 6:00 PM – North Haven Memorial Library, 17 Elm Street, North Haven, CT 06473

May 6, 2013 at 6:00 PM – West Haven City Hall, Conf. Rm. B, 355 Main Street, West Haven, CT 06516

May 20, 2013 at 6:00 PM – Branford Fire Department, 45 North Main Street, Branford, CT 06405

May 23, 2013 at 6:00 PM – Madison Senior Center, 29 Bradley Road, Madison, CT 06443

Visit our website www.scrcog.org for more details.

Figure 3.5 SCRCOG Legal Notice for Public Workshops

Jamie Caplan, with the help of SCRCOG staff and Advisory Committee members, hosted each workshop. Those in attendance had an opportunity to introduce themselves at the start of each workshop. This proved an effective way to gain a sense of the audience and their hazard concerns and motivation for attending the workshop.

The meeting in West Haven included a number of citizens from the West Haven Watershed Restoration Committee. According to their Frequently Asked Questions (which is found in Appendix G) they are a group of West Haven residents who live in the southeastern corner of the city. They are "concerned that continued flooding due to erosion, poor drainage and global warming are contributing to the slow deterioration of our neighborhood." Some of the residents were very emotional saying they have lived in the area for most of their lives and cannot imagine being evacuated again. They expressed interest in communicating and collaborating with their local government but were unclear how to go about this. In fact, this question of collaboration came up in the Branford and Madison workshops as well and is being addressed in this plan in terms of regional collaboration and education. Martha Smith, Grants Coordinator, from the Southwest Conservation District, was in attendance at the West Haven meeting and expressed some knowledge about mitigation planning. It is worth noting that the public in attendance at this meeting mentioned several times that they would like their property to be bought by the city. The number one mitigation action submitted by Abdul Quadir, City Engineer, is a buyout project for this area.

The public workshop in Branford had the highest number of participants with about fifty people. The meeting was televised on Branford's local station and several reporters were in attendance. Janice Plaziak, Branford Town Engineer and Kurt Weiss, North Branford Town Engineer were in attendance and assisted with questions as they arose from the audience. Several community groups from Branford were in attendance. Their level of concern and emotion matched that in West Haven. However, the citizens in Branford are more interested in hardening the shoreline. The Town's First Selectman Anthony DaRos was in attendance and he mentioned the need to protect the tax base along the shoreline by implementing flood mitigation measures. He expressed a similar desire at the Branford Municipality Meeting. As expressed in Chapter 2: Regional Planning Area, Branford is unique in having several taxing districts within the town limits.

The public workshop in Madison had about twenty participants. Several of them had participated in the Municipality Meeting and were fairly knowledgeable about the mitigation planning process. Cathy Lezon, Community Relations Lead, Connecticut Light and Power (CL&P) attended the Workshops in Branford and Madison. Speaking after the meeting in Madison, Eugene Livshits, Cathy Lezon and Jamie Caplan agreed that a mitigation action should be to increase the level of conversation between the jurisdictions and CL&P.

A questionnaire was distributed at each workshop. A blank questionnaire can be found in Appendix G. The first question "which municipality do you live in?" produced the following results:

- 27 Branford
- 9 West Haven
- 5 Madison
- 1 North Haven
- 1 Guilford

It should be noted that some questionnaires were blank for this question.

Regarding level of concern for natural hazards, the highest levels of concern were noted in the following order: Coastal Flood, Hurricane/Tropical Storm, Coastal Erosion, Sea Level Rise and Winter Storm. These results match those of the Risk Analysis. The public reported which community assets are the **most vulnerable** to natural hazard impact in the following order: people, infrastructure, cultural/historic, and economic, environmental, governance. It should be noted that the next question asks about the **importance** of community assets. Fire and Police Stations were most important followed closely by major bridges, and then schools and hospitals. In terms of preparing for natural hazards, thirty people responded having 72/hour kits, twenty-three have car kits and twenty have generators.

The majority of people who completed a questionnaire took the time to write additional comments. Their comments are included below exactly as the respondent wrote them:

1. Shut or close "cattle crossing" on Meadow Street can prevent flooding, water rushes through viaduct and floods property
2. Linden Avenue is the only access to a peninsula that is the home of 300 plus families. It faces

the waves of Long Island Sound directly at high tides and hurricanes, tropical storms and Nor'easters. The erosion of the banks near the road is severe we are extremely worried that we will lose access to our homes. We are hoping that emergency funds will become available to enhance the strength of the road.

3. The Old Field Creek watershed in West Haven needs flood mitigation work to try to ameliorate severe storm flooding particularly to the 2nd Avenue and 3rd Avenue extension area. Possibly for the long term this area should be turned into public parkland by buying out private owners whose houses are at repeated risk.
4. Living against the marsh/wetlands has caused repeated flooding and damage. I can't sell the house. I can't go through more flooding. I feel helpless and trapped!
5. We will need help preparing my personal property from recurring damage for future storms/flooding. Live on a floodplain concerned that Irene and Sandy were not "100 year" storms but are the beginnings of a future "pattern."
6. Replace or repair flood control dikes.
7. The time is now to make changes. This includes the general public to prepare for natural hazards. A Public Awareness Education Campaign is needed with our community with honest conversations on expectations of roles.
8. Raise Beach Street and Monahan Place.
9. The Old Field Creek Flood Plain is a 100 year flood zone and in need of work. It is as important as the Cove River Flood Plain and the High School. We also need dunes on our neglected section of beachfront and a cleaning or dredging of the marsh to allow for better drainage after storms.
10. Very concerned about increased frequency of flooding.
11. Until we see the draft, this is difficult to comment on. One concern that must be considered is that we as a community are not only concerned with "building better." How about NOT building in vulnerable areas?
12. Old Field Creek – what is going to change with end and overflow at Peck Avenue? Right now the water has nowhere else to go except into our yards, garages and homes. Is there a way first to keep the rush of water coming in and the second where it can further go?
13. The Branford River flooding has caused neighborhood damage, property loss, flooded homes and the inability to leave the neighborhood because of road flooding. The lower part of Blackstone Acres is cut off. There was mention of flood gates (that were removed during bridge reconstruction on South Montowese Street) being put up again. Tidal and storm surge concerns and flooding in "Blackstone Acres", Riverside Drive and Woodvale Road area.
14. Meadow Street might be helped by using the Rail Road bed as a berm and closing the underpass at the "Eel Pot." Closeable "foot valves" could be used to preclude the back flow of river water. A large pump system could be installed to pump storm water over the tracks (or through the berm) to remove water from Meadow Street at that point.
15. The biggest problem with the flooding on Meadow Street was when the salt water from the Branford River went under the Rail Road Bridge next to the Eel Pot. I suggest we block this opening with sandbags or a flood gate.
16. The problem in Indian Neck, Linden Avenue.
17. Linden Avenue is the only egress for a multitude of families in Branford, and the barrier

seawall is loose fitting away in the last two hurricanes. Loose stones have been dumped along the road. This piece of coastline for so many families needs to be hardened.

18. Please give serious consideration to flood situation on Meadow Street in Branford. With advent of new Super Storms flooding there has become dangerous. Cattle crossing needs to be sealed the most cost effective and will not be traffic hardships on town people. Very few use it. When the Branford River overflows its banks the Cattle Crossing becomes a spillway and shoots water into the area like a flash flood.

19. Concerned about Linden Avenue collapsing again needs a betterment project to protect. Also concerned about my own home/property on Linden Avenue.

20. Mitigation plan for Linden Shore District. Protection of the road/waterfront is order to protect 425 family residents, which have only one-way access in and out of the area.

21. Concerned about how the town (Branford) can identify these coastal concerns and see how I can assist to develop a plan, and future procedures to make Branford safer and ready for future national disasters and climate change. Branford needs out of the box thinking and a master plan for tidal rise and storm influx.

22. Linden Avenue will fall into the water before funds are available to create or maintain seawalls that are needed. Many homes that use this road do NOT participate in taxes we are required to pay to maintain this road. Will they be shocked when they are unable to leave the peninsula? The town needs to step up in this process.

23. I think the education and awareness piece is very important and needs to be repeated with every new property owner and repeated for the rest on a periodic basis.

24. Wireless communications hardening seems to be an area needing attention if not by the town then by the state.

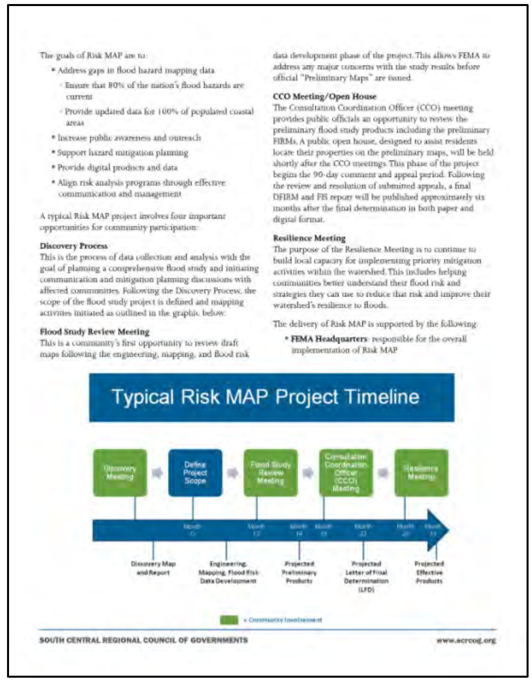
Reviewing and Commenting on the Draft Mitigation Plan

The draft plan was posted to the SCRCOG website for two weeks. Comments were collected via email, fax and mail. The Advisory Committee let their jurisdiction leadership know about the comment period so they could review the plan well ahead of the time they were requested to adopt the plan.

Toolkit for Floodplain Mapping

The JCC Team designed a toolkit pertaining to FEMA's Digital Flood Insurance Rate Maps (DFIRMs) that was incorporated into the public outreach process. The toolkit was geared toward property owners through the use of handouts prepared in lay terms, as well as visual aids to assist in their understanding of the floodplain mapping process, the differences in various flood zones, implications for insurance requirements and premium rates, and the procedures for an appeals process. SCRCOG was provided with a complete digital version of the toolkit that includes a pre-developed PowerPoint presentation, talking points, custom handouts/maps, and Fact Sheets that are specifically tailored for the South Central Region.

In completing this task, the JCC Team utilized AECOM's expertise as a current FEMA Risk MAP contractor and offered a training course that provided a comprehensive overview of FEMA's mapping process and navigating the Letter of Map Revision (LOMR) process in Connecticut.



The goals of Risk MAP are to:

- Address gaps in flood hazard mapping data
  - Ensure that 80% of the nation's flood hazards are current
  - Provide updated data for 100% of populated coastal areas
- Increase public awareness and outreach
- Support hazard mitigation planning
- Provide digital products and data
- Align risk analysis programs through effective communication and management

A typical Risk MAP project involves four important opportunities for community participation:

Discovery Process
This is the process of data collection and analysis with the goal of planning a comprehensive flood study and initiating communication and mitigation planning discussions with affected communities. Following the Discovery Process, the scope of the flood study project is defined and mapping activities initiated as outlined in the graphic below.

Flood Study Review Meeting
This is a community's first opportunity to review draft maps following the engineering, mapping, and flood risk data development phase of the project. This allows FEMA to address any major concerns with the study results before official "Preliminary Maps" are issued.

CCO Meeting/Open House
The Consultation Coordination Officer (CCO) meeting provides public officials an opportunity to review the preliminary flood study products including the preliminary FIRMs. A public open house, designed to assist residents locate their properties on the preliminary maps, will be held shortly after the CCO meetings. This phase of the project begins the 90-day comment and appeal period. Following the review and resolution of submitted appeals, a final DFIRM and FIS report will be published approximately six months after the final determination in both paper and digital format.

Resilience Meeting
The purpose of the Resilience Meeting is to continue to build local capacity for implementing priority mitigation activities within the watershed. This includes helping communities better understand their flood risk and strategies they can use to reduce that risk and improve their watershed's resilience to floods.

The delivery of Risk MAP is supported by the following:

- **FEMA Headquarters**: responsible for the overall implementation of Risk MAP

SOUTH CENTRAL REGIONAL COUNCIL OF GOVERNMENTS www.scrcog.org

Figure 3.6 The SCRCOG Risk Map Timeline

Involvement of Additional Stakeholders

The five neighboring jurisdictions in the South Central Region were provided an opportunity to participate in the development of the Plan through participation on the Advisory Committee Meetings. The following organizations also participated.

University of New Haven – Hazard Mitigation Planning Graduate Course

Fire Chief Peter Struble from Wallingford is a member of the Advisory Committee. He is also an Adjunct Professor at the University of New Haven. This presented an opportunity to involve the students in his Hazard Mitigation Course with the opportunity to learn about the mitigation planning process. On February 16, 2013, Jamie Caplan and Eugene Livshits spent the morning at the University of New Haven presenting the South Central Region Multi-Jurisdiction Hazard Mitigation Plan project and the process of mitigation planning. The students in the class identified mitigation actions for their final project. The Planning Team reviewed the final projects and the mitigation actions were recommended to the Advisory Committee when appropriate. The opportunity to involve these graduate students in the planning process is a true benefit to the plan as well as to mitigation in southern Connecticut.

Connecticut Light and Power

SCRCOG staff and Jamie Caplan met with a representative from Connecticut Light and Power (CL&P) on July 10, 2013. This meeting was a direct result of CL&P participating in two of the project's Public Workshops. The purpose of the meeting was to strengthen the relationship between the utility and the jurisdictions in the region. Conversation focused around mitigation efforts CL&P is taking, specifically those related to tree hazards. CL&P has enhanced their tree trimming and vegetation management program as a result of the storms in the last several years. They have increased their tree maintenance cycle to four years in an effort to ensure that trees do not hang over any wires. CL&P works with the Tree Warden or other designated person in each jurisdiction prior to beginning work in their area.

CL&P also mentioned that they have identified all substations in the region that they consider to be at-risk to flooding or storm surge and have generated a short-term mitigation plan for each substation. These mitigation plans may be shared with the jurisdictions, especially if they require permits from the jurisdiction. CL&P is interested in receiving a current list of generators located at critical facilities in each jurisdiction.

United Illuminating

SCRCOG staff met with representatives from United Illuminating on September 19, 2013, regarding mitigation actions. It is the intention of SCRCOG staff to continue conversation with each of the utilities in the region regarding mitigation planning. Open communication between the utilities and the jurisdictions allows for better planning and coordinated mitigation efforts.

Regional Planning Commission (RPC)

The Regional Planning Commission (RPC) is coordinated through the South Central Regional Council of Governments and has representation from the local Planning and Zoning Commission of each of the municipalities in the Region. Responsibilities of the RPC include review of Zoning Amendments, Subdivision Applications, Open Space Grant Applications and Plans of Conservation and Development for which advisory comments are prepared. On January 10, 2013 the RPC held a dinner meeting and Jamie Caplan and Darrin Punchard, the lead consultants for this Plan were the guest speakers. Invitations to the dinner were extended by SCRCOG to Elected Officials, Local Commissions (Planning/Zoning, Inland/Wetlands, Economic), and Municipal Planning Staffs for all fifteen municipalities in the SCRCOG region.

The Nature Conservancy

Adam Whelchel of The Nature Conservancy (TNC) was invited by SCRCOG staff to participate as a stakeholder in the planning process. TNC had a concurrent project in Connecticut using their Coastal Resiliency Tool. The TNC project, located on the web at www.coastalresilience.org, has the focus of helping Connecticut communities adapt to hazards and helping people and nature through hazard mitigation and preparedness. As mentioned previously, Mr. Whelchel presented several times at Advisory Committee meetings. TNC participated in the mitigation planning process in Guilford, a SCRCOG municipality, and Mr. Whelchel often shared success stories and lessons learned from there.

Association of State Floodplain Managers (ASFPM) Conference

Darrin Punchard and Jamie Caplan presented the Plan at the ASFPM Conference in Hartford, CT on June 13, 2013. The presentation was titled, *Regional Hazard Mitigation Planning in South Central Connecticut*. The presentation focused on our approach of including ten distinct communities into a multi-hazard mitigation plan. Key elements of the presentation including adding future value to each community such as their participation in the Community Rating System in the future and SCRCOG providing additional and continued regional hazard mitigation leadership. The risk assessment was reviewed with a focus on climate change and sea level rise, Hazus and the use of

Problem Statements. Approximately fifty people participated in the session. The presentation inspired a number of questions and received positive feedback from the audience.

Plan Adoption

Hard copies of the Plan were distributed to the SCRCOG Board and to members of the Advisory Committee for review before adoption. In addition, a digital copy was posted on the SCRCOG website for public comment. Each jurisdiction also made a hard copy available for public comment in their City/Town Clerk's office.

CHAPTER 4. RISK ASSESSMENT

Hazard Identification

The South Central Region is vulnerable to a wide range of hazards that threaten life and property. Current regulations and FEMA guidance require, at a minimum, a description and evaluation of all natural hazards that affect the jurisdictions in the planning area. An evaluation of technological or human-caused hazards is encouraged, though not required, for plan approval. The South Central Region has focused solely on natural hazards at this time. Incorporation of other hazards may be evaluated in future versions of the plan, which will be monitored, evaluated and updated regularly.

Upon a review of the full range of natural hazards included in FEMA planning guidance, SCRCOG initially identified a number of potential hazards to be addressed in the South Central Region Multi-Jurisdiction Hazard Mitigation Plan. These hazards were identified through an extensive process that considered input from Advisory Committee members, research of past disaster declarations in New Haven County, a review of Connecticut's 2010 Natural Hazard Mitigation Plan Update, and reviews of local hazard mitigation plans for neighboring jurisdictions. Readily available information from reputable sources, including federal and state agencies, was also evaluated to supplement information provided by these primary sources.

Table 4.6 summarizes the full range of potential natural hazards for the South Central Region. This includes 16 individual hazards classified according to four categories (Atmospheric, Hydrologic, Geologic and Other). Some of these hazards are considered to be interrelated or cascading (i.e., hurricanes may cause flooding and tornadoes, drought conditions may increase the likelihood of wildfires), but for preliminary hazard identification purposes these individual hazards are distinguished separately. It should also be noted that some hazards, such as earthquakes or winter storms may impact a large area yet cause little damage, while other hazards, such as a tornado, may impact a small localized area yet cause extensive damage. Descriptive profiles of all hazards deemed significant enough for further analysis are provided in the *Hazard Analysis* section.

Table 4.6 Potential Natural Hazards for the South Central Region

Atmospheric	Hydrologic	Geologic	Other
Extreme Temperatures	Coastal Erosion	Earthquake	Wildfire
Hurricane/Tropical Storm	Dam Failure	Landslide	
Nor'easter	Drought	Soil Hazards *(includes expansion, subsidence, and sinkholes)*	
Severe Thunderstorm *(includes high winds, hail, and lightning)*	Flood *(includes coastal, riverine and urban flooding. Also includes ice jams and storm surge)*	Tsunami	
Severe Winter Storm *(includes snow and ice)*	Sea Level Rise		
Tornado			

Table 4.7 documents the evaluation process used for determining which of the initially identified hazards were deemed significant enough for further study in the risk assessment. The table indicates whether or not the hazard was identified as a significant hazard, how this determination was made, and why this determination was made. Hazard events not identified for inclusion at this time may be addressed during future evaluations and updates of the risk assessment if deemed necessary by the Advisory Committee during the plan update process.

Table 4.7 Initial Evaluations of Potential Natural Hazards for the South Central Region

Potential Natural Hazard	Significant Enough for Further Analysis? (Yes or No)	How was this determination made?	Why was this determination made?
ATMOSPHERIC			
Extreme Temperatures	YES	• Recommended for further evaluation by Advisory Committee • Review of local hazard mitigation plans for neighboring jurisdictions • Review of NOAA historical event data	• Frequency of previous occurrences (extreme heat and extreme cold) • Potential life/safety threat for vulnerable populations • Potential for increased frequency, duration and intensity of extreme heat due to the effects of climate change

Potential Natural Hazard	Significant Enough for Further Analysis? (Yes or No)	How was this determination made?	Why was this determination made?
Hurricane/Tropical Storm	YES	• Review of State Hazard Mitigation Plan • Review of Federal disaster declaration history • Use of NOAA Digital Coast (Historical Hurricane Tracks)	• Recent local experience (Sandy, 2012, Irene in 2011, Hanna in 2008), and history of major, destructive storms in the past century • Identified as significant hazard for coastal and inland communities in the State Hazard Mitigation Plan • NOAA historical records indicate that 43 storm tracks have come within 65 miles of the planning area since 1858 (annual probability of 28%) • Potential to cause severe, extensive damage and disruption
Nor'easter	YES (Will be combined with Severe Winter Storm)	• Review of State Hazard Mitigation Plan • Review of Federal disaster declaration history • Review of local hazard mitigation plans for neighboring jurisdictions	• Frequency of previous occurrences • Recent historical events have caused fatalities, injuries and property damage • Potential to cause severe, extensive damage and disruption – particularly along coastal areas
Severe Thunderstorm *(includes high winds, hail, and lightning)*	YES	• Review of NOAA historical event data	• Frequency of previous occurrences • NOAA historical records include 326 severe thunderstorm events in the region since 1955, causing fatalities, injuries and property damage
Severe Winter Storm *(includes snow and ice)*	YES (Will be combined with Nor'easter)	• Review of State Hazard Mitigation Plan • Review of Federal disaster declaration history • Review of local hazard mitigation plans for neighboring jurisdictions • Review of NOAA historical event data	• Frequency of previous occurrences • NOAA historical records include 20 severe winter storm events since 1996 resulting in property damages • Multiple Federal Disaster and/or Emergency Declarations
Tornado	YES	• Review of State Hazard Mitigation Plan • Review of Federal disaster declaration history • Review of NOAA historical event data and National Severe Storms Laboratory (NSSL) website	• NOAA historical records include 15 tornado events in the region since 1955, causing fatalities, injuries and property damage – including a devastating F4 tornado that struck Hamden in 1989 • Significant life/safety threat

Potential Natural Hazard	Significant Enough for Further Analysis? (Yes or No)	How was this determination made?	Why was this determination made?
HYDROLOGIC			
Coastal Erosion	YES	• Identified as significant hazard concern in Branford, Madison and West Haven • Review of CT DEEP data on Erosion Susceptibility and Erosion Sites	• Erosion is a chronic condition along most shoreline areas in the region • Frequency of rapid, episodic erosion caused by storm events • Coastal and upland property is becoming more exposed to coastal flood hazards due to erosion
Dam Failure	YES	• Review of State Hazard Mitigation Plan • Review of CT DEEP inventory of state-regulated dams • Review of National Performance of Dams Program Inventory (Stanford University)	• History of dam failure occurrences in Connecticut causing multiple casualties and severe damage • 198 dams are located in the planning area (ten participating jurisdictions), with 47 dams classified as significant or high hazard potential • Significant life/safety threat
Drought	YES	• Review of State Hazard Mitigation Plan • Review of National Drought Mitigation Center website and Palmer Drought Severity Index (PDSI)	• There have been 5 severe droughts to impact Connecticut since 1929 per the State Hazard Mitigation Plan • According to the PDSI, the planning area is located in a region that experienced severe drought conditions 5-10% of the time during a 100-year period • Potential for increased frequency, duration and severity of drought events due to the effects of climate change • Future droughts may severely impact reservoirs and other sources of water supply

Potential Natural Hazard	Significant Enough for Further Analysis? (Yes or No)	How was this determination made?	Why was this determination made?
Flood *(includes coastal, riverine and urban flooding. Also includes ice jams and storm surge)*	**YES**	• Review of State Hazard Mitigation Plan • Review of Federal disaster declaration history • Review of FEMA Digital Flood Insurance Rate Maps • Review of NOAA historical event data • Review of FEMA NFIP policy and claims statistics • Use of CT DEEP Coastal Hazards Viewer (for storm surge)	• Flood identified as the most prevalent and frequent hazard in Connecticut per the State Hazard Mitigation Plan • Special flood hazard areas have been identified and mapped by FEMA for coastal and inland areas of the region • Multiple Federal Disaster and/or Emergency Declarations • Frequency of previous flood occurrences in the region. NOAA historical records include 89 flood events in the region since 1993, causing fatalities and property damage • FEMA NFIP claims statistics report 2,453 reported flood losses for costing more than $25 million in claims in the planning area (ten participating jurisdictions)
Sea Level Rise	**YES**	• Use of The Nature Conservancy's Coastal Resilience Mapping Tool • Use of CT DEEP Coastal Hazards Viewer • Review of State Hazard Mitigation Plan • Review of local hazard mitigation plans for neighboring jurisdictions	• Visualization of potential future flood scenarios indicates potential inundation for planning area (Branford, Madison, West Haven)
GEOLOGIC			
Earthquake	**YES**	• Review of State Hazard Mitigation Plan • Review of USGS data on historic earthquake events • Review of USGS hazard maps • Review of earthquake hazard information provided by the Northeast States Emergency Consortium • Review of NOAA National Geophysical Data Center (NGDC) Earthquake Intensity Database	• History of seismic activity in the state (140 since 1958 – all low magnitude events) • The New Haven-Greenwich area is one of two areas in the state identified as most vulnerable to earthquakes per the State Hazard Mitigation Plan • While considered a low probability event, the potential impacts of moderate earthquake event (MMI II-V) could be substantial, particularly for older and unreinforced masonry buildings built on fill or unstable soil

Potential Natural Hazard	Significant Enough for Further Analysis? (Yes or No)	How was this determination made?	Why was this determination made?
Landslide	NO	• Review of USGS Landslide Incidence and Susceptibility Map • Review of NOAA historical event data • Discussions with Advisory Committee and local municipal staff • Review of Public Opinion Survey results	• No historic landslide occurrences recorded in the planning area according to USGS and NOAA data • USGS hazard map shows low landslide incidence/ susceptibility for the planning area, with the exception of West Haven (moderate incidence/ susceptibility) • Not identified as significant hazard of concern by local officials or citizens in response to Public Opinion Survey
Soil Hazards *(includes expansion, subsidence, and sinkholes)*	NO	• Review of local hazard mitigation plans for neighboring jurisdictions • Discussions with Advisory Committee and local municipal staff • Review of Public Opinion Survey results	• No documented history of previous occurrences causing damage in the region • Not identified as significant hazard of concern by local officials or citizens in response to Public Opinion Survey
Tsunami	NO	• Review of State Hazard Mitigation Plan • Review of NOAA Digital Coast (Tsunami Prone Map) • Review of NGDC/WDC Global Historical Tsunami Database	• No history of previous tsunami occurrences affecting Connecticut • Tsunamis present an "extremely small risk" of impacting Connecticut, per the State Hazard Mitigation Plan
OTHER			
Wildfire	YES	• Review of State Hazard Mitigation Plan • Review of Connecticut's Forest Resource Assessment and Strategy (2010) • Review of Connecticut Wildland Urban Interface Map (University of Wisconsin, SILVIS Lab)	• Frequency of previous occurrences, although most are small and suppressed early (burning less than 10 acres) • Large amount of wildland/urban interface and intermix areas in the region • Potential for increased frequency and intensity of wildfire events due to the effects of climate change • The introduction of disease, pests and invasive plants increases vegetative fuel loads in wildland areas

Hazard Analysis

Requirement §201.6(c)(2)(i)
The risk assessment shall include a description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

The Hazard Analysis section provides detailed descriptions of each natural hazard deemed significant enough (through Hazard Identification) for further study in the risk assessment.

Complete hazard profiles are available for the following 12 hazards:

- **Extreme Temperatures**
- **Hurricane/Tropical Storm**
- **Severe Thunderstorm**
- **Severe Winter Storm/Nor'easter**
- **Tornado**
- **Coastal Erosion**
- **Dam Failure**
- **Drought**
- **Flood**
- **Sea Level Rise**
- **Earthquake**
- **Wildfire**

Each hazard profile includes a summary account of the following:

- **Description:** Provides general definitions and brief descriptions of the hazard, its characteristics and potential effects.
- **Location:** Provides information on the geographic areas within the planning area that are susceptible to occurrences of the hazard.
- **Extent:** Provides information on the potential strength or magnitude of the hazard.
- **Previous Occurrences:** Provides information on the history of previous hazard events in the planning area, including their impacts on people and property.
- **Probability of Future Events:** Describes the likelihood of future hazard occurrences in the planning area. This includes a summary of any anticipated effects that climate change may have on the frequency, duration and intensity of future hazard events according to the U.S. Global Change Research Program and reports by the Connecticut Governor's Steering Committee on Climate Change. A brief overall summary of these effects in the Northeast region is provided below.

The Effects of Climate Change in the Northeast United States

The Northeast annual average temperature has increased by 2°F since 1970, with winter temperatures rising twice this much. Warming has resulted in many other climate-related changes including more frequent very hot days, a longer growing season, an increase in heavy downpours, less winter precipitation falling as snow and more as rain, reduced snowpack, earlier break-up of winter ice on lakes and rivers, earlier spring snowmelt resulting in earlier peak river flows, rising sea surface temperatures, and rising sea level. These trends are projected to continue, with more dramatic changes under higher emissions scenarios compared to lower emissions scenarios. Some of the extensive climate-related changes projected for the region could significantly alter the region's economy, landscape, character, and quality of life.[94]

Summary of Major Disaster and Emergency Declarations

Prior to completing the hazard-by-hazard analysis, it is important to note and document past major disaster and emergency declarations that have included New Haven County. Major disaster and emergency declarations are issued by the President of the United States at a county level when an event has been determined to be beyond the capabilities and resources of state and local governments to respond and recover. A *major disaster declaration* is issued as a result of the disaster or catastrophic event and constitutes a broader authority that helps states and local communities, as well as families and individuals, recover from the damage caused by the event. An *emergency declaration* is issued to protect property and public health and safety and to lessen or avert the imminent threat of a major disaster or catastrophe.

Since 1953, the first year presidential declarations were issued, New Haven County has been included in 12 major disaster declarations and 11 emergency declarations (**Table 4.8**). Many additional emergencies and disasters have occurred that were not severe enough to require federal disaster relief through a presidential declaration.

[94] United States Global Change Research Program. Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Table 4.8 Major Disaster and Emergency Declarations, 1953-2012

Major Disaster Declarations		Emergency Declarations	
Date	**Description**	**Date**	**Description**
8/20/1955	Hurricane, Torrential Rain & Floods	2/7/1978	Blizzard & Snowstorms
6/14/1982	Severe Storms & Flooding	3/16/1993	Severe Winds & Blizzard, Record Snowfall
6/18/1984	Severe Storms & Flooding	3/11/2003	Snowstorm
10/11/1985	Hurricane Gloria	1/15/2004	Snow
7/18/1989	Severe Storms & Tornadoes	2/17/2005	Snow
9/16/1991	Hurricane Bob	9/13/2005	Hurricane Katrina Evacuation
12/17/1992	Winter Storm & Coastal Flooding	5/2/2006	Snow
02/02/1996	Blizzard of '96	8/27/2011	Hurricane Irene
5/11/2007	Severe Storms and Flooding	10/31/2011	Severe Storm
3/3/2011	Snowstorm	10/28/2012	Hurricane Sandy
9/2/2011	Tropical Storm Irene	2/10/2013	Severe Winter Storm
10/30/2012	Hurricane Sandy		
3/21/2013	Severe Winter Storm & Snowstorm		

Source: FEMA

Under a presidential declaration, state and affected local jurisdictions are eligible to apply for federal reimbursement of up to 75 percent of approved costs for debris removal, emergency services related to the storm, and the repair or replacement of damaged public facilities. Funding is also made available for implementing hazard mitigation measures, including those identified in local hazard mitigation plans.

Extreme Temperatures

Description

According to the National Weather Service, extreme temperatures (including extreme heat and extreme cold) are the number one weather-related killer in the United States.

Extreme heat may be generally defined as temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity. At certain levels the human body cannot maintain proper internal temperatures and may experience severe health disorders including heat cramps, heat exhaustion or heatstroke (a life threatening condition).

Extreme cold may be generally defined as prolonged periods of time with freezing temperatures, often made worse by the impact of wind chill factors (the combined elements of air temperature and wind on exposed skin). At certain levels the human body may suffer from frostbite or hypothermia, making extreme cold a potential severe and life threatening hazard to people left unprotected from the elements. Freezing temperatures may cause severe damage to crops and other vegetation, and pipes may freeze and burst in structures that are poorly insulated or without heat. Long cold spells may cause rivers and lakes to freeze and lead to ice jams that can act as a dam, resulting in severe flooding (covered under *Flood*).

Location

The entire planning area is uniformly susceptible to the occurrence of extreme temperatures. In general, inland areas are more susceptible to extreme heat than coastal areas.

Extent

The National Weather Service's Heat Index is a measure of the effects of the combined elements of air temperature and relative humidity on the human body, particularly for people in higher risk groups (elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight). **Table 4.9** summarizes the extent of these effects.

Table 4.9 Effects of Extreme Heat on the Human Body

Heat Index	Heat Disorder
80–89° F	Fatigue possible with prolonged exposure and/or physical activity.
90–104° F	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity.
105–129° F	Sunstroke, heat cramps or heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity.
130° F and Higher	Heatstroke/sunstroke highly higher likely with continued exposure.

Source: NOAA

The National Weather Service's Wind Chill Index is used to measure the dangers of frostbite caused by the combined elements of freezing temperatures and wind. **Table 4.10** summarizes the extent of this effect.

Table 4.10 Effects of Extreme Cold on the Human Body

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: NOAA

Previous Occurrences

NOAA historical records indicate that there have been no fatalities in the planning area due to extreme temperatures as far back as 1995. Only 1 fatality (heat related) was recorded for Connecticut during this period (2002).

While summers are humid and very warm, temperatures rarely exceed 100° F and only exceed 90°F on 7-8 days per year. In the summer of 1999, Connecticut experienced extreme heat for a period of 3-5 consecutive days over 100 degrees making it the most severe heat wave on record. The highest recorded ambient temperature for the region is 103°F.

Freezing temperatures are common throughout the region during winter months, with average low temperatures falling below 30°F from December through February. The lowest recorded ambient temperature for the region is -24°F.

Notable recent occurrences in the planning area include:

- July 22-23, 2011 – An oppressive hot and humid air mass produced excessive heat that resulted in daytime temperatures 95 to 105 degrees. The heat index was as high as 108°F at Tweed Airport in New Haven. No fatalities or injuries were attributed to this event.

Probability of Future Events
Extreme temperatures will continue to be a likely occurrence in the planning area. It is anticipated that the effects of climate change will result in an increase in the frequency, duration and intensity of extreme heat events, and a decrease in the frequency of extreme cold events. Heat waves are projected to become much more commonplace in a warmer future with potentially major implications for human health.

Hurricane/Tropical Storm

Description
Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation of winds developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and with a diameter averaging 10 to 30 miles across. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes. Coastal areas are also vulnerable to the additional forces of storm surge, wind-driven waves, and tidal flooding which can be more destructive than cyclone wind. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which extends from June through November.

Location
The entire planning area is susceptible to the occurrence of hurricanes and tropical storms. Coastal areas are more susceptible to the forces of storm surge and tidal flooding (covered under *Flood*).

Extent
The National Weather Service's Saffir-Simpson Hurricane Wind Scale, shown in **Table 4.11**, is used to categorize the strength and magnitude of hurricane events according to sustained wind speed, and also provides estimates of potential property damage.

Table 4.11 Saffir-Simpson Hurricane Wind Scale

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74–95 mph	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96–110 mph	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111–129 mph	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130–156 mph	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

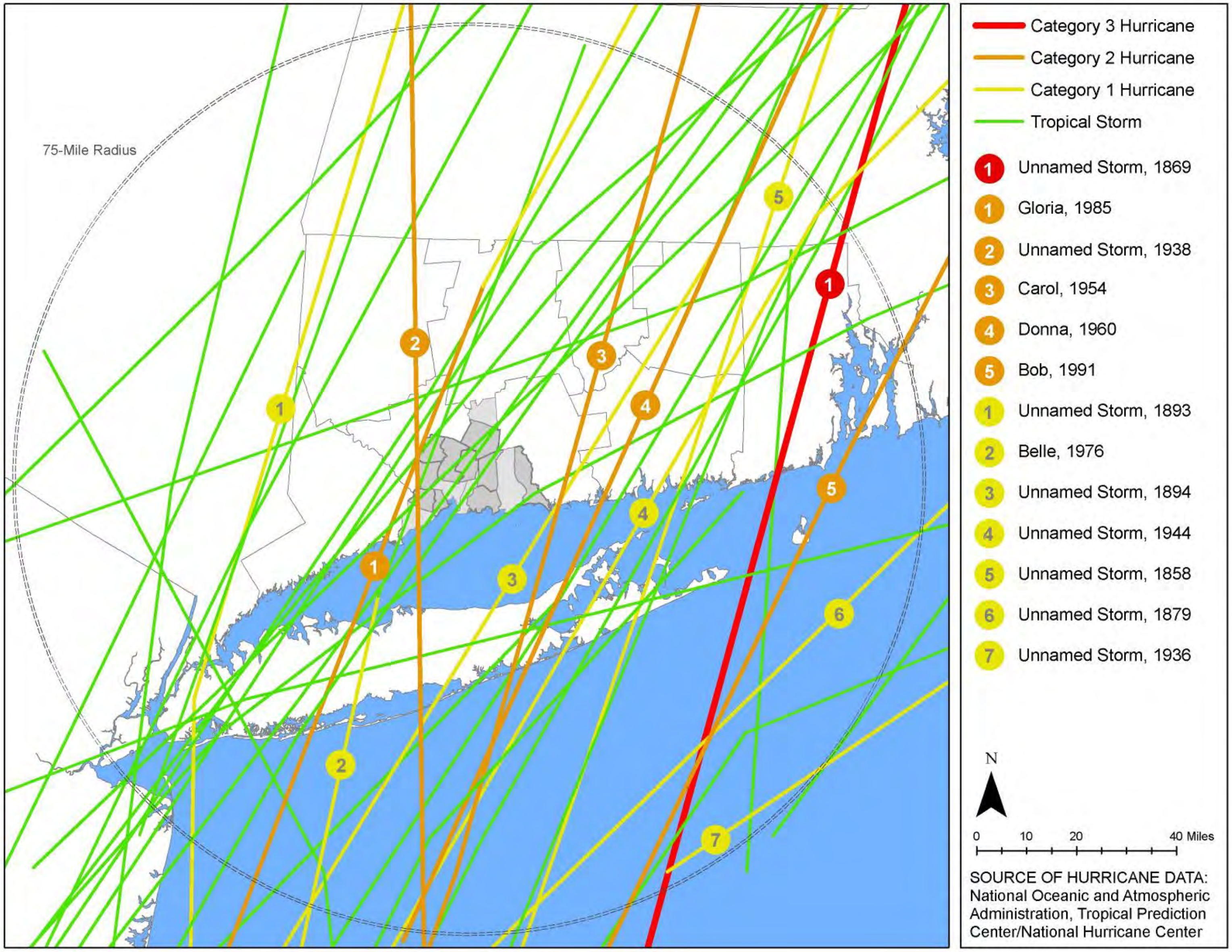
Source: NOAA

Southern New England is prone to Tropical Storms and Tropical Depressions. These storms have wind speeds less than a Category 1 Hurricane.

- Tropical Storm 39 – 73 mph
- Tropical Depression 38 mph or less

Previous Occurrences

According to NOAA historical records, 36 hurricane/tropical storm tracks have come within 75 miles of the planning area since 1851. This includes 23 tropical storms, seven Category 1 hurricanes, five Category 2 hurricanes, and one Category 3 hurricane. **Map 4.3** shows the historical tracks of these storms, some of which are further described below. The map does not include the tracks of an additional extra-tropical systems or tropical depressions that also came within 75 miles of the planning area.



MAP 4.3 Historical Storm Tracks

Notable recent occurrences in the planning area include:

- October 29-30, 2012 (Hurricane Sandy) – Hurricane Sandy, with a wind diameter stretching more than 1,000 miles, became the largest Atlantic hurricane on record and is estimated to be the second costliest in history, only surpassed by Hurricane Katrina in 2005. The storm made landfall as a "post-tropical cyclone" in Atlantic City, New Jersey with sustained winds of 90 miles per hour and a devastating storm surge for communities in the tri-state area. Its effects were directly felt in the South Central Region, with damaging winds and storm surge that caused extensive flooding and erosion along the immediate shoreline (covered under *Flood*).
- August 28, 2011 (Tropical Storm Irene) – Tropical Storm Irene passed to the west of the planning area, bringing damaging winds, storm surge and coastal flooding (covered under *Flood)* to the planning area. The most significant local impacts to the region caused by tropical storm force winds were downed trees, which resulted in moderate property damages, road closures, communications disruptions (especially cellular networks), and widespread long-term power outages, with some areas going longer than a week before power was restored.

The most intense hurricane to strike Connecticut occurred on September 21, 1938. Known widely as the "New England Hurricane of 1938" or "Long Island Express," the storm made landfall as a Category 2 hurricane near Milford and moved rapidly through New England. The storm generated wind gusts as high as 130 miles per hour, a storm surge up to 18 feet along coastal areas, and up to 17 inches of rainfall in central Connecticut causing severe inland flooding. Overall the storm is estimated to have resulted in 564 fatalities and 1,700 injuries, and $624 million in property damages in Connecticut (2012 dollars).

Other notable historic hurricane and tropical storm events for Connecticut include:

- September 15, 1999 (Tropical Storm Floyd) – The remnants of Tropical Storm Floyd dumped heavy rainfall across Connecticut resulting in widespread flooding, while winds caused many downed trees and power outages throughout New England.
- August 19, 1991 (Hurricane Bob) – Hurricane Bob made landfall as a strong Category 2 hurricane in near Newport, Rhode Island, with winds causing light to moderate damages throughout Connecticut. Coastal and inland flooding was minimal. The storm was blamed for 6 fatalities in the state, and an overall total of approximately $1.1 billion in property damages (2012 dollars) for Southern New England.
- September 27, 1985 (Hurricane Gloria) – Hurricane Gloria made landfall as a Category 2 hurricane in the Westport area, felling thousands of trees and causing minor structural damage across Connecticut. The storm struck at low tide, resulting in low to moderate storm surges along the coast, and did not cause substantial inland flooding due to relatively light rainfall. The amount and spread of vegetative debris and widespread power outages were the greatest impacts caused by the storm.
- August 10, 1976 (Hurricane Belle) – After passing over Long Island as a Category 1 hurricane, Belle made landfall as a Tropical Storm near Stratford. The high winds downed trees and caused widespread power outages, spread moderate to heavy rainfall across the area, and generated a small storm surge that caused minor shoreline damage.
- September 12, 1960 (Hurricane Donna) –Hurricane Donna made landfall as a Category 2 hurricane near Old Lyme, generating a storm surge of up to 10 feet along the coast and moderate rainfall across inland areas.

- August 11-18, 1955 (Tropical Storms Connie and Diane) – The combined effects of these two back-to-back storms caused devastating flooding across Connecticut (covered under *Flood*).
- August 31, 1954 (Hurricane Carol) – Hurricane Carol made landfall as a Category 2 hurricane near Clinton shortly after high tide, producing storm surges of 10 to 15 feet from New London eastward that caused widespread coastal flooding. The combination of strong winds and storm surge damaged or destroyed thousands of buildings across the Northeast. Downed trees caused many damages and power outages across the eastern portion of Connecticut, but the western part of the state suffered little effects due to the compact nature of the storm.
- September 15, 1944 – The "Great Atlantic Hurricane" made landfall as a Category 1 hurricane near New London, bringing strong winds and heavy rainfall across the state. Most of the wind damage occurred in Southeastern portions of the state, though wind gusts over more than 100 miles per hour were recorded in Hartford.
- September 8, 1869 – A major unnamed storm made landfall in southwestern Rhode Island as a Category 3 hurricane. This was a compact storm, estimated at only 60 miles wide, and it quickly weakened over land.

Probability of Future Events

Hurricanes and tropical storms will continue to be a likely occurrence in the planning area. Based on historical event data, the annual probability of a hurricane or tropical storm track coming within 75 miles of the planning area is 23 percent, though the chance of a major hurricane (Category 3-5) at landfall is much less. The effects of climate change on future hurricane and tropical storm events cannot be determined at the present time due to insufficient evidence. However, Connecticut's State Hazard Mitigation Plan states that "given the past history of major storms and a reasonable estimate of likely future scenarios, it would be prudent for Connecticut to expect that there will be forthcoming hurricanes which make landfall in or near Connecticut and they will be of a greater intensity and longer duration than in the past."

Severe Thunderstorm

Description

Severe thunderstorms are created when air masses of varying temperatures meet, and can occur singularly, in lines, or in clusters, but generally affect a small area when they occur. They can move through an area very quickly or linger for several hours. The primary damaging forces associated with these storms are straight-line winds, hail, and lightning – but they can also cause flash flooding or spawn tornadoes.

- *Straight-line winds* (including downbursts and microbursts), which in extreme cases have the potential to cause wind gusts that exceed 100 miles per hour, are capable of toppling trees, downing down power lines, and causing moderate to major property damage.
- *Hail* has the potential to cause minor to moderate property damage, particularly the larger hail stones associated with severe thunderstorms. The size of hailstones is a direct result of the size and severity of the storm.
- *Lightning* remains one of the top three storm-related killers in the United States and is a significant life/safety threat to people, but also has the potential to damage property and ignite both structure and wildland fires.

Thunderstorms can occur during any season, but are more likely to occur during the spring and early summer months of March through June. They can occur at any time of day, but are more likely to form in the late afternoon and early evening.

Location
The entire planning area is uniformly susceptible to the occurrence of severe thunderstorms.

Extent
A thunderstorm is classified as "severe" when it contains one or more of the following damaging effects: winds gusting in excess of 50 knots (57.5 mph), hail measuring at least three-quarters of an inch in diameter, or a tornado.

Previous Occurrences
Severe thunderstorms are a frequent occurrence in the planning area. NOAA historical records include 326 severe thunderstorm events in New Haven County since 1955, causing 2 fatalities, 16 injuries and approximately $1.47 million in reported property damages (2012 dollars). The majority of damages were caused by severe thunderstorm winds, though $156,000 in damage was attributed to lightning. It is believed that many additional historic events and/or losses have occurred but gone unreported or unrecorded.

Notable recent occurrences in the planning area include:

- September 30, 2010 – Severe thunderstorm winds caused more than $500,000 in property damages across the region.
- June 8, 2008 – Lightning struck a pavilion at Hammonasset Beach in Madison, resulting in 1 fatality and 4 injuries.

Probability of Future Events
Severe thunderstorms will continue to be a highly likely occurrence in the planning area. According to NOAA, the effects of climate change on future severe thunderstorm events cannot be determined at the present time due to insufficient evidence.

Severe Winter Storm/Nor'easter

Description
Severe winter storms can range from a moderate snowfall over a period of a few hours to blizzard conditions (sustained winds or frequent gusts of 35 miles per hour or more) with blinding wind-driven snow that lasts for several days. Heavy accumulations of snow or ice can bring down trees and power lines, disabling electric power and communications for days or weeks, and can paralyze a region by shutting down all air and rail transportation and disrupting medical and emergency services. Severe winter storms are indirectly and deceptively a significant threat to human life and safety, primarily due to automobile accidents, overexertion and exposure. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on local communities.

Severe winter storms may include snow, ice, sleet, freezing rain, or a mix of these wintry forms of precipitation. Heavy accumulations of snow create hazards to transportation, as well structures with flat rooftops not engineered to withstand heavy snow loads. Sleet – raindrops that freeze into ice pellets before reaching the ground – usually bounce when hitting a surface and do not stick to objects; however, sleet can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing, forming a glaze of ice. Even small accumulations of ice or freezing rain can cause a significant hazard, especially to trees and power lines. An ice storm occurs when heavy accumulations of freezing rain falls and freezes immediately upon impact. Communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Nor'easters are low pressure, severe storm systems that affect the Mid-Atlantic and New England States primarily during winter months. They can form over land or water and are notorious for producing heavy snow, rain, and tremendous waves that crash onto Atlantic beaches, often causing beach erosion and structural damage. Wind gusts associated with these storms can exceed hurricane force in intensity, and when combined with snow result in blizzard conditions that form deep drifts capable of paralyzing a region. Similar to hurricanes, nor'easters are capable of causing substantial damage to coastal areas due to their associated strong winds and heavy surf. A nor'easter gets its name from the continuously strong northeasterly winds blowing in from the ocean ahead of the storm.

Location

The entire planning area is susceptible to the occurrence of severe winter storms and nor'easters. Coastal areas are more susceptible to the forces of strong winds, heavy surf and tidal flooding (covered under *Flood*).

Extent

The classification scale presented in **Table 4.12** categorizes severe winter storms/nor'easters on the eastern and central United States by intensity index category. It consists of a five-level hierarchy, with a category 1 winter storm/nor'easter being the least severe in terms of its intensity and a category 5-winter storm/nor'easter being the most severe.

Table 4.12 Classification Scale for Severe Winter Storms/Nor'easters

Intensity Index Category	Maximum Snowfall Amounts	Maximum Snowfall Rate	Potential Wind Speeds	Maximum Drifting Potential	Closings/ Delays On Communities, Schools, And Travel	Impact On Coastal And Maritime Interests	Nature Of Disruption
1	< 10 in.	Very low < 1 in./hr	Weak	Minor < 20 in.	Maybe minor (hours)	Minor	Minimal–nuisance
2	10–20+ in.	Moderate 1+ in./hr	Strong	Moderate 3 ft.	Maybe moderate (hours to a day common)	Minor to moderate	Nuisance–inconvenience
3	20–30+ in.	High 2+ in./hr	Gale Force	High 4–6+ ft.	Possibly extensive/ lengthy (several days possible)	Moderate to severe	Inconvenience–crippling
4	30–40+ in.	Very High 2-3+ in./hr	Gale-force hurricane	Very High 6–10+ ft.	Probably extensive/ lengthy (up to a week may be common)	Severe	Crippling–paralyzing
5	40–50+ in.	Overwhelming > 3+ in./hr	Gale-force hurricane	Exceptional 10–15+ ft.	Extensive/ lengthy (up to a week common)	Extreme	Paralyzing

Source: Gregory A. Zielinski, Institute for Quaternary and Climate Studies, University of Maine

Previous Occurrences
NOAA historical records include 21 winter storm events in the region since 1996, causing no fatalities or injuries, and approximately $2.3 million in reported property damages (2012 dollars). It is believed that additional losses have occurred but gone unreported or unrecorded in NOAA records.

Notable recent occurrences in the planning area include:

- February 7-8, 2013 "Winter Storm Nemo" – By February 7, 2013, this powerful winter storm had prompted winter storm warnings and winter weather advisories for the entire northeastern United States, from the Upper Midwest to New England, including the state of Connecticut. A blizzard warning was also in effect for all of Connecticut and surrounding areas and a state of emergency was declared in Connecticut on February 8. The highest amount of snowfall in the United States recorded from this storm event was 40 inches in Hamden. More than 800 National Guard soldiers and airmen were activated in Connecticut, Massachusetts, and New York to support actions needed on state roads.
- October 29-30, 2011 (Winter Storm Alfred) – A historic and unprecedented early-season winter storm impacted the area with more than one foot of heavy wet snow falling on interior portions of Southern Connecticut, while coastal areas received mainly rainfall during the event. In addition to the heavy rain and snow, strong winds were experienced along the immediate coastline. Hundreds of thousands of people across southern

Connecticut lost power during this event as heavy snow accumulated on trees that still had partial to full foliage during mid-autumn. This caused extensive felling of trees and limbs across the region, which not only downed power lines but also resulted in many road closures, creating many dangerous situations of isolated residential areas with no ingress for emergency vehicles. Communications networks were also significantly disrupted (especially cellular networks). This was the first time a winter storm of this magnitude has ever occurred in October.

- January/February 2011 – A heavy snowpack after multiple snowstorms since the end of December caused multiple roof collapse events across Southern Connecticut. A barn roof collapsed in Bethany at the end of a cul-de-sac on Hunter Trail, trapping between 12 and 15 horses. Rescue operations took 3½ hours. Also in Bethany, about 13 people escaped injury when half of the roof collapsed at Fairfield County Millwork, Inc. at 20 Sargent Drive.
- January 6, 2009 (Ice Storm) – A significant amount of ice accumulated across interior portions of southern Connecticut. Numerous power lines and large tree limbs were reported down across the region.
- April 15, 2007 (Nor'easter) – A strong late season Nor'easter brought high winds that downed many trees and power lines across the region, and heavy rains that caused widespread and significant flooding across the region. FEMA reported that flood damages in Connecticut exceeded an estimated $7.1 million (2012 dollars) and more than 200 people in were forced to evacuate their residences. In New Haven County, 32 residential properties and two commercial structures were reported to have sustained major damage.

Other historic severe winter storm events for Connecticut as recorded by NOAA or as noted in the State Hazard Mitigation Plan include:

- February 11-12, 2006 (Nor'easter) – Connecticut received record snowfall in parts of the state from this storm (second largest snowfall recorded since 1906) and received a Presidential Emergency Declaration. The Governor ordered state highways shut down to help facilitate efficient snow removal by State Department of Transportation snow removal crews.
- January 22-23, 2005 (Blizzard) – Connecticut received a Presidential Emergency Declaration for this storm event. NOAA analyzed this storm and ranked it a Category 4 – Crippling event on its Northeast Snowfall Impact Scale.
- December 5-7, 2003 – Heavy snowfall amounts were recorded in parts of Connecticut including as much as twenty inches in Windham County, nineteen inches in Hartford County, and eighteen inches in Fairfield, New London, and Tolland Counties. This event received a Presidential Emergency Declaration.
- January 8-9, 1996 (Winter Storm Ginger / Blizzard of 1996) – Snowfall totals up to 27 inches recorded in Connecticut. The storm forced the State to shut down for twenty-four hours, with all roads shut except for emergency travel.
- March 12-14, 1993 (Storm of the Century) – Snowfall totals of 10-20 inches recorded across Connecticut.
- December 10-13, 1992 (Nor'easter of 1992) – Three people were killed and 26 homes were destroyed in Connecticut as a result of the storm. Tides in Long Island Sound were stacked up by the continued strong east/northeast winds reaching 55 miles per hour. This "stacking" of water resulted in the third highest tide (10.16 Feet NGVD as measured at Bridgeport, CT) ever recorded in Long Island Sound and caused more than $7.1 million in

damages (2012 dollars) to over 6,000 homes. Inland areas received up to four feet of snow in northeastern Connecticut. The heavy wet snow snapped tree limbs and power lines cutting power to 50,000 homes.

- February 5, 1978 (Blizzard of 1978) – Record snowfall amounts were recorded in several areas of Connecticut. The State of Connecticut was essentially shut down for three days when the Governor ordered all roads closed except for emergency travel.
- December 18, 1973 (Ice Storm Felix) – Connecticut's most severe ice storm resulted in two fatalities and caused widespread power outages, lasting several days.
- March 11-14, 1888 (Blizzard) – The most significant blizzard to impact Connecticut also referred to as the "Great White Hurricane." Snowfall in Connecticut from this event was estimated at 45-50+ inches. Significantly high snowdrifts were created (some areas of the northeast reported up to 50 foot snow drifts) and the storm literally shut down major cities throughout the Northeast states. It is recorded that over 400 hundred people along the east coast died as a result of the blizzard. Total damages were estimated at over 492 million dollars (2012 dollars).

Probability of Future Events
Severe winter storms will continue to be a highly likely occurrence in the planning area. It is anticipated that the effects of climate change will result in winters that are much shorter with fewer cold days and more precipitation, but less precipitation falling as snow and more as rain. This will result in reduced snowpack, earlier breakup of winter ice on lakes and rivers, and earlier spring snowmelt resulting in earlier peak river flows.

Tornado

Description
A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by strong thunderstorm activity (but may also be spawned from hurricanes and other coastal storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. Most tornadoes are a few dozen yards wide and touch down only briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

Tornadoes often develop so rapidly that little, if any, advance warning is possible making them a significant life/safety threat to people. They are more likely to occur during the spring and early summer months of March through June and can occur at any time of day, but are more likely to form in the late afternoon and early evening. Tornadoes associated with tropical cyclones are most frequent in September and October when the incidence of tropical storm systems is greatest.

Location
The entire planning area is uniformly susceptible to the occurrence of tornadoes.

Extent

The Enhanced Fujita Scale (EF-scale), shown in **Table 4.13**, is used to categorize the strength and magnitude of tornado events based on estimated wind speeds and related damage. This represents an update to the original Fujita Scale (F-scale) and has been implemented since February 2007.

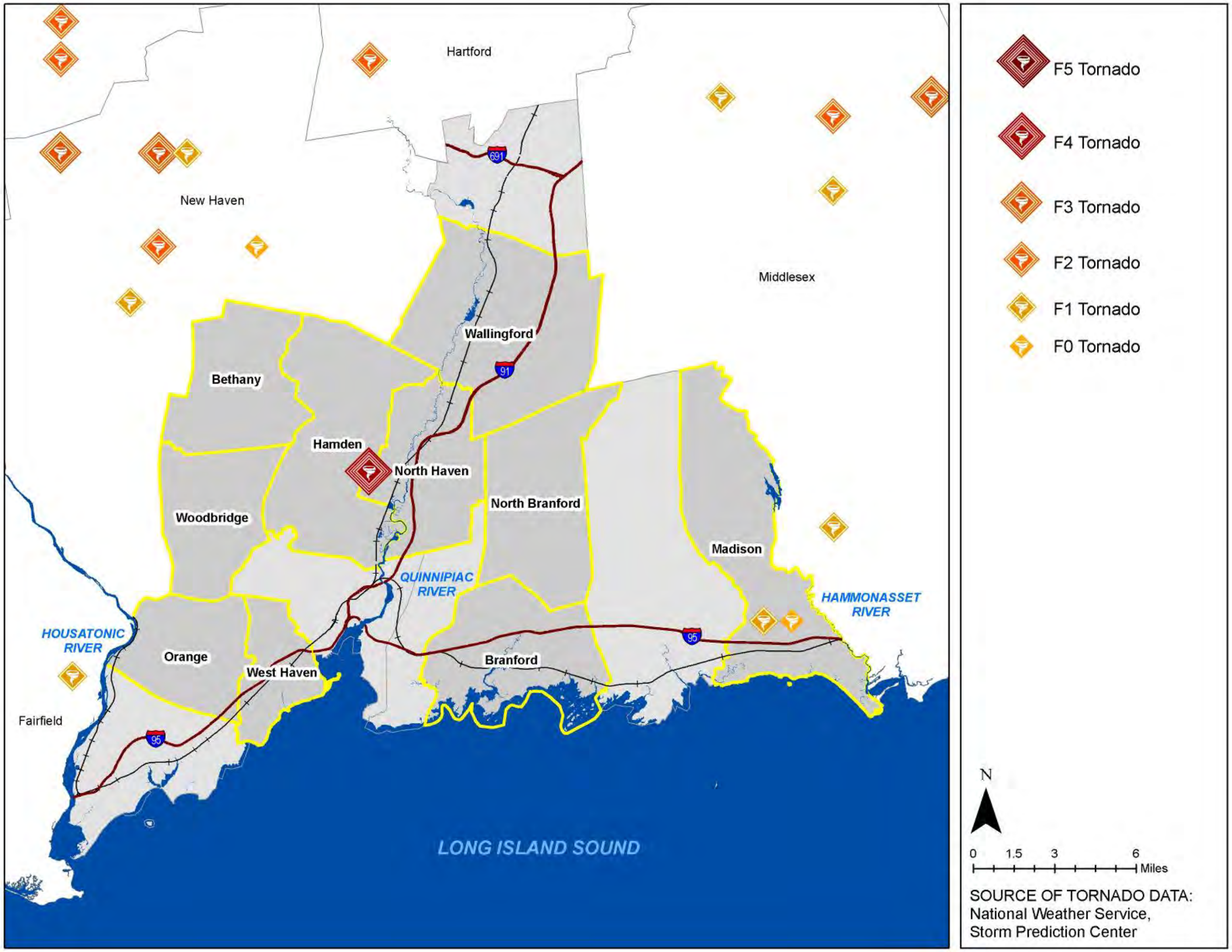
Table 4.13 Enhanced Fujita Scale

Rating	Wind Speed (3 Second Gust)	Potential Damage
EF-0	65–85 mph	Light – Causes some damage to siding and shingles.
EF-1	86–110 mph	Moderate – Considerable roof damage. Winds can uproot trees and overturn singlewide mobile homes. Flagpoles bend.
EF-2	111–135 mph	Considerable – Most singlewide mobile homes destroyed. Permanent homes can shift off foundations.
EF-3	136–165 mph	Severe – Hardwood trees debarked. All but small portions of houses destroyed.
EF-4	166–200 mph	Devastating – Complete destruction of well - built residences, large sections of school buildings.
EF-5	Over 200 mph	Incredible – Significant structural deformation of mid- and high-rise buildings.

Source: NOAA

Previous Occurrences

NOAA historical records include 13 tornado events in New Haven County since 1955, causing 1 fatality, 87 injuries and approximately $375 million in reported property damages (2012 dollars). **Map 4.4** shows the touchdown locations of previous tornado occurrences in the region as identified by NOAA (tornado track/swath data is incomplete or not available). Three of these tornado events occurred within the planning area.



MAP 4.4 Previous Tornado Occurrences

Notable previous occurrences include:

- July 31, 2009 – An EF-1 tornado cut a narrow, discontinuous swath of damage nearly 3 miles long in Madison from near Copse Trail east-southeast to Hull Road between Acorn and Saxon Roads. Downed trees on Wellsweep Drive were strewn in multiple directions in a pattern indicative of a tornado. Snapped and uprooted hardwood trees were also indicative of maximum wind speeds around 100 mph. No fatalities or injuries were associated with this event, but it did cause an estimated $10,000 in property damages.
- July 10, 1989 – As part of a widespread outbreak, a violent F4 tornado touched down in Hamden. The damage path was five miles long and damaged or destroyed nearly 400 structures in its path, mostly in the Highwood section of town. Industrial cranes and cars were tossed through the air, and rows of houses, as well as an industrial park, were flattened. The event caused an estimated $350 million in property damages (2012 dollars) and approximately 40 injuries, but no fatalities.
- May 24, 1962 – An F3 tornado caused 1 fatality, 45 injuries, and approximately $19 million in property damages (2012 dollars) across a damage path estimated to be 11.6 miles long from near Middlebury, through Waterbury and to Southington.

Probability of Future Events

Tornadoes will continue to be an occasional occurrence in the planning area. Based on historical data, the annual probability for tornado events in the planning area is estimated to be 5 percent. It is unlikely that very strong tornadoes (EF-3, EF-4 or EF-5) will strike the area though as proven by historic events it does remain possible. According to NOAA, the effects of climate change on future tornado events cannot be determined at the present time due to insufficient evidence.

Coastal Erosion

Description

Coastal erosion may be generally defined as a gradual, chronic but natural condition of losing shoreline sediments (mostly beach sand and dune systems) due to wind, waves, tides, currents, and other natural coastal processes. Other long-term influences may include subsidence and sea level rise. Rapid coastal erosion exacerbates the long-term threat and typically results from episodic natural hazard events such as hurricanes, nor'easters, and storm surge which have the ability to flatten dunes and create massive erosion in only hours or days. Erosion may also be worsened by human activities such as boat wakes, shoreline hardening, and offshore dredging.

As coastal erosion continues the shoreline moves landward, posing an increased threat of damages to adjacent property and infrastructure. Natural recovery from episodic erosion events can take months or years. If a beach and dune system does not recover quickly enough naturally, coastal and upland property may be exposed to further damage in subsequent events. Shoreline hardening techniques such as seawalls, revetments, bulkheads, groins and jetties may stave off coastal erosion but in most cases they worsen existing erosion or cause new erosion in adjacent areas.

Location

Most shoreline areas in Branford, Madison and West Haven are susceptible to the occurrence of long-term and storm-induced coastal erosion. Although some information on areas of coastal erosion does exist, formal compilation of this data and a spatial, graphic representation of erosion hazard areas have not been developed for the Connecticut shoreline.

According to the Connecticut Department of Energy and Environmental Protection (CT DEEP), erosion in beach areas along the north-south trending shoreline from Milford to New Haven (including West Haven) has traditionally been a concern, and has been aggravated by extensive stabilization of sediment sources in headland areas. Most of the shoreline between New Haven and Guilford (including Branford) is deemed stable, though there are local areas of concern. From Guilford to Old Lyme (including Madison), erosion of beaches and low bluffs is common. In many areas, structural erosion control efforts such as groins and seawalls have altered natural shoreline processes and have aggravated the problem by trapping natural sediment needed for beach replenishment. In other areas, including Madison's Hammonasset Beach, sand replenishment has been used to slow the progress of coastal erosion.

While there is currently no geospatial data available for identifying coastal erosion hazard areas available, it is something that CT DEEP has identified as a program need for future mapping efforts in coordination with the Office of Long Island Sound Programs (OLISP). Per the State Hazard Mitigation Plan this includes the acquisition of historic shoreline data for use in identifying and quantifying areas of erosion and accretion. Although this data is not currently available for use in this analysis, locally identified areas of critical erosion concern, as identified by coastal jurisdictions, are included in the Problem Statement tables provided in the *Risk Analysis* section.

Extent

Coastal erosion is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time, measured in units of feet or meters per year. There is no universal scientific scale or index used to classify the magnitude or severity of coastal erosion based on these rates, though some states have applied them (Connecticut has not).

Previous Occurrences

According to a recent USGS report the average rate of long-term shoreline change for the New England coast was -0.5 meters per year with an uncertainty in the long-term trend of ±0.09 meters per year.[95] However the actual rates of erosion vary substantially along the coast as a function of shoreline type and are influenced primarily by episodic events.

The most significant episodic erosion events for the planning area have been associated with large coastal storms including hurricanes, tropical storms and nor'easters (covered under *Hurricane/Tropical Storm* and *Severe Winter Storm/Nor'easter*). The most recent events include Hurricane Sandy (October 2012) and Tropical Storm Irene (August 2011). These events contributed to the rapid erosion of primary frontal dune systems, damage to seawalls and

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[95] Hapke, C.J., Himmelstoss, E.A., Kratzmann, M., List, J.H., and Thieler, E.R., 2010, National assessment of shoreline change; historical shoreline change along the New England and Mid-Atlantic coasts: U.S. Geological Survey Open-File Report 2010-1118.

revetments, and the loss of other protective features along the immediate shoreline, which as a result significantly increases the risk of property damages to future coastal flooding events.

Probability of Future Events

Coastal erosion will continue to be a highly likely occurrence along many shoreline areas of the planning area. This includes both the continuous but slow onset, long-term effects of natural coastal processes as well as rapid, episodic erosion caused by large coastal storms. It is anticipated that the effects of climate change, including sea level rise, will result in an increase in the extent of coastal erosion.

Dam Failure

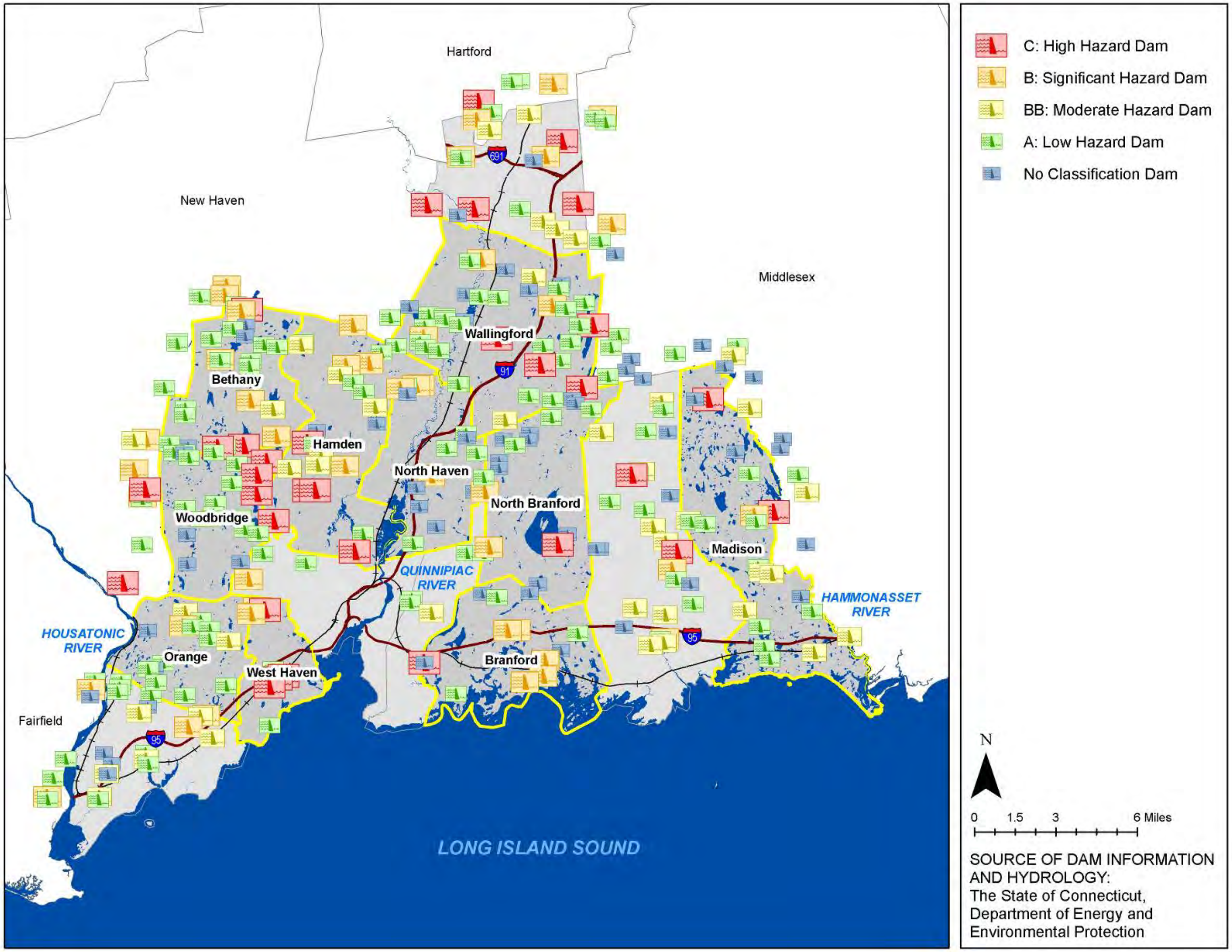
Description

Dam failure is the collapse, breach or other failure of a dam structure that results in an uncontrolled release of impounded water causing downstream flooding. Dam failures can result from natural events, human-induced events, or a combination. Failures due to natural events such as prolonged periods of rainfall and flooding can result in overtopping (the most common cause), though "dry day" failures caused by earthquakes or other unforeseen events are particularly hazardous because there is generally little to no advance warning. Human-induced failures may be attributed to improper design, improper maintenance, or negligent operation and typically include inadequate spillway capacity resulting in overtopping, or internal erosion caused by embankment or foundation leakage (piping). Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream, damaging or destroying everything in its path.

Location

According to CT DEEP, there are 267 state-regulated dams within the South Central Region, and an additional 56 dams that are within 1 mile of the region. Of these total 323 dams, 32 are classified as having high hazard potential (Class C) and 44 are classified as having a significant hazard potential (Class B). A description of each hazard class as defined by the State is provided below, under *Extent*.

Map 4.5 shows the location of all state-regulated dams in the South Central Region, along with those within 1 mile of the region, according to their assigned hazard class. **Table 4.14** lists the number of these dams for each municipal jurisdiction in the region by hazard class. There are an additional 57 dams located in the region (and 10 dams within 1 mile of the region) that do not have a recorded hazard classification.



MAP 4.5 State Regulated Dams

Table 4.14 State-Regulated Dams in South Central Region, by Hazard Class

Jurisdiction	High Hazard	Significant Hazard	Moderate Hazard	Low Hazard	Negligible Hazard
Bethany	3	4	1	13	0
Branford	0	5	0	3	0
East Haven	1	0	1	4	0
Guilford	2	2	9	8	0
Hamden	5	3	6	7	0
Madison	2	1	5	9	0
Meriden	3	2	4	2	0
Milford	0	2	6	7	0
New Haven	0	1	0	2	0
North Branford	1	1	0	3	0
North Haven	0	5	0	8	0
Orange	0	1	2	9	0
Wallingford	4	3	2	23	0
West Haven	4	2	0	2	0
Woodbridge	3	0	0	14	0
Within 1 mile of Region	4	12	6	24	0
Total	**32**	**44**	**42**	**138**	**0**

Source: State of Connecticut, Department of Energy and Environmental Protection

Extent

Two factors influence the potential severity of a dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream. The potential extent of dam failure may be classified according to their "hazard potential," meaning the probable damage that would occur *if* the structure failed, in terms of loss of human life and economic loss or environmental damage. The State of Connecticut classifies dam structures under its regulations according to hazard potential as described in **Table 4.15**. It is important to note that these classifications are not based on the adequacy or structural integrity of existing dam structures.

Table 4.15 Classification of Hazard Potential for Connecticut Dams

Class	Hazard Potential	Description of Impacts *(if dam were to fail)*
AA	Negligible	No measurable damage to roadways; no measurable damage to land and structures; negligible economic loss.
A	Low	Damage to agricultural land; damage to unimproved roadways; minimal economic loss.
BB	Moderate	Damage to normally unoccupied storage structures; damage to low volume roadways; moderate economic loss.
B	Significant	Possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to or interruption of the use of service of utilities; damage to primary roadways and railroads; significant economic loss.
C	High	Probable loss of life; major damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to main highways; great economic loss.

Source: State of Connecticut, Department of Energy and Environmental Protection

Previous Occurrences

There is no record of any damages, fatalities or injuries associated with dam failure in the planning area. According to the National Performance of Dams Program (NPDP) Inventory at Stanford University and a review of data made available by the Association of State Dam Safety Officials (ASDSO), there has been only one report of a dam failure event in the planning area.

On April 16, 2007 the Disbrow Pond dam in Bethany failed when the embankment failed near the inlet structure. The breach was approximately 12 feet high and 15 feet wide but resulted in no damages. The dam, which was designed by the Natural Resource Conservation Service, is classified as a low hazard dam (Class A).

There have been many significant dam failures across Connecticut, mainly caused by major flood events, which resulted in human casualties and millions of dollars in property damage. However according to CT DEEP all of these dam failures occurred outside of the planning area.

Probability of Future Events

Dam failure remains an unlikely occurrence for all state-regulated dams. The CT DEEP's Dam Safety Section is tasked with monitoring the routine inspection and maintenance of those dams that present the greatest risk or are in need of structural repair. Dam owners are responsible for complying with maintenance and repair requirements, and developing emergency action plans.

State regulations require that over 600 dams in Connecticut be inspected annually and prioritizes inspections of those dams which pose the greatest potential threat to downstream persons and properties. Other structures are inspected as time and funding permit, and upon notification of potentially significant deficiencies or emergency conditions. Regulated dams must be designed to pass the 100-year rainfall event with one foot of freeboard, an additional factor of safety against overtopping. The most critical and hazardous dams are required to meet a spillway design standard much higher than passing the runoff from a 100-year rainfall event. As more dams get repaired in the future, the number of those that do not meet these minimum requirements decreases.

It is anticipated that the effects of climate change will not increase the probability of future dam failure events, though projections for increased heavy rainfall events should continue to be considered in the regulation of dam repair and/or construction.

Drought

Description

Drought is defined as a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area. Drought is a natural climatic condition caused by an extended period of limited rainfall beyond that which occurs naturally in a broad geographic area. High temperatures, high winds and low humidity can worsen drought conditions, and can make areas more susceptible to wildfire. Human demands and actions can also hasten drought-related impacts.

Droughts are frequently classified as one of following four types: meteorological, agricultural, hydrological or socio-economic. Meteorological droughts are typically defined by the level of "dryness" when compared to an average, or normal amount of precipitation over a given period of time. Agricultural droughts relate common characteristics of drought to their specific agricultural-related impacts. Hydrological drought is directly related to the effect of precipitation shortfalls on surface and groundwater supplies. Human factors, particularly changes in land use, can alter the hydrologic characteristics of a basin. Socio-economic drought is the result of water shortages that limit the ability to supply water-dependent products in the marketplace.

Location

The entire planning area is susceptible to the occurrence of droughts, though coastal areas may be considered somewhat less susceptible based on historical records.

Extent

The Palmer Drought Severity Index (PDSI), shown in **Table 4.16**, measures the difference between water supply (precipitation and soil moisture) and water demand (amount needed to replenish soil moisture and keep larger bodies of water at normal levels). It primarily reflects long-term drought and has been used extensively to initiate drought relief.

Table 4.16 Palmer Drought Severity Index

PDSI Value	Classification
+4.0 or above	Extremely Moist
+3.0 to +3.9	Very Moist Spell
+2.0 to +2.9	Unusual Moist Spell
-1.9 to +1.9	Near Normal
-2.0 to -2.9	Moderate Drought
-3.0 to -3.9	Severe Drought
-4.0 or less	Extreme Drought

Source: NOAA

Previous Occurrences

NOAA historical records indicate that there have been 19 periods of severe to extreme droughts in the region since 1895, as listed in **Table 4.17**. These records also indicate that severe to extreme drought conditions were experienced by inland areas 8.5 percent of the time and coastal areas 6.2 percent of the time.

Table 4.17 Periods of Severe or Extreme Drought in South Central Region, 1895-2012

Drought Period	Duration	Lowest PDSI Value
1/1901 – 2/1901	2 months	-3.97 in 2/1901
11/1909 – 12/1909	2 months	-3.28 in 12/1909
4/1910 – 9/1911	18 months	-5.20 in 5/1911
9/1912 – 2/1913	6 months	-3.66 in 11/1912
7/1913 – 9/1913	3 months	-3.97 in 8/1913
9/1914 – 12/1914	4 months	-3.62 in 11/1914
4/1915 – 6/1915	3 months	-3.98 in 6/1915
11/1924 – 6/1925	8 months	-4.01 in 4/1925
11/1929 – 4/1931	18 months	-4.77 in 9/1930
10/1931 – 2/1932	5 months	-4.35 in 12/1931
4/1932 –7/1932	4 months	-3.41 in 5/1932

Drought Period	Duration	Lowest PDSI Value
11/1949 – 1/1950	3 months	-3.52 in 12/1949
7/1957 – 11/1957	5 months	-3.68 in 9/1957
9/1964 – 1/1965	5 months	-4.16 in 11/1964
3/1965 – 2/1967	24 months	-5.19 in 12/1965
3/1985 – 4/1985	2 months	-3.84 in 4/1985
8/1995 – 9/1995	2 months	-3.61 in 8/1995
7/1999 – 8/1999	2 months	-3.50 in 7/1999
1/2002 – 4/2002	4 months	-3.67 in 2/2002

Source: Northeast Regional Climate Center, Cornell University

The impact of previous droughts on local communities vary widely, though most are related to social, economic and environmental concerns rather than direct threats to life and property. Past events in the South Central Region have resulted in some costly impacts associated with the drying of residential wells in rural areas, though these impacts have not been widespread. It is also worth noting that previous periods of severe to extreme drought conditions have led to increased numbers and sizes of wildfires across the region (covered under *Wildfire*).

Probability of Future Events

Drought will continue to be an occasional occurrence in the planning area. It is anticipated that the effects of climate change will result in an increase in the frequency, duration and intensity of droughts. By late this century, under a higher emissions scenario, short-term (one to three month) droughts are projected to occur as frequently as once each summer.

Flood

Description

Flooding is the most frequent and costly natural hazard in the United States (and in Connecticut). Nearly 90 percent of presidential disaster declarations result from natural events where flooding was a major cause of human casualties and property damages.

Flooding may be generally defined as the partial or complete inundation of normally dry land by the overflow and accumulation of excess water. Flooding may classified according to three distinct hazard types:

- *Riverine floods* include overbank flooding from a river or stream channel onto adjacent floodplains, and are generally caused by excessive precipitation from large-scale weather systems. A rapid accumulation of heavy localized downpours may also impact smaller streams and creeks to cause *flash floods*, characterized by a rapid rise in water level and/or high velocity flow with little warning. Other potential causes of riverine floods include ice jams or dam failures.

- *Coastal floods* occur along the shorelines of large water bodies and are caused by the wind-driven waves, storm surge and heavy rainfall produced by hurricanes, tropical storms, nor'easters and other large, low-pressure coastal storms with cyclonic flows. Coastal flood hazards are often exacerbated over the long term by coastal erosion and sea level rise.
- *Urban floods* occur where the physical development of a community has decreased the ability of natural groundcover to absorb and retain surface water runoff, and existing drainage systems are incapable of conveying or retaining storm water flow. They are most often caused by isolated, high-intensity rainfall events of relatively short duration (1 to 3 hours). Even when drainage systems are designed to acceptable standards, urban flooding may occur when they are obstructed by debris, sediment or other materials that limit their functional capacity.

Location

Riverine Flood

Most of the South Central Region is located in the South Central Coast River Basin, with some western portions of Bethany Woodbridge and Orange in the Housatonic River Basin, and very small portions of Wallingford, North Branford, and Madison in the Connecticut River Basin.

Three major rivers flow through planning area, including the Quinnipiac, Housatonic and Hammonasset. The Housatonic River flows southeasterly and defines a portion of the western municipal boundary for Orange. The Quinnipiac River flows south through Wallingford, North Haven, and Hamden before continuing through New Haven to New Haven Harbor, an inlet of Long Island Sound. The Hammonasset River flows south and defines the eastern municipal boundary for Madison, emptying into Long Island Sound just east of Hammonasset State Park. In addition to these major rivers, there are a large number of smaller rivers and tributaries, streams, lakes and other water bodies throughout the region that are associated with special flood hazard areas as delineated by FEMA.

Map 4.6 shows the locations of all special flood hazards areas for the South Central Region as shown on current FEMA Digital Flood Insurance Rate Maps (DFIRMs).[96] Jurisdiction-specific maps provided in the *Risk Analysis* show the locations of these special flood hazard areas for each participating jurisdiction. Descriptions for these special flood hazard areas are provided in the *Extent* portion of this section.

Coastal Flood

Coastal special flood hazard areas as currently mapped on FEMA DFIRMs are included in the map figures listed above for riverine flood. This includes "VE Zones" which are defined as areas subject

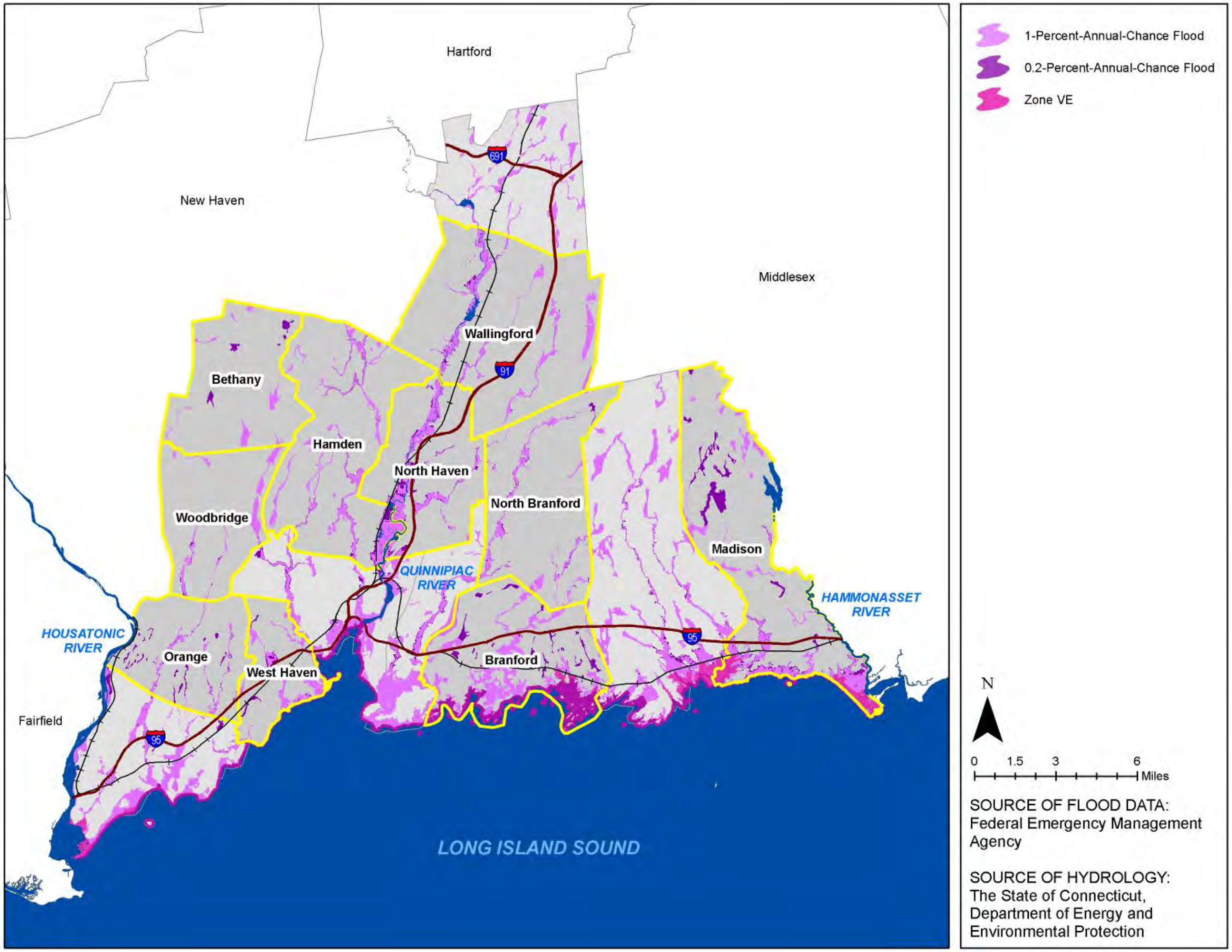
[96] Current effective date for FEMA's Digital Flood Insurance Rate Maps (DFIRMs) for New Haven County is 12/17/2010.

to inundation by the 1 percent annual chance flood event with additional hazards due to storm-induced velocity wave action.

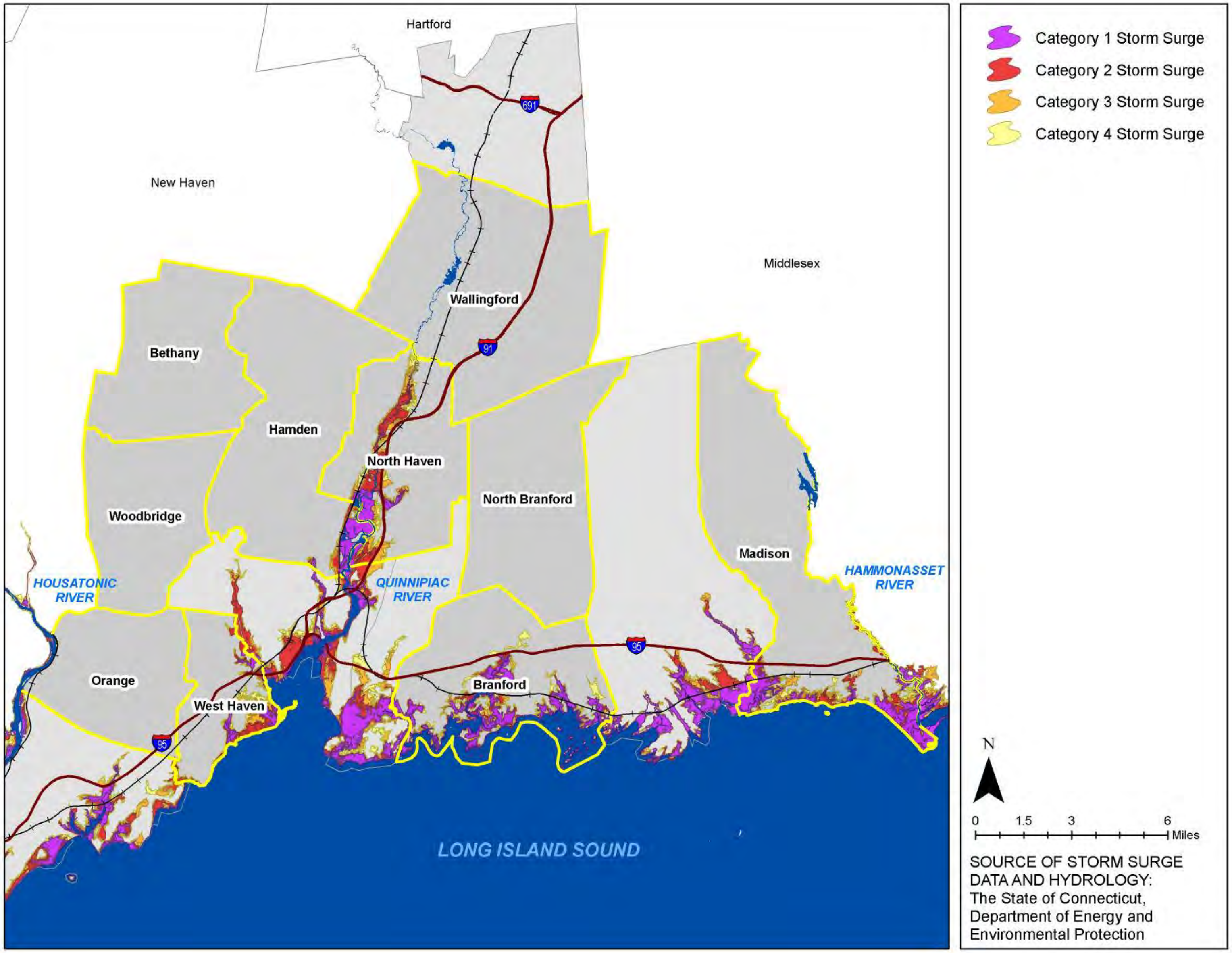
Map 4.7 shows the location of all storm surge inundation areas for the South Central Region**.** Jurisdiction-specific maps provided in the *Risk Analysis* section show the location of storm surge inundation areas for each those jurisdictions potentially affected (Branford, Hamden, Madison, North Haven, and West Haven). These maps illustrate areas that could be inundated by "worst case" scenarios associated with Category 1 through 4 hurricanes striking the coast of Connecticut.

Urban Flood

Urban floods often strike rapidly, terminate quickly, and occur in areas generally not considered at risk to major flooding (including areas outside of mapped floodplains). The primary areas of concern with regard to urban flooding for each participating jurisdiction are well known to local officials, and are often attributed to inadequate drainage of impervious surfaces. The localized areas of most critical concern, as identified by jurisdictions, are included in the Problem Statement tables provided in the *Risk Analysis* section.



MAP 4.6 Special Flood Hazard Areas (Region)



MAP 4.7 Storm Surge Inundation Areas (Region)

Extent

Riverine Flood

The severity of a riverine flood event is typically determined by a combination of several major factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; the degree of vegetative clearing; and impervious surface.

The periodic flooding of lands adjacent to rivers, streams and shorelines (floodplains) is a natural and inevitable occurrence that can be expected to take place based upon established recurrence intervals. The recurrence interval of a flood is typically defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. Flood magnitude (spatial extent and depths) increases with increasing recurrence interval.

Floodplain areas are delineated according to the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood and the 100-year floodplain by the 100-year flood. A more appropriate way of expressing flood frequency is the percent chance of occurrence in any given year (annual probability). For example, the 100-year flood has a 1 percent chance of occurring in any given year, and the 500-year flood has a 0.2 percent chance of occurring in any given year. Statistically, the 1 percent annual chance flood has a 26 percent chance of occurring during a 30-year period of time, which is equal to the duration of many home mortgages. Contrary to what the term suggests, a "100-year flood" is not a flood that occurs only once every 100 years. A "100-year flood" can and often does occur multiple times in a century.

Special flood hazard areas identified on FEMA DFIRMs (as shown in the map figures for riverine flood) are defined as the areas that will be inundated by the flood event having a 1 percent chance of being equaled or exceeded in any given year. The 1 percent annual chance flood is also referred to as the base flood, and is the national minimum standard for applying FEMA's NFIP floodplain management regulations and mandatory flood insurance purchase requirements. Areas shown to be inundated by the 0.2 percent annual chance are considered moderate flood hazard areas, and areas outside of these areas are considered minimal flood hazard areas.

Coastal Flood

The intensity and duration (or forward speed) of a storm is the most influential factor affecting the severity and impact of storm surges. While hurricanes and tropical storms often move through areas relatively quickly, nor'easters can last for days and multiple tidal cycles – often causing major coastal flooding, erosion and damage from wind-driven wave action.

Special flood hazard areas identified as "VE Zones" on FEMA DFIRMs (as shown in the map figures for riverine flood) are defined as areas subject to inundation by the 1 percent annual chance flood event with additional hazards due to storm-induced velocity wave action. Mandatory flood insurance purchase requirements and floodplain management standards apply for these areas.

Urban Flood

The severity of urban flooding varies greatly and is highly dependent on rainfall intensity and duration, but is generally limited to minimal, localized damages and/or temporary disruptions to transportation infrastructure. However the lack of warning associated with urban flood events often creates significant threats to public safety due to flooded roadways, and results in increased damage to property that could have been prevented with more advance notice (particularly for vehicles left unattended in areas susceptible to urban flooding).

Previous Occurrences

NOAA historical records include 94 flood events in the region since 1993, causing 2 fatalities, no injuries and more than $4 million in reported property damages (2012 dollars). The majority of these events may be classified as urban or flash floods, with significant street flooding that make roads impassable, submerge parked vehicles, and result in serious life safety threats to drivers. These flood events also often isolate people in localized areas with access restricted by low-lying roadways. However, the damage figures associated with these events are believed to greatly underestimate the value of actual flood losses that have occurred but gone unreported or unrecorded in NOAA records.

FEMA historical records include a total of nearly $35 million in insured damages for participating jurisdictions as recorded through the National Flood Insurance Program (NFIP) since the late 1970s. The average claims payment per flood loss is approximately $12,000. **Table 4.18** lists the number of insured losses and total claims payments for historical flood damages in each jurisdiction as recorded under the NFIP as of April 30, 2013. It should be noted that this information only reflects previous losses as reported through claims under the NFIP, and that additional uninsured or unreported losses have occurred throughout the region.

Table 4.18 NFIP Statistics on Flood Losses and Claims Payments (as of December 31, 2012)

Jurisdiction	NFIP Entry Date	Total Flood Losses	Total Claims Payments
Bethany	08/23/1977	3	$7,226
Branford	12/15/1977	731	$11,264,948
Hamden	06/15/1979	537	$3,335,994
Madison	09/15/1978	573	$10,840,157
North Branford	07/03/1978	68	$457,504
North Haven	09/17/1980	151	$1,547,692
Orange	03/18/1980	132	$1,258,874
Wallingford	09/15/1978	125	$ 900,437
West Haven	01/17/1979	492	$4,646,142
Woodbridge	03/16/1981	68	$509,909
	Total	**2,880**	**$34,768,883**

Source: FEMA

Notable recent occurrences in the planning area include:

- October 29-30, 2012 – The storm surge and tidal flooding associated with Hurricane Sandy (covered under *Hurricane/Tropical Storm*) resulted in major flood damage and erosion along the Connecticut shoreline. According to FEMA estimates for New Haven County, the storm caused minor damage to 342 structures, major damage to 150 structures, and destroyed 4 structures. It is estimated that storm surge inundation impacted hundreds of roadways, 3 schools, 1 fire station, 34 electrical facilities, 1 waste water facility, and 65 communication facilities throughout the county. As of January 9, 2013 more than 1,453 people had applied to FEMA for Individual Assistance for more than $9 million in losses.
- August 28, 2011 – The large envelope of winds associated with Tropical Storm Irene pushed a 3 to 8 foot storm surge into Long Island Sound resulting in moderate to major coastal flooding, wave damage and erosion. This resulted in damage or destruction of over 100 homes along the Connecticut shoreline, though the majority of these were in neighboring jurisdictions outside of the planning area. Heavy damage to public beaches and other public and private facilities also occurred. In West Haven, heavy damage was sustained to several coastal properties in Savin Rock. In Branford, several feet of water inundated Linden Avenue and neighboring properties. This combined with wave action caused severe erosion and undermining of roadways in the area with about a dozen homes and businesses significantly damaged. Along Seaview Avenue several homes were flooded and damaged with up to 6 feet of surge.
- July 8, 2011 – The combination of an approaching upper level disturbance and a stationary front in the vicinity produced thunderstorms with very heavy rainfall that caused flash flooding in Middlesex and New Haven Counties, and more than $1 million in estimated property damages.
- March 7, 2011 – Heavy rains and melting snow from an unnamed winter storm caused the Housatonic River to swell more than two feet above flood stage. Several vehicles and approximately 20 homes in New Haven County were damaged.
- March 31, 2010 – A Nor'easter centered off the Delmarva coast produced an extended period of heavy rainfall across the area as it tracked very slowly to the northeast. This caused widespread flooding across portions of Southern Connecticut and more than $100,000 in estimated property damages.
- May 27, 2008 – Strong thunderstorms in advance of a cold front crossed the tri-state area producing isolated flash flooding in New Haven County and more than $600,000 in estimated property damages.
- April 15, 2007 – A strong late season Nor'easter impacted the region with a period of heavy rain that caused widespread and significant river, stream, and urban flooding of low lying and poor drainage areas. The storm also produced moderate tidal flooding across portions of Long Island Sound. This storm resulted in considerable damage to property.
- April 16, 1996 – Flash flooding across New Haven County caused more than $2.2 million in estimated property damages (2012 dollars).

According to FEMA's Flood Insurance Study (FIS), the most notable and serious riverine floods in the region occurred in 1815, 1893, 1927, March 1936, January and September 1938, January 1949, August and October 1955, January 1978, June 1982, March and April 1987, and June 1992. Riverine floods have occurred in every season of the year, with some of the most severe floods occurring in early spring as a result of snow melt and heavy rains. Late summer and autumn are another critical season for flood danger due to heavy rainfall and the possibility of hurricanes and tropical storms. Winter floods result from occasional thaws, particularly in years of heavy snowfall.

The most severe coastal flooding in the region has occurred as a result of high tides and storm surge caused hurricanes, tropical storms and nor'easters (covered under *Hurricane/Tropical Storm* and *Severe Winter Storm/Nor'easter*). The region was heavily impacted by storm surge from hurricanes in 1938 and 1954. The storm surge accompanying these storms represented a recurrence interval ranging from 22 to 50 years. In more recent years, the region has suffered damaging storm surges and tidal flooding from Tropical Storm Irene (2011) and Hurricane Sandy (2012), as described earlier in this section.

Some of the historic major flood events impacting the region as noted in the FIS and the State Hazard Mitigation Plan include:

- June 1982 – The South Central Region was especially hard hit during the 1982 floods across Connecticut, caused by a large low-pressure system that produced prolonged and heavy rainfall over several days following a prior week of rainfall that had saturated the ground. Flooding in the south central portion of New Haven County was estimated to greater than a 200-year recurrence interval. Streams that experienced the most severe flooding were the Wepawaug River (Lower Reach) in Orange and Milford, and the Mill River in Hamden. Very little flooding of large rivers occurred during this event. In total more $662 million in damages (2012 dollars) and 11 fatalities were recorded across Connecticut as a result of the 1982 floods. More than 15,000 homes were damaged (mostly by minor flooding), with 1,500 homes considered moderately damaged and 37 homes destroyed. In addition, more than 400 commercial and industrial properties were damaged, and many state and local roads, bridges, dams, and utility infrastructure also suffered damages.
- August 1955 – The greatest flood of record within the Housatonic and Naugatuck River watersheds occurred in August 1955 when two tropical storms, Connie and Diane, produced heavy precipitation across saturated soils within one week of each other. Severe flooding occurred across Connecticut as a result of these back-to-back storms, causing more than 100 fatalities and more than $4.3 billion in estimated property damage (2012 dollars) across Connecticut. It is estimated that the August 1955 peak flood discharge has a return frequency of about 110 years on the Housatonic River.
- March 1936 – The "Great Connecticut River Flood" of March 1936 was the result of a combination of melting snow and moderately heavy rains over a 13-day period. The Housatonic River was one of three major rivers affected with record flood heights. The floodwaters left an estimated 14,000 people homeless and several people died as a result of this event. The flood resulted in an estimated $333 million in property damage (2012 dollars) across Connecticut.

Probability of Future Events

Floods of varying extent will continue to occur in the planning area. Riverine floods will continue to be an occasional occurrence in planning area, while coastal and urban floods will likely occur more frequently. It is anticipated that the effects of climate change, including sea level rise, will result in an increase in the extent and frequency of storm surge and coastal flooding. Severe urban flooding due to more precipitation and heavy downpours is also likely to occur more frequently.

Sea Level Rise

Description

Sea level rise refers to an increase in mean sea level over time. There is strong scientific evidence that global sea level is now rising at an increased rate and will continue to rise during this century. The Intergovernmental Panel on Climate Change (IPCC) estimates that the global average sea level will rise between 0.6 to 2 feet (0.18 to 0.59 meters) in the next century. However, climate models, satellite data, and hydrographic observations demonstrate that sea level is not rising uniformly around the world. Depending on the region, sea level might be projected to rise several times the global mean rise or can actually fall.

The two major causes of global sea level rise are thermal expansion caused by the warming of the oceans (since water expands as it warms) and the loss of land-based ice (such as glaciers and polar ice caps) due to increased melting. Local sea level change, which is of more direct concern to coastal communities, is a combination of the rise in sea level and the change in land elevation. Areas experiencing coastal erosion and land subsidence accelerate the rate of sea level rise occurring locally. Coastal communities experiencing increases in mean sea level are at greater risk to the effects of coastal flood hazards as natural, protective buffers such as coastal wetlands and dunes are lost and property and infrastructure become more exposed to the frequency and severity of coastal flood and storm surge inundation.

Location

Map 4.8 shows potential sea level rise inundation areas for the South Central Region based on expected 2080 sea level rise conditions, assuming a scenario of a 1-meter rise in sea level. The figure is based on the "high" estimate of projected mean high water inundation in the year 2080 due to sea level rise (not inclusive of any storm surge scenario) as mapped by The Nature Conservancy.

Extent

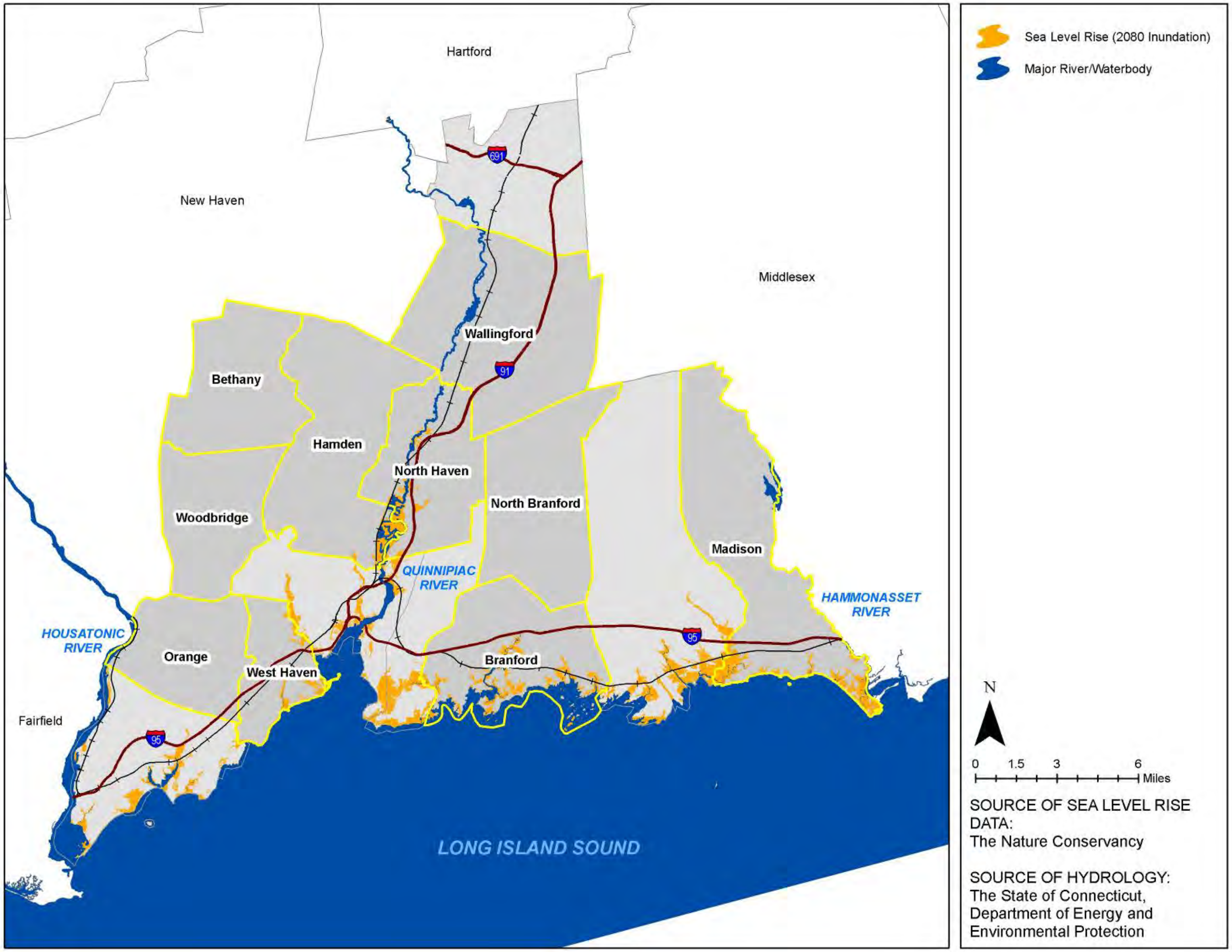
The sea level rise hazard is a slow onset hazard, and the severity or magnitude of which is measurable only over long periods of time as further described below. Of greater concern is the influence sea level rise will have on the severity of episodic hazard events such as storm surge and coastal flooding, as well as long term coastal erosion. It can be expected that sea level rise will be an amplifier of the magnitude for these other coastal hazards.

Previous Occurrences

According to the NOAA, while studies show that sea levels changed little from AD 0 until 1900, sea levels began to climb in the 20th century. Records and research show that global sea level has been steadily rising at a rate of 1 to 2.5 millimeters (0.04 to 0.1 inches) per year since 1900, and this rate may be increasing. Since 1992, new methods of satellite altimetry indicate a rate of rise of 3 millimeters (0.12 inches) per year.

Probability of Future Events

Sea level rise is expected to continue occurring along the Connecticut shoreline well into the future, with projections ranging from 12 to 23 inches by the end of the century (41 to 55 inches with the "Rapid Ice-Melt Sea Level Rise" scenario). It is anticipated that the effects of climate change will increase the rate and severity of sea level rise, and perhaps more importantly, continued sea level rise will result in an increase in the extent and frequency of storm surge and coastal flooding.



MAP 4.8 Sea Level Rise Inundation Areas (Region)

Earthquake

Description

An earthquake is the sudden motion or trembling of ground caused by an abrupt release of accumulated strain on tectonic plates that comprise the Earth's crust. While these thick plates move slowly and continuously over the interior of the earth, they collide, slide, catch, and hold – but eventually, when the mounting stress exceeds the elastic limit of the rock, faults along or near plate boundaries rupture or slip abruptly and an earthquake occurs. The ensuing seismic hazard effects on the Earth's surface include ground shaking, surface fault ruptures, and ground failures, which have the potential to cause widespread damage to buildings and infrastructure. Earthquakes may also provoke secondary hazards such as tsunamis, landslides, dam failures, or large fires ignited by ruptured gas lines.

The underground point of initial rupture is known as an earthquake's focus or hypocenter, and the point at ground level directly above the hypocenter is known as its epicenter. In general, the severity of the resulting ground motion increases with the amount of energy released and decreases with distance from the epicenter. Larger earthquakes usually begin with slight tremors but rapidly take the form of one or more violent shocks, and are followed by vibrations of gradually diminishing force called aftershocks. While the great majority of earthquakes strike near continental margins or in areas where large plates collide or move past each other, some, including those in the Northeast United States, can occur within plate boundaries.

Location

The entire planning area is uniformly susceptible to the occurrence of earthquakes. Unlike other areas of the country where earthquakes occur along known fault lines, earthquakes in the Northeast do not correlate with the many known faults that exist in the region. They occur in the middle of plates, far from the plate boundaries.

Map 4.9 shows peak ground acceleration and the location of epicenters for historically significant earthquakes across the Northeast United States according to the United States Geological Survey (USGS).

Peak ground acceleration is the amount of earthquake generated ground shaking that, over a specified period of time, is predicted to have a specified chance of being exceeded. It is expressed as a percentage of the force of gravity (%g). Map 4.10 shows the peak acceleration with 10 percent probability of exceedance in 50 years, a common standard for USGS earthquake hazard maps. The entire planning area falls within a zone with a peak ground acceleration value of 2-3%g, which is considered a low risk zone.

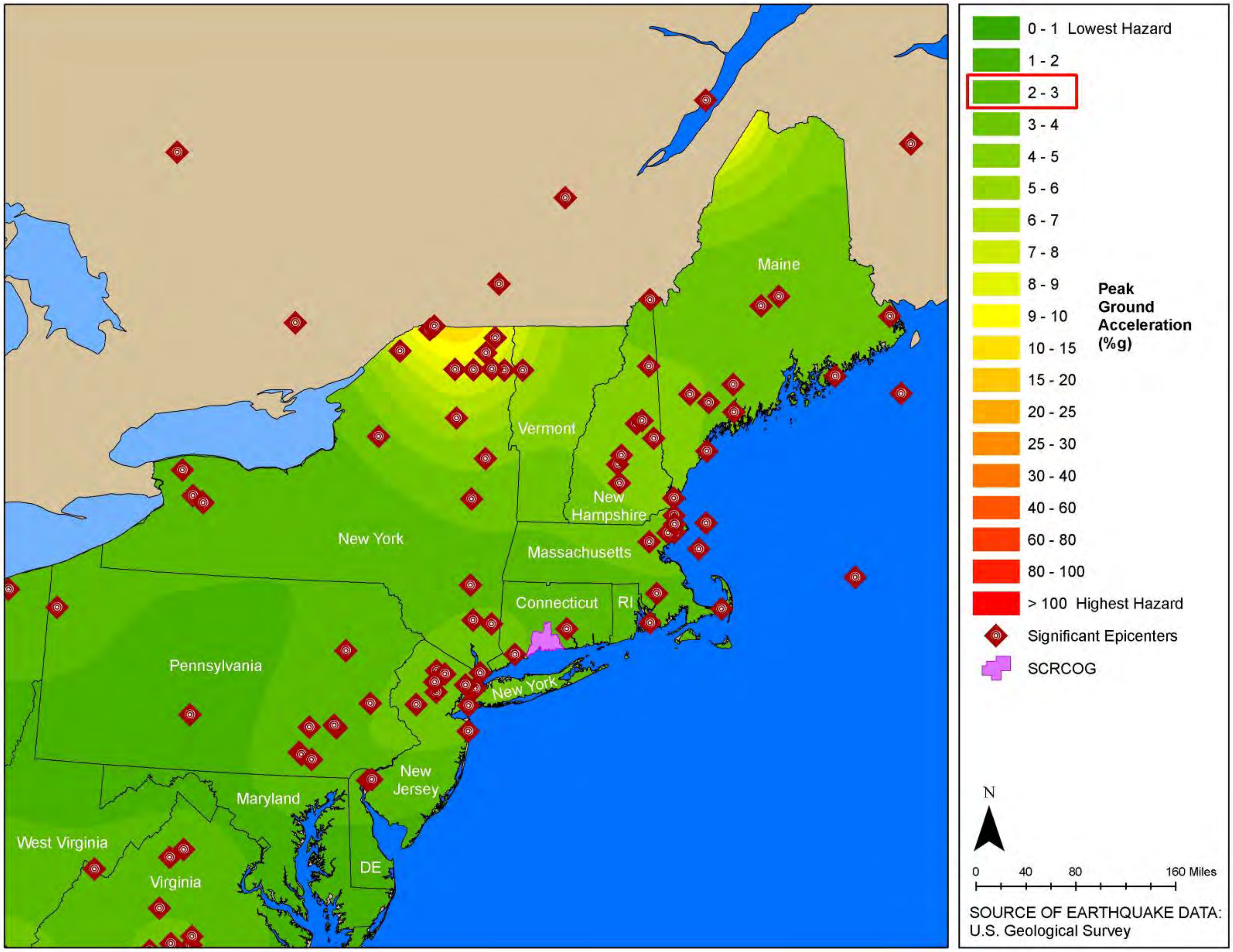
Significant earthquakes, as defined by the USGS, are those "within or near to the United States that caused deaths, property damage, or geological effects, or that were experienced by populations in the epicentral area." More information on past notable earthquakes for the planning area is provided below under *Previous Occurrences*.

Extent

The magnitude of an earthquake is a measure of the amount of energy released as seismic waves at the hypocenter. The Richter Scale classifies earthquake magnitude as determined from measurements recorded by seismographs, and according to a single number on an open-ended logarithmic scale. Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy.

The intensity of an earthquake is a measure of the strength of ground shaking and its effects on the Earth's surface at a certain location. Intensity is most commonly measured using the Modified Mercalli Intensity Scale, which is based on observed seismic effects versus any mathematical basis. The Scale is composed of 12 increasing levels of intensity (designated by Roman numerals) that range from imperceptible shaking to catastrophic destruction.

Table 4.19 summarizes the range of magnitudes and related intensities for earthquakes according to the Richter and Modified Mercalli Intensity (MMI) scales, along with abbreviated descriptions of effects on people, human structures, and the natural environment near the epicenter.



MAP 4.9 Peak Ground Acceleration and Historically Significant Earthquake Epicenters

Table 4.19 Classification of Earthquake Magnitude and Intensity

<table>
<tr><th colspan="2">Magnitude
(Richter Scale)</th><th>Typical Maximum Intensity
(MMI Scale)</th><th>Abbreviated Description of Effects (Near Epicenter)</th></tr>
<tr><td colspan="2">1.0 to 3.0</td><td>I</td><td>Not felt except by a very few under especially favorable conditions.</td></tr>
<tr><td colspan="2" rowspan="2">3.0 to 3.9</td><td>II</td><td>Felt only by a few persons at rest, especially on upper floors of buildings.</td></tr>
<tr><td>III</td><td>Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.</td></tr>
<tr><td colspan="2" rowspan="2">4.0 to 4.9</td><td>IV</td><td>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 motorcars rocked noticeably.</td></tr>
<tr><td>V</td><td>Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.</td></tr>
<tr><td rowspan="2">5.0 to 5.9</td><td></td><td>VI</td><td>Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.</td></tr>
<tr><td rowspan="3">6.0 to 6.9</td><td>VII</td><td>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.</td></tr>
<tr><td rowspan="5">7.0 and higher</td><td>VIII</td><td>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, and walls. Heavy furniture overturned.</td></tr>
<tr><td>IX</td><td>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.</td></tr>
<tr><td rowspan="3"></td><td>X</td><td>Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.</td></tr>
<tr><td>XI</td><td>Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.</td></tr>
<tr><td>XII</td><td>Damage total. Lines of sight and level are distorted. Objects thrown into the air.</td></tr>
</table>

Source: USGS

Previous Occurrences

The Northeast region of the United States has a long history of earthquakes, though the vast majority of these had a calculated magnitude of less than 3.0. This includes more than 140 earthquakes centered in Connecticut since 1638, according to the Northeast States Emergency Consortium and New England Seismic Network.

The largest and most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. It has been estimated to be a VII intensity event. According to USGS records, stonewalls were shaken down, tops of chimneys were knocked off, and latched doors were thrown open.

The second strongest earthquake in Connecticut occurred near Hartford on November 14, 1925. Plaster was knocked from walls and dishes were shaken from shelves. More recently, an intensity V earthquake in southern Connecticut occurred on November 3, 1968. Plaster was reportedly cracked in Madison during this event, and small items fell and broke.

Other notable earthquakes occurred in Connecticut in 1837, 1840, 1845, 1858, 1875, 1953, all of which were moderate tremors that caused alarm but resulted in minimal damages. There have also been several earthquakes centered outside of Connecticut that were strongly felt in the state but caused little to no damage. This includes recent strong earthquakes centered in Virginia (2011) and Maine (2012).

Probability of Future Events

Earthquakes with a magnitude of 3.0 and greater will remain an occasional occurrence in the planning area, however, based on historical data and USGS hazard maps, it is susceptible to only minor ground shaking events. It is anticipated that the effects of climate change will have no relation to the probability of future earthquake events.

Wildfire

Description

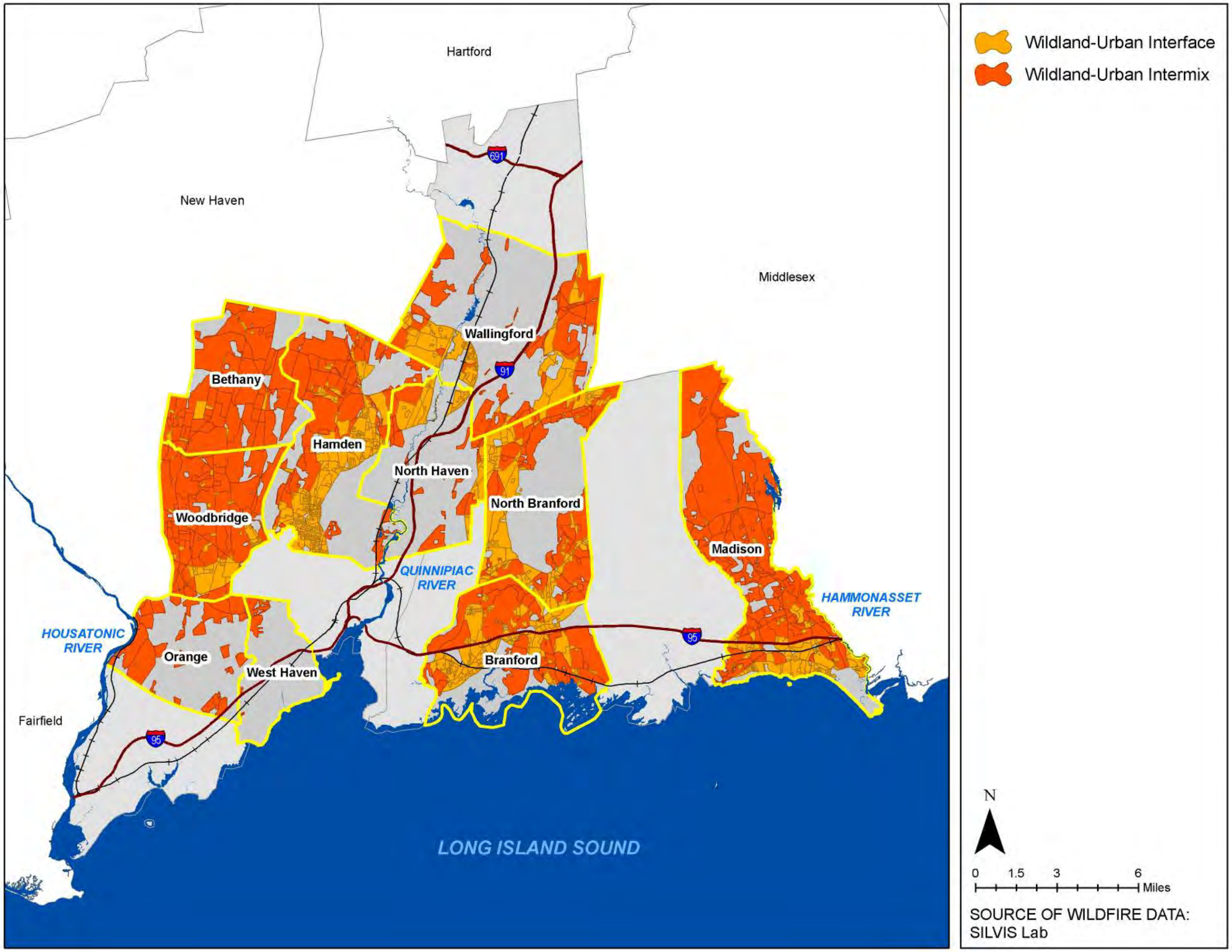
A wildfire is an unwanted, uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Other names such as brush fire or forest fire may be used to describe the same phenomenon depending on the type of vegetation being burned. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase the frequency and severity of wildfire for people and property located within wildfire hazard areas, and particularly for those in rural areas with limited capabilities for rapid fire suppression. When not quickly detected and contained, wildfires have the potential to cause extensive damage to property and threaten human life.

Wildfires are part of the natural management of many forest ecosystems, but most are caused by human ignition factors. Over 80 percent of wildfires are started by negligent human behavior during dry conditions such as improperly discarding cigarettes, burning debris, or extinguishing campfires in wooded areas. The second most common cause of wildfires is lightning strikes that occur during dry thunderstorms.

Location

The wildland/urban interface is defined as the area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. **Map 4.10** illustrates the location of wildfires hazard areas across the region as mapped by the SILVIS Laboratory at the University of Wisconsin.[97] These hazard areas include two types of wildland/urban interface areas: intermix and interface. Intermix areas are described as areas where housing and vegetation intermingle; interface areas are described as areas with housing in the vicinity of contiguous wildland vegetation. Jurisdiction-specific maps provided in the *Risk Analysis* section show the locations of these wildfire hazard areas for each participating jurisdiction.

[97] Radeloff, V.C., R.B. Hammer, S.I Stewart, J.S. Fried, S.S. Holcomb, and J.F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15: 799-805.



MAP 4.10 Wildland Urban Interface/Intermix Areas (Region)

Extent

The magnitude of wildfire events is often characterized by their speed of propagation, total number of acres burned, and potential destructive impacts to people and property. The magnitude and severity of wildfires is greatly dependent on weather, fuel conditions, topography, and existing fire detection, control and suppression capabilities.

Previous Occurrences

The Forestry Division of CT DEEP maintains statistical records of past wildfire occurrences that were reported from local Fire Marshals and Fire Departments throughout the state. According to these records there have been 330 wildfire incidents reported in the planning area since 1991, however the average size (total acres burned) per occurrence is very small at only 3.36 acres. **Table 4.20** summarizes these statistics for each jurisdiction in the planning area. As can be seen in the table, most of the historically reported wildfire events have occurred in the Town of Hamden, and according to local officials, most of these were located in Sleeping Giant State Park in the northeastern portion of town (and not in proximity to human development).

According to the State Forest Fire Supervisor there are no recorded property damages or human casualties attributed to these events, and it is believed that many additional small fires have occurred in the planning area but gone unreported to the State.

Table 4.20 Statistics on Reported Wildfire Occurrences in Planning Area (1991-June 2012)

Jurisdiction	Number of Fires	Total Acres Burned	Average Fire Size (Acres)
Bethany	13	116.45	8.96
Branford	21	76.00	3.62
Hamden	263	482.28	1.83
Madison	8	101.50	12.69
North Branford	1	0.10	0.10
North Haven	6	19.70	3.28
Orange	9	23.00	2.56
Wallingford	6	1.10	0.18
West Haven	1	0.20	0.20
Woodbridge	2	0.30	0.15
Total	**330**	**820.63**	*(Average)* **3.36**

Source: State of Connecticut, Department of Energy and Environmental Protection

Probability of Future Events

Wildfires will continue to be a highly likely occurrence in the planning area, though the magnitude and impact of these events will be minimal due to some aggressive forest/fuels management programs, as well as early detection and fire suppression. It is anticipated that the effects of climate change, including more frequent and prolonged drought conditions, will increase the frequency and intensity of wildfire events; however the United States Forest Service indicates that it is difficult to project what the exact impacts of climate change may be. Another related factor that is expected to increase the probability of future wildfire events is the introduction of disease, pests, and invasive plants that result in the dieback of mature tree species thus creating increased vegetative fuel loads in wildland areas.

Risk Analysis

The Risk Analysis section provides detailed risk and vulnerability information for each participating jurisdiction. This includes a summary account of the following:

- **Community Assets:** An inventory of buildings and populations specific to each participating jurisdiction.
- **Vulnerable Assets:** Community assets that may be susceptible to damage from a given hazard based on GIS (geographic information system) inventories.
- **Potential Impacts:** The consequences or effects of a hazard on the jurisdiction and its community assets.
- **Loss Estimates:** Potential monetary losses that reflect physical, economic, or social damages.
- **Problem Statements:** Statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets. These statements were primarily derived from discussion with local municipal officials during Advisory Committee Meetings and individual Municipality meetings and local site visits, in addition to GIS-based analysis using best available data. They were generated to assist in the early identification and analysis of potential mitigation actions for each jurisdiction.

Overview

This section builds upon the information provided in the previous *Hazard Identification* and *Hazard Analysis* sections by identifying and characterizing an inventory of at-risk assets for each jurisdiction and then assessing the potential impact and amount of damages that can be expected from each identified hazard event.

The primary objective of the risk analysis is to quantify exposure and potential loss estimates for each hazard. In so doing, participating jurisdictions better understand their unique risks to identified hazards and potential problem areas, which aids in evaluating and prioritizing mitigation actions.

This section is a compilation of 10 separate risk analyses—one for each participating jurisdiction—driven by the best available data for each jurisdiction. This yields stronger results than conducting one overall analysis for the entire planning area, where differences and gaps in data would essentially limit the analysis in many instances to a “lowest common denominator” in terms of uniformity in the datasets.

Methodology

Vulnerable Assets

Two sets of asset inventories were used for the risk analysis. Where available and appropriate, local datasets containing critical facilities and other locations of community interest and/or value, such as historic properties, were used to determine vulnerable assets. Where local data was not available, information on police stations, fire stations, hospitals, and schools was derived from Hazus-MH 2.1 datasets, including numbers of structures and estimated building values. In some instances, building replacement values from Hazus-MH were used to fill gaps in local data for residential, commercial, and industrial buildings at risk.

The following are certain hazard-specific data, methods, and assumptions that were used in the analysis.

<u>Coastal Erosion</u>

- Data does not currently exist to prepare accurate or meaningful exposure analysis or loss estimation for this hazard.

<u>Dam Failure</u>

- Assets potentially vulnerable to dam failure were determined based on dam failure inundation mapping available for 15 high hazard dams in the planning area.
- Source of dam data: State of Connecticut Department of Energy and Environmental Protection (http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707)

<u>Drought</u>

- It is assumed that drought would not cause direct physical damage to buildings, critical facilities, and populations, although hardships and indirect damages could potentially occur during extended periods of drought conditions.
- Annualized loss estimates for this hazard are based on historical damages reported to the National Climatic Data Center of the National Oceanic and Atmospheric Administration.

<u>Earthquake</u>

- The numbers and values of vulnerable assets for the earthquake hazard are total exposure values, assuming that all buildings and populations would be equally exposed to the effects of this hazard.
- Hazus-MH version 2.1 was used to calculate estimated losses for this hazard.
- Soil classification data for New Haven County from a 2005 Hazus risk assessment by the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM) was used for this analysis.
- NEHRP soil classification A (hard rock) was used for each community based on location within the soil classification map included in the 2005 assessment.

- Specific parameters include: liquefaction = 0; landslide = 0; groundwater depth = 5 feet (default); and return period of 100-year with a magnitude of MM7.

Extreme Temperatures

- Estimates of vulnerable populations for the extreme temperatures hazard is based on elderly age 65 and over.
- Annualized loss estimates for this hazard are based on historical damages reported to the National Climatic Data Center of the National Oceanic and Atmospheric Administration.

Flood

- Exposure results for the flood hazard are not cumulative. In other words, the number of buildings intersecting the 0.2-percent-annual-chance floodplain does not include the number of buildings intersecting the 1-percent-annual-chance floodplain. Numbers and values of assets for events of increasing magnitude should be read as “in addition to” the preceding magnitudes.
- Preliminary Digital Flood Insurance Rate Map (DFIRM) data was identified as best available data and therefore utilized for this analysis. Included in the DFIRM data are the 1-percent-annual-chance floodplain (Zone A/AE), the 0.2-percent-annual-chance floodplain, and Zone VE.
- Hazus-MH version 2.1 was used to calculate estimated losses for the riverine and coastal components of this hazard using the riverine model for riverine flooding and the coastal model for coastal flooding. Because the DFIRM data (as described above) does not differentiate between A Zones and Coastal A Zones, all A/AE Zones were factored into the riverine flood hazard results and only VE Zones were used for the coastal flood hazard results.
- The calculations for riverine flooding and coastal flooding are handled separately within Hazus-MH using distinct methodologies for riverine and coastal flood hazard areas. As such, loss estimates and annualized losses for these two separate types of flooding do not always correlate when compared with one another. Depth of flooding plays a large part in the difference between the riverine results and the coastal results for the planning area, in addition to the mapped flood hazard boundaries.
- Coastal flood hazard results are only presented for West Haven, Branford, and Madison as Hamden and North Haven do not have VE Zones present within their jurisdictional boundaries. However, sea level rise data is presented for Hamden and North Haven as explained under Sea Level Rise below.
- Source of flood hazard data: Federal Emergency Management Agency Preliminary DFIRM (Digital Flood Insurance Rate Map) data; National Flood Insurance Program (NFIP) records.
- Source of hydrology data (for mapping purposes): State of Connecticut Department of Energy and Environmental Protection (http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707)
- Exposure results for the storm surge hazard are not cumulative. In other words, the number of buildings intersecting the Category 2 storm surge inundation area does not include the number of buildings intersecting the Category 1 storm surge inundation area. Numbers and values of assets for events of increasing magnitude should be read as “in addition to” the preceding magnitudes.

- Source of storm surge inundation data: State of Connecticut Department of Energy and Environmental Protection (http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&depNav_GID=1707)

Hurricane/Tropical Storm

- The numbers and values of vulnerable assets for the hurricane/tropical storm hazard are total exposure values, assuming that all buildings and populations would be equally exposed to the effects of this hazard.
- Hazus-MH version 2.1 was used to calculate estimated losses for the hurricane wind component of this hazard.

Sea Level Rise

- Sea level rise data was provided by The Nature Conservancy and covers (from west to east) the jurisdictions of West Haven, Hamden, North Haven, Branford, and Madison. This is not a direct correlation to the coastal flood hazard analysis conducted for West Haven, Branford, and Madison as Hamden and North Haven do not have VE Zones present.
- The sea level rise analysis is based on the "high" estimate of projected mean high water inundation in the year 2080 due to sea level rise (not inclusive of any storm surge scenario). The Nature Conservancy used a scenario of a 1-meter rise in sea level in its mapping approach.

Severe Thunderstorm

- The numbers and values of vulnerable assets for the severe thunderstorm hazard are total exposure values, assuming that all buildings and populations would be equally exposed to the effects of this hazard.
- Annualized loss estimates for this hazard are based on historical damages reported to the National Climatic Data Center of the National Oceanic and Atmospheric Administration.

Severe Winter Storm/Nor'easter

- The numbers and values of vulnerable assets for the severe winter storm/nor'easter hazard are total exposure values, assuming that all buildings and populations would be equally exposed to the effects of these hazards.

Tornado

- The numbers and values of vulnerable assets for the tornado hazard are total exposure values, assuming that all buildings and populations would be equally exposed to the effects of these hazards.
- Annualized loss estimates for this hazard are based on historical damages reported to the National Climatic Data Center of the National Oceanic and Atmospheric Administration.

Wildfire

- Results for the wildfire hazard are based on a combination of wildland-urban interface and wildland-urban intermix areas.
- Source of wildfire hazard data: The SILVIS Laboratory at the University of Wisconsin: (http://silvis.forest.wisc.edu/maps/wui/state)

Potential Impacts

The potential impacts section is primarily an exposure analysis consisting of the numbers of parcels, buildings (where building footprint data was available), critical facilities, historic assets (where data was available), and people that intersect known hazard areas, based on GIS analysis.

It is important to note that these are total numbers potentially at risk and do not reflect any one hazard scenario. For example, 200 buildings may intersect the 1-percent-annual-chance floodplain but not all floodplain areas may flood during a given flood event. Similarly, 200 buildings may intersect the 1-percent-annual-chance floodplain but all 200 buildings may be elevated sufficiently above the base flood elevation so as to reduce their vulnerability significantly. Therefore, the numbers in this section are simply an indicator of the total number of assets potentially exposed to the hazard and of potential interest in the mitigation planning process.

Loss Estimates

Loss estimates were derived from two sources: the Hazus-MH loss estimation methodology provided by FEMA and statistical analysis based on historical hazard occurrences. In most instances, loss estimates result in an Annualized Loss Estimate (ALE) that provides an understanding of potential future losses for a given hazard relative to other hazards studied. In some instances, the ALE was determined to be "negligible," which is a dollar value less than $5,000. This is a standard dollar value used in previously approved plans to represent the distinction between negligible annualized losses and meaningful annualized losses for purposes of analysis, ranking, and planning.

Hazus-MH Loss Estimation Methodology

FEMA's Hazus-MH loss estimation methodology was used to determine potential losses for the hurricane (wind and surge), flood (riverine and coastal), and earthquake hazards.

Annualized losses for the hurricane wind hazard include building and contents damages and inventory, relocation, capital, wage and rental income losses.

Statistical Analysis Methodology

For the severe thunderstorm, severe winter storm/nor'easter, and tornado hazards, total historical losses from the National Climatic Data Center for each hazard were divided by the number of years for which data was available and then divided by the number of jurisdictions impacted to determine an Annualized Loss Estimate for each town.

This approach would have been utilized for other hazards included in this risk analysis as well, such as drought and wildfire, if historical losses existed for those hazards.

Problem Statements

Problem statements consist of a compilation of anecdotal information as obtained from local community officials as well as some findings of the GIS-based risk analysis. If applicable, potential solutions or mitigation actions are also discussed with problem statements. The purpose of this section is to leverage the risk assessment process in a way that supports the development of a meaningful mitigation strategy.

Community Assets

People

The total population for the planning area according to the 2010 census is 274,963. (The total population for New Haven County as a whole is 862,477 as of the 2010 census.) **Table 4.21** lists 2010 population numbers for each participating jurisdiction along with populations that may have unique vulnerabilities (elderly age 65 and over and youth under the age of 18,). The information is presented in descending order based on total population.

Table 4.21 Population Distribution by Jurisdiction[98]

Jurisdiction	2010 Population	Elderly (Age 65+)	Youth (Under 18)
Hamden	60,960	9,171	11,622
West Haven	55,564	6,912	11,555
Wallingford	45,135	7,436	9,478
Branford	28,026	5,387	4,962
North Haven	24,093	4,792	5,004
Madison	18,269	3,318	4,779
North Branford	14,407	2,522	3,182
Orange	13,956	2,664	3,246
Woodbridge	8,990	1,718	2,130
Bethany	5,563	783	1,349
Total	**274,963**	**44,703**	**57,307**

[98] Based on 2010 Census data obtained from http://www.census.gov.

From a regional perspective, the Town of Hamden has the largest population in the study area (at 60,960), with the City of West Haven as a close second (at 55,564). In contrast, Bethany has the smallest population (at 5,563) and Woodbridge has the second smallest (at 8,990).

Populations with Unique Vulnerabilities

Populations with unique vulnerabilities include students and visiting populations associated with colleges and universities, which would include Quinnipiac University in Hamden, the University of New Haven in West Haven, and Yale West in West Haven.

Special needs populations can include hospital patients, which would include Gaylord Hospital in Wallingford (with an estimated 88 beds), Masonic Hospital in Wallingford (with an estimated 503 beds) and the Connecticut Hospice in Branford (with an estimated 52 beds).[99]

Built Environment

Critical Facilities

Critical facilities are structures and institutions necessary for a community's response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery.[100] Critical facilities may include airports, emergency operations centers (EOCs), fire stations, hospitals and medical facilities, police stations, rail stations, schools, shelters, and town halls. **Table 4.22** provides an inventory of relevant assets by jurisdiction.

[99] Based on data from Hazus-MH default inventories.

[100] Federal Emergency Management Agency, *Local Mitigation Planning Handbook*, Washington, Federal Emergency Management Agency, 2012. Available at: http://www.fema.gov/hazard-mitigation-planning-resources

Table 4.22 Critical Facilities

Jurisdiction	Airports	EOCs	Fire Stations	Hospitals	Nursing Homes/ Assisted Care Facilities	Police Stations	Public Works Facilities	Rail Stations	Schools	Shelters	City/Town Halls
Bethany[101]	0	1	2	0	0	2	2	0	2	3	1
Branford[102]	0	1	5	1	3	1	1	1	5	0	1
Hamden[103]	0	0	7	0	0	1	3	0	17	3	1
Madison[104]	0	0	2	0	3	1	1	1	11	1	1
North Branford[105]	0	1	4	0	2	1	1	0	5	1	1
North Haven[106]	0	1	4	0	0	1	1	0	8	1	1
Orange[107]	0	1	2	0	2	1	2	0	8	1	1
Wallingford[108]	0	1	5	2	4	1	1	1	18	4	1
West Haven[109]	0	0	9	1	4	1	1	1	17	1	1
Woodbridge[110]	0	1	1	0	0	1	1	0	5	0	1
Total	**0**	**7**	**41**	**4**	**18**	**11**	**14**	**4**	**96**	**15**	**10**

[101] Based on a combination of data from Hazus-MH default inventories and SCRCOG.

[102] Based on data provided by the Town of Branford and SCRCOG.

[103] Based on a combination of data from the Town of Hamden, SCRCOG, and Hazus-MH default inventories.

[104] Based on a combination of data from Hazus-MH default inventories and SCRCOG.

[105] Based on a combination of data from Hazus-MH default inventories and SCRCOG.

[106] Based on a combination of data from Hazus-MH default inventories and SCRCOG.

[107] Based on a combination of data from Hazus-MH default inventories and the Town of Orange.

[108] Based on a combination of data from the Town of Wallingford, SCRCOG, and Hazus-MH default inventories.

[109] Based on a combination of data provided by the City of West Haven and SCRCOG.

[110] Based on a combination of data from Hazus-MH default inventories and SCRCOG.

Cultural Resources and Historic Assets

Cultural resources and historic assets are generally unique or irreplaceable in nature due to their age or unique properties or characteristics. Museums, geological sites, concert halls, parks, stadiums, and other such assets are important to a community and can be considered a cultural resource. Officially recognized cultural resources and historic assets can be found on lists maintained as part of the National Register of Historic Places, State historic registries, and local historical preservation societies. **Table 4.23** provides a list of known cultural resources and historic assets within the planning area.

Table 4.23 Cultural Resources and Historic Assets

Cultural Asset	National Register of Historic Places[111]	Local Designation
Bethany		
Stanley Downs Memorial Building		X
Russell Farm and Outbuildings		X
Christ Episcopal Church		X
Congregational Church		X
Branford[112]		
Branford Center Historic District	X	
Branford Point Historic District	X	
Canoe Brook Historic District	X	
Route 146 Historic District	X	
Stony Creek-Thimble Islands Historic District	X	
More than 20 historic homes	X	
Hamden		
Alphonso Johnson House	X	
Atwater-Linton House	X	
George Atwater House	X	
Elam Ives House	X	
Eli Whitney Boardinghouse	X	
Eli Whitney Gun Factory (Museum)	X	
Farmington Canal Lock No. 13	X	
Hamden Bank & Trust Building	X	

[111] Data obtained from the National Register of Historic Places database at: http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome

[112] The Town of Branford has a total of 969 historic sites according to local GIS data.

Cultural Asset	National Register of Historic Places[111]	Local Designation
Hamden High School	X	
Hamden Memorial Town Hall	X	
Mount Carmel Congregational Church and Parish House	X	
Jonathan Dickerman House	X	
Orrin Todd House	X	
Pistol Factory Dwelling	X	
Sleeping Giant Tower	X	
Whitneyville Congregational Church	X	
Madison		
Allis-Bushnell House	X	
Deacon John Graves House		X
Hammanasset Paper Mill Site	X	
Jonathan Murray House	X	
Madison Green Historic District	X	
Meigs-Bishop House	X	
Memorial Town Hall (Archives)		X
Shelley House	X	
State Park Supply Yard	X	
North Branford		
Fourth District School	X	
George Baldwin House	X	
Gordon S. Miller Museum		X
Howd-Linsley House	X	
Little Red School House		X
Little White Gas Station		X
Maltby-Stevens Factory Site	X	
North Branford Center Historic District	X	
Northford Center	X	
Reynolds-Beers House		X
North Haven		
Pines Bridge Historic District	X	
Rising Sun Tavern	X	
Orange		
Col. Asa Platt House	X	
Henry F. Miller House	X	

Cultural Asset	National Register of Historic Places[111]	Local Designation
Orange Center Historic District	X	
Stone-Otis House		X
The Academy Museum		X
William Andrew House	X	
Wallingford		
Center Street Cemetery	X	
Franklin Johnson House	X	
John Barker House	X	
Joseph Blakeslee House	X	
Nehemiah Royce House	X	
Samuel Parsons House	X	
Samuel Simpson House	X	
Theophilus Jones House	X	
Wallingford Center Historic District	X	
Wallingford Railroad Station	X	
West Haven		
American Mills Web Shop	X	
Old West Haven High School	X	
Union School	X	
Ward-Heitman House	X	
West Haven Green Historic District	X	
Yale West Art Collection		X
Woodbridge		
Chatfield Farmstead	X	
Cement Kiln on Litchfield Turnpike		X
Dr. Andrew Castle House	X	
New England Cement Company Kiln and Quarry	X	
Thomas Darling House and Tavern	X	
Woodbridge Green Historic District	X	

Other Existing Assets

Other existing assets include single and multi-family residential housing, commercial structures, industrial facilities, and other buildings, which includes education, government, and religious buildings. All structures are exposed to risk, but certain buildings or concentrations of buildings may be more vulnerable because of their location, age, construction type, condition, or use.[113] **Table 4.24** lists the number of residential, commercial, and industrial buildings in each jurisdiction.

Table 4.24 Other Existing Structures

Jurisdiction	Total Number of Parcels[114]	Total Number of Buildings	Residential Breakdown [115]	Commercial Breakdown [116]	Industrial Breakdown [117]	Other
Bethany	2,393	3,444[118]	1,829	131	45	1,439
Branford	13,207	26,414	10,652	741	269	14,752
Hamden	16,742	26,607	14,855	695	76	10,981
Madison	7,692	8,049[119]	7,367	467	156	59
North Branford	5,721	8,470	4,844	297	136	3,193
North Haven	8,992	9,491[120]	8,482	627	240	142
Orange	5,402	5,692[121]	5,082	471	127	12
Wallingford	13,851	18,945[122]	14,234	976	372	3,363
West Haven	14,434	20,634	14,836	946	299	4,553
Woodbridge	3,585	2,048	1,710	254	74	10

[113] Federal Emergency Management Agency, *Local Mitigation Planning Handbook*, Washington, Federal Emergency Management Agency, 2012. Available at: http://www.fema.gov/hazard-mitigation-planning-resources

[114] Based on data provided by each municipality.

[115] Based on data from Hazus-MH 2.1.

[116] Based on data from Hazus-MH 2.1.

[117] Based on data from Hazus-MH 2.1.

[118] Based on housing unit numbers from 2010 census data.

[119] Based on housing unit numbers from 2010 census data.

[120] Based on housing unit numbers from 2010 census data.

[121] Based on housing unit numbers from 2010 census data.

[122] Based on housing unit numbers from 2010 census data.

Bethany

Vulnerable Assets—Bethany

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.25**.

Table 4.25 Vulnerable Assets by Hazard - Bethany

Hazard	Number of Parcels[123]	Number of Housing Units[124]	Critical Facilities [125]	Historic Assets[126]	Population [127]
Extreme Temperatures	0	0	0	0	783
Hurricane/Tropical Storm	2,393	3,444	13	1	5,563
Severe Thunderstorm	2,393	3,444	13	1	5,563
Severe Winter Storm/Nor'easter	2,393	3,444	13	1	5,563
Tornado	2,393	3,444	13	1	5,563
Dam Failure[128]					
High Hazard	19	814	0	Unknown	2,004
Significant Hazard	5	55	0	Unknown	149
Drought	0	0	0	0	0
Flood[129]					
1-Percent-Annual-Chance	85	1,247	0	Unknown	3,353
0.2-Percent-Annual-Chance	26	485	0	Unknown	844
Earthquake	2,393	3,444	13	1	5,563
Wildfire	2,366	3,444	13	1	5,563

[123] Based on local data provided by the Town of Bethany.

[124] Based on housing unit numbers from 2010 census data.

[125] Based on critical facilities data from Hazus-MH consisting of fire stations, police stations, and schools.

[126] Based on local data provided by the Town of Bethany.

[127] Based on population numbers from 2010 census data.

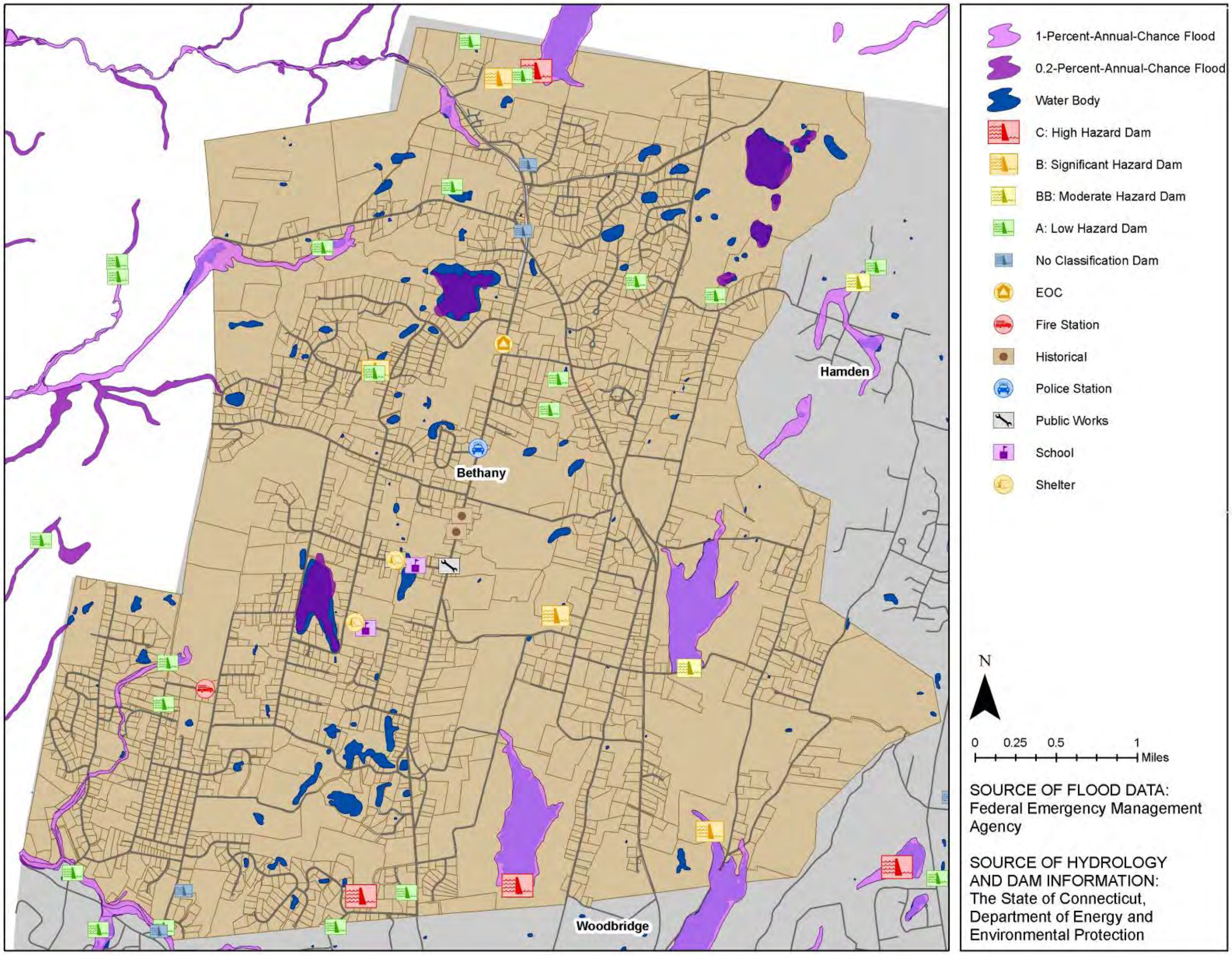
[128] Dam failure inundation mapping was available for Long Hill Reservoir Dam, Lake Bethany Dam, and Lake Chamberlain Dam. Inundation mapping was not available for 20 other dams located in the Town of Bethany.

[129] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

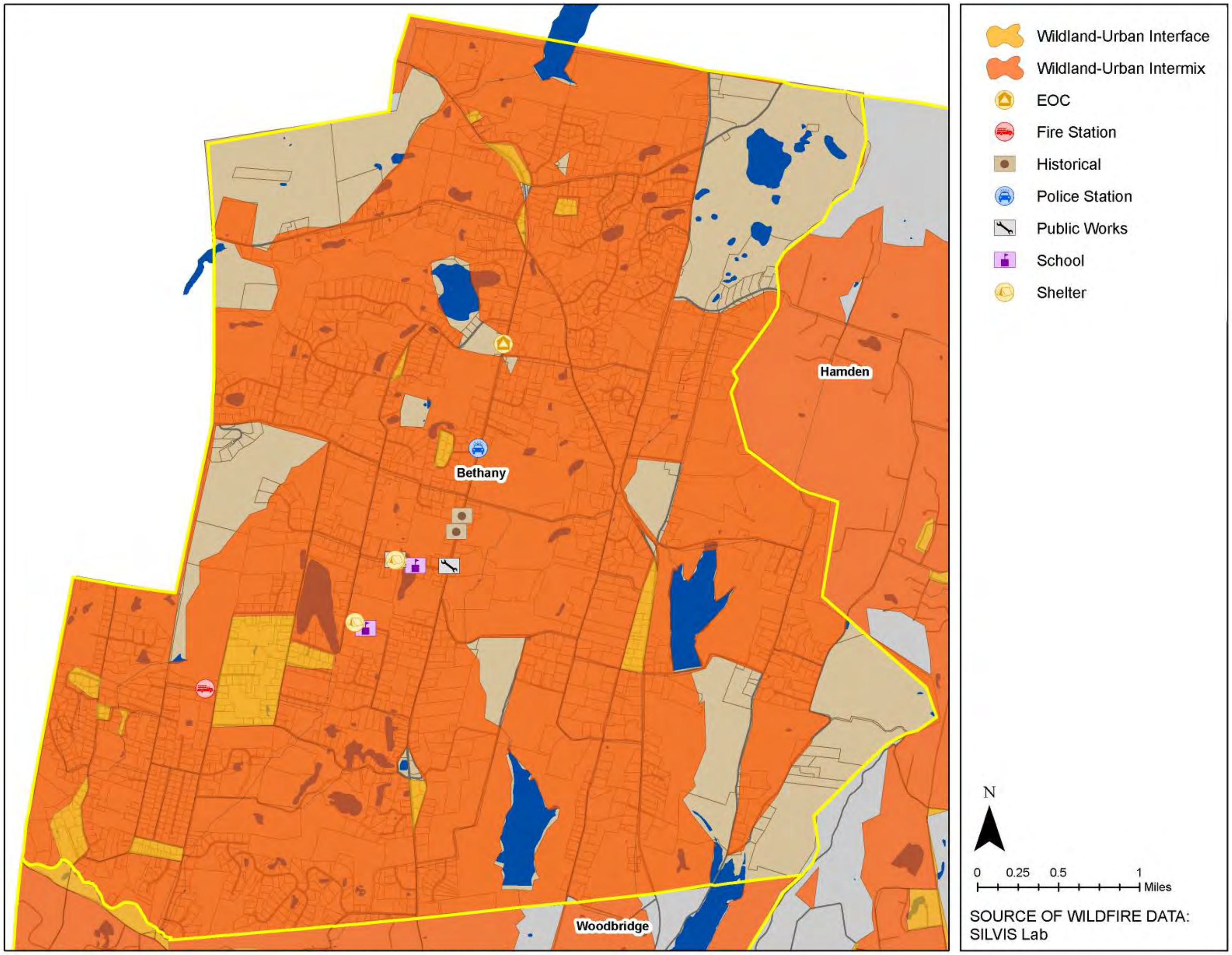
Repetitive Loss and Severe Repetitive Loss Properties

According to FEMA records, there are no identified repetitive loss or severe repetitive loss properties in Bethany. As of December 31, 2012, the Town of Bethany had a total of only 3 claims totaling $7,226 in losses for all NFIP-insured structures.

Maps 4.11 and **4.12** show flood and wildfire hazard areas within the Town of Bethany.



MAP 4.11 Flood Hazard Areas - Bethany



MAP 4.12 Wildland Hazard Areas - Bethany

Potential Impacts—Bethany

Table 4.26 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.26 Potential Impacts by Hazard - Bethany

Hazard	Value of At-Risk Parcels[130]	Value of At-Risk Critical Facilities	Value of At-Risk Historic Assets
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$453,915,000	$97,947,174	Unknown
Severe Thunderstorm	$453,915,000	$97,947,174	Unknown
Severe Winter Storm/Nor'easter	$453,915,000	$97,947,174	Unknown
Tornado	$453,915,000	$97,947,174	Unknown
Dam Failure			
High Hazard	$44,071,000	$0	Unknown
Significant Hazard	$13,022,000	$0	Unknown
Drought	$0	$0	$0
Flood[131]			
1-Percent-Annual-Chance	$214,785,000	$0	Unknown
0.2-Percent-Annual-Chance	$106,308,000	$0	Unknown
Earthquake	$453,915,000	$97,947,174	Unknown
Wildfire	$453,915,000	$97,947,174	Unknown

[130] Based on estimated exposure values from Hazus-MH (building values only).

[131] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Bethany

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.27**).

Table 4.27 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Bethany

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$830,000	$50,000	$10,000	$10,000	$900,000
Contents	$400,000	$150,000	$20,000	$60,000	$630,000
Inventory	$0	$0	$0	$0	$0
Subtotal	**$1,230,000**	**$200,000**	**$30,000**	**$70,000**	**$1,530,000**
Business Interruption					
Income	$0	$0	$0	$0	$0
Relocation	$0	$0	$0	$0	$0
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$0	$0	$0	$0
Subtotal	**$0**	**$0**	**$0**	**$0**	**$0**
TOTAL	**$1,230,000**	**$200,000**	**$30,000**	**$70,000**	**$1,530,000**

In addition, Hazus estimates 21 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 7 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.28** and **4.29**.

Table 4.28 Number of Buildings Damaged - Bethany

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	1	0	0	0	1
50-year	11	0	0	0	11
100-year	89	5	0	0	94
200-year	265	29	1	1	296
500-year	564	128	15	7	714
1,000-year	741	274	60	32	1,107

Table 4.29 Buildings-Related Economic Losses - Bethany

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$86,000	$0	$0	$0	$86,000
50-year	$553,610	$17,870	$4,130	$3,500	$579,110
100-year	$1,789,270	$107,990	$23,580	$22,750	$1,943,590
200-year	$4,478,950	$411,390	$117,130	$123,730	$5,131,200
500-year	$15,625,560	$1,471,900	$544,340	$495,150	$18,136,950
1,000-year	$39,291,860	$3,812,060	$1,472,300	$1,043,550	$45,619,770

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

<u>Annualized Loss Estimates</u>

Table 4.30 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.30 Annualized Loss Estimates by Hazard - Bethany

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$191,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$83,150
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Bethany

Table 4.31 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Bethany. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.31 Problem Statements - Bethany

Primary Hazards of Concern
• Tree-related hazards are widespread during **hurricane/tropical storm** and **severe winter storm** events, particularly downing electrical lines, and when falling and blocking roads that isolate many rural areas throughout town and pose life/safety threat due to no emergency access. Hazardous trees on Town-owned property are also a significant and costly concern.
• **Riverine flooding –** there is limited development in the floodplain however riverine flooding remains a concern, especially at crossings with roadways (undersized culverts).
• **Dam failure** – failure of the Long Hill Reservoir Dam at New Naugatuck Reservoir could affect the trailer park on northwest side of town.
• Slight concern associated with **drought** related to the large number of wells across town (no town water supply), though only a few known incidents. Owners know what to do.
• Town also has concerns related to serving as a host community for evacuees from coastal areas during major storms.
Geographic Areas of Concern
• Southwest side of town has been isolated due to downed trees across roads, particularly along Miller Road (30-40 homes became isolated during Winter Storm Alfred and Hurricane Irene). This area is also prone to flooding (noted as existing floodplain area, but also some concern with the Hopp Brook Pond Dam).
Vulnerable Community Assets
• Miller Road has suffered damage/washout in past due to flooding and blown culvert (culvert was replaced to same standard under FEMA Public Assistance – Mitigation under Section 406 deemed too costly).
• Community shelters (two schools) – are not deemed adequate, not outfitted for 24-hour/overnight accommodations (limited generator power, no kitchen facilities). Also identified as potentially at risk to roof collapse under heavy snow loads. ➢ Potential solutions/mitigation actions: • Retrofit school structures or consider possible alternatives. The hangar at old airport on Amity Road has already been proposed, and the Town is seeking grant funding through the State's Small Town Economic Assistance Program (STEAP). • Generator quick connects may be funded through other means, including FEMA grants.
• Town hall – no generator for backup power. ➢ Potential solutions/mitigation actions: Install quick connects for portable generators.
• Cellular towers that are not connected to backup generator power (communication problem in the past).
• Homebound elderly residents, including some who are oxygen-dependent, are a particularly vulnerable segment of the population when isolated and/or suffering power outages from severe winter storms and other events. ➢ Potential solutions/mitigation actions: Maintain list of special needs residents and provide oxygen and other essentials in advance of storm events.
• Laticrete is one of the Town's major employers (approximately 125 employees), along with the schools.
• 1 critical facility is within close proximity to a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact this facility.

Branford

Vulnerable Assets—Branford

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.32**.

Table 4.32 Vulnerable Assets by Hazard - Branford

Hazard	Number of Parcels[132]	Number of Buildings[133]	Critical Facilities[134]	Historic Assets[135]	Population[136]
Extreme Temperatures	0	0	0	0	5,387
Hurricane/Tropical Storm	13,207	26,414	19	969	28,026
Severe Thunderstorm	13,207	26,414	19	969	28,026
Severe Winter Storm/Nor'easter	13,207	26,414	19	969	28,026
Tornado	13,207	26,414	19	969	28,026
Coastal Erosion[137]	Unknown	Unknown	Unknown	Unknown	Unknown
Dam Failure[138]					
High Hazard	2,895	4,496	8	290	14,435
Significant Hazard	0	0	0	0	0
Drought	0	0	0	0	0
Flood[139]					
1-Percent-Annual-Chance	2,564	2,986	3	321	15,190
0.2-Percent-Annual-Chance	261	51	0	15	7,099

[132] Based on data provided by the Town of Branford.

[133] Based on data provided by the Town of Branford.

[134] Based on data provided by the Town of Branford.

[135] Based on data provided by the Town of Branford.

[136] Based on population numbers from 2010 census data.

[137] Data does not currently exist to determine vulnerable assets to the coastal erosion hazard.

[138] Dam failure inundation mapping was available for Lake Gaillard Dam and Lake Saltonstall Dam. Inundation mapping was not available for nine other dams located within the Town of Branford.

[139] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Number of Parcels[132]	Number of Buildings[133]	Critical Facilities[134]	Historic Assets[135]	Population[136]
Zone VE	968	467	0	160	2,535
Category 1 Storm Surge	1,815	1,140	1	274	10,256
Category 2 Storm Surge	2,481	2,350	2	356	12,377
Category 3 Storm Surge	2,494	2,450	5	415	14,613
Category 4 Storm Surge	2,704	2,498	3	406	18,211
Sea Level Rise	2,194	1,299	2	282	11,898
Earthquake	13,207	26,414	19	969	28,026
Wildfire	8,506	17,269	13	388	23,892

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Branford also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.33**).[140]

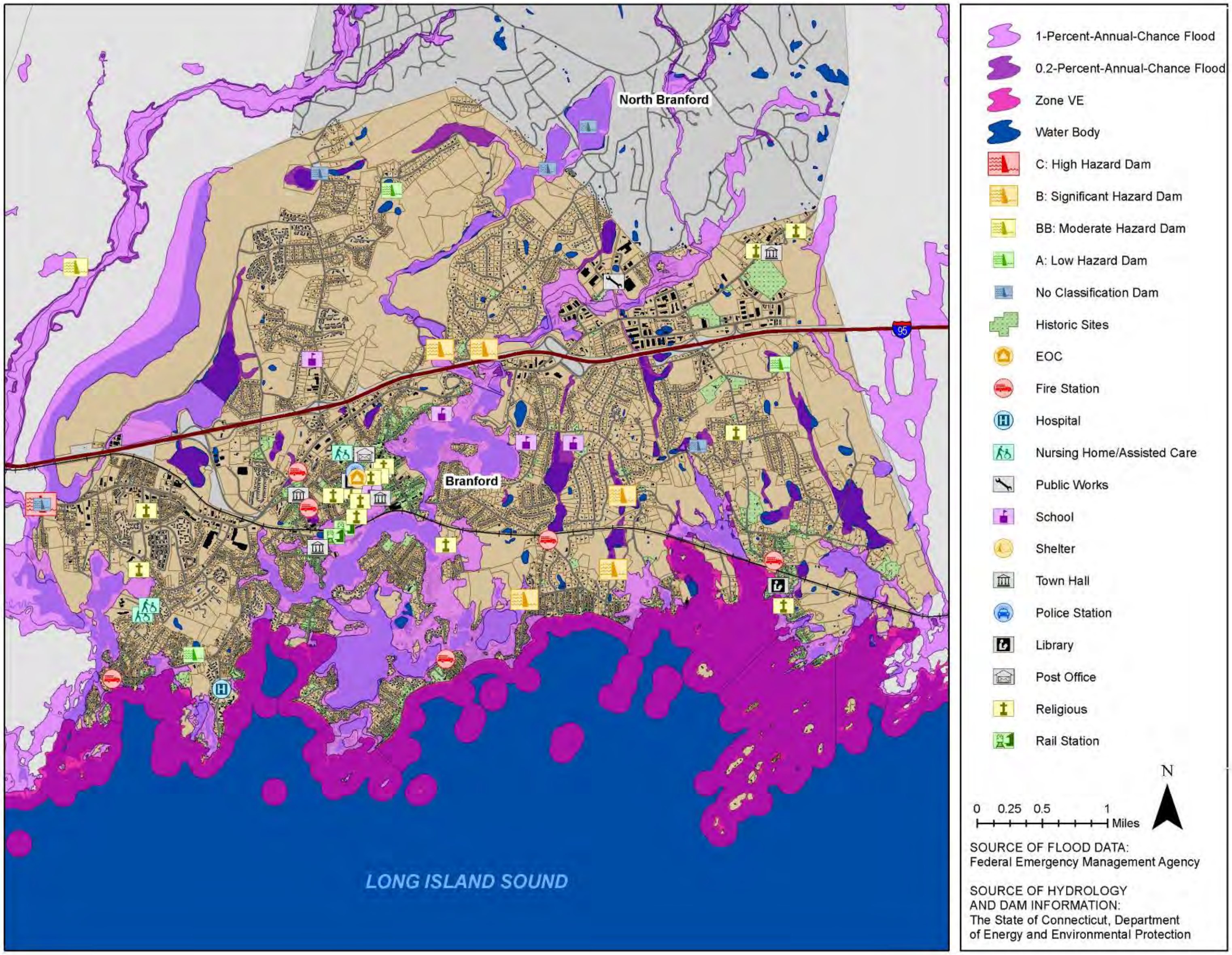
Table 4.33 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Branford

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	59	18	$854,922	$195,358	$1,050,280
Severe Repetitive Loss	10	1	$44,950	$0	$44,950

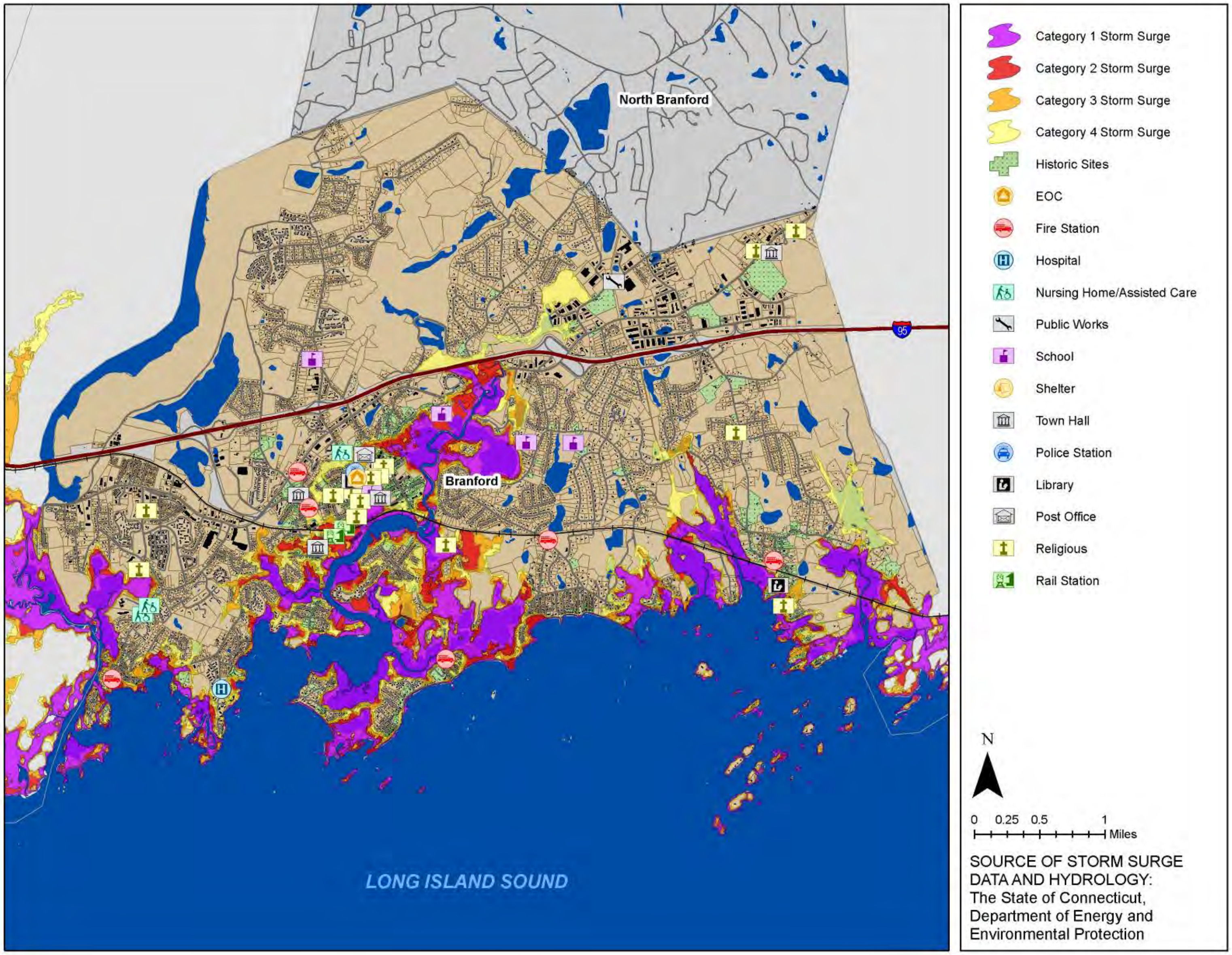
As of December 31, 2012, the Town of Branford had a total of 726 claims totaling $8,210,900 in losses for all NFIP-insured structures.

Maps 4.13 through **4.16** show flood, storm surge, sea level rise, and wildfire hazard areas within the Town of Branford.

[140] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.

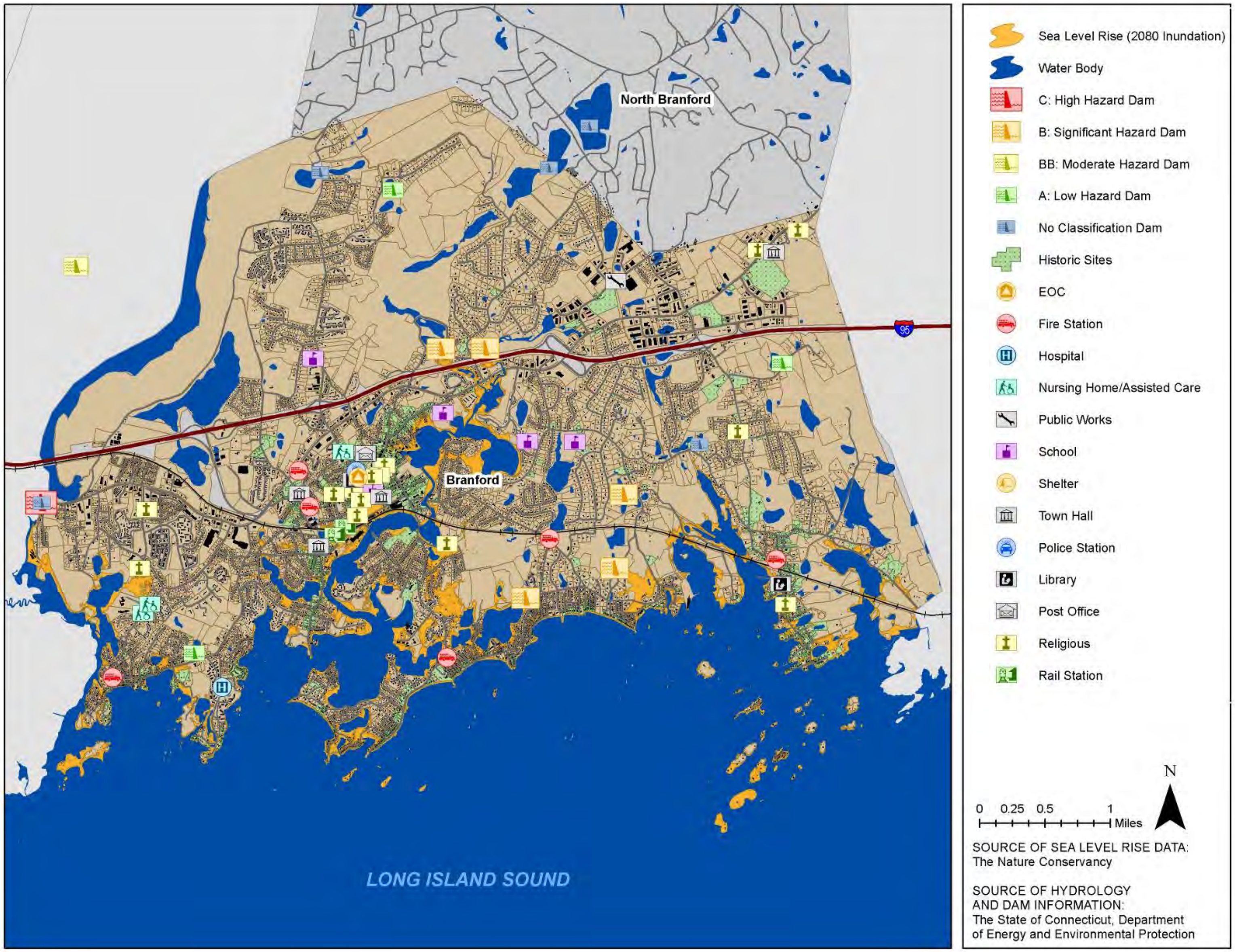


MAP 4.13 Flood Hazard Areas - Branford

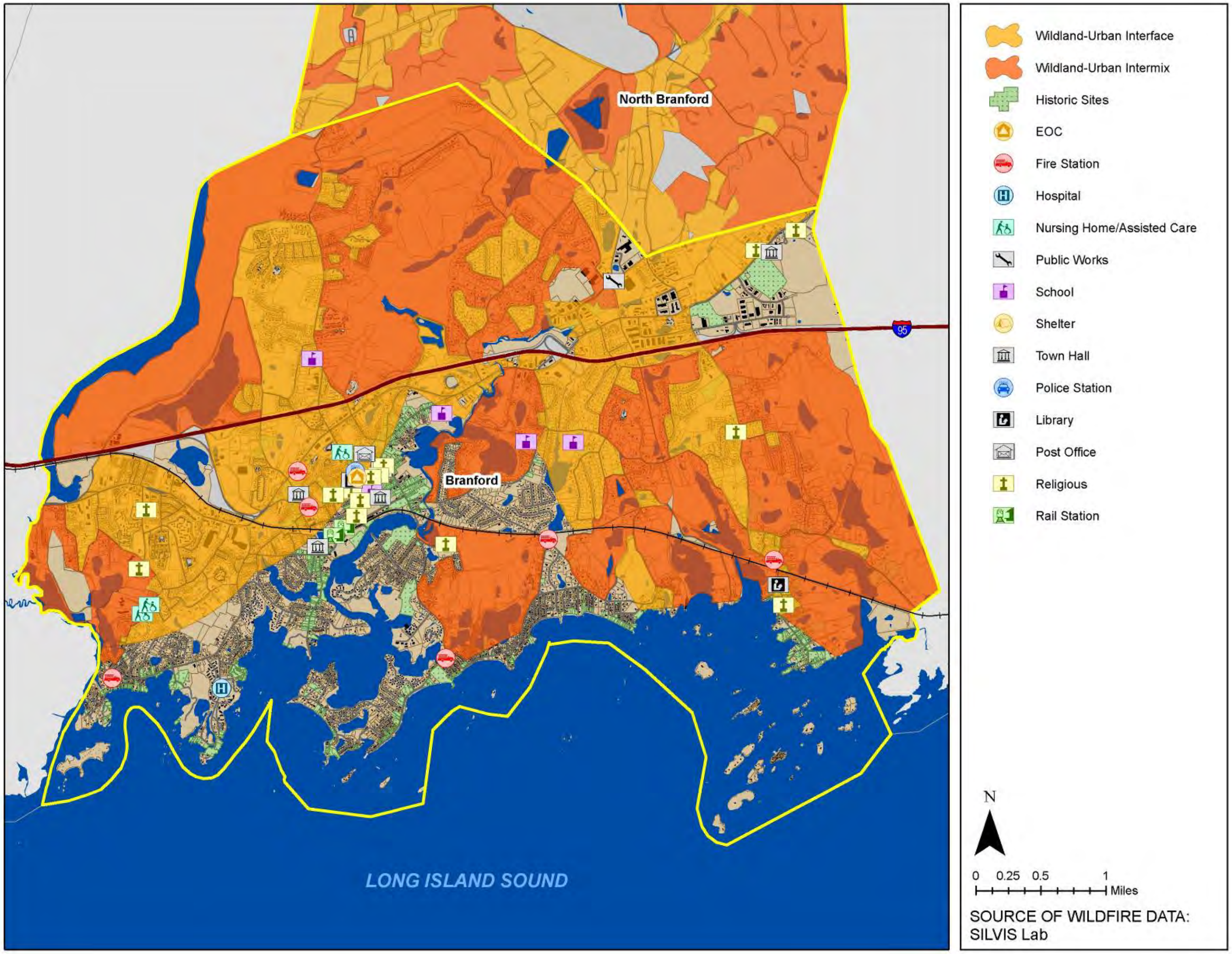


MAP 4.14 Storm Surge Hazard Areas - Branford

2014



MAP 4.15 Sea Level Rise Hazard Areas - Branford



MAP 4.16 Wildland Hazard Areas - Branford

Potential Impacts—Branford

Table 4.34 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.34 Potential Impacts by Hazard - Branford

Hazard	Value of At-Risk Parcels[141]	Value of At-Risk Critical Facilities[142]	Value of At-Risk Historic Assets[143]
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$2,685,402,155	$120,889,700	$514,292,800
Severe Thunderstorm	$2,685,402,155	$120,889,700	$514,292,800
Severe Winter Storm/Nor'easter	$2,685,402,155	$120,889,700	$514,292,800
Tornado	$2,685,402,155	$120,889,700	$514,292,800
Coastal Erosion[144]	Unknown	Unknown	Unknown
Dam Failure			
High Hazard	$646,766,075	$45,098,600	$182,328,490
Significant Hazard	$0	$0	$0
Drought	$0	$0	$0
Flood[145]			
1-Percent-Annual-Chance	$561,384,070	$2,654,200	$205,192,120
0.2-Percent-Annual-Chance	$79,526,060	$0	$10,696,270
Zone VE	$175,080,250	$0	$100,284,320
Category 1 Storm Surge	$407,981,155	$135,200	$199,690,750
Category 2 Storm Surge	$564,628,075	$2,519,000	$244,634,380
Category 3 Storm Surge	$615,384,770	$5,432,700	$261,232,425
Category 4 Storm Surge	$682,662,340	$23,504,300	$275,649,380

[141] Based on data provided by the Town of Branford.

[142] Based on data provided by the Town of Branford.

[143] Based on data provided by the Town of Branford.

[144] Data does not currently exist to determine potential impacts from the coastal erosion hazard.

[145] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Value of At-Risk Parcels[141]	Value of At-Risk Critical Facilities[142]	Value of At-Risk Historic Assets[143]
Sea Level Rise	$441,271,525	$135,200	$214,493,120
Earthquake	$2,685,402,155	$120,889,700	$514,292,800
Wildfire	$1,744,091,540	$52,541,000	$215,614,750

Loss Estimates—Branford

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.35**).

Table 4.35 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Branford

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$46,430,000	$10,660,000	$4,030,000	$1,340,000	$62,460,000
Contents	$29,770,000	$28,110,000	$7,940,000	$7,890,000	$73,710,000
Inventory	$0	$440,000	$1,450,000	$90,000	$1,980,000
Subtotal	**$76,200,000**	**$39,210,000**	**$13,420,000**	**$9,320,000**	**$138,150,000**
Business Interruption					
Income	$0	$150,000	$0	$10,000	$160,000
Relocation	$70,000	$30,000	$0	$0	$100,000
Rental Income	$30,000	$10,000	$0	$0	$40,000
Wage	$10,000	$130,000	$0	$70,000	$200,000
Subtotal	**$110,000**	**$320,000**	**$0**	**$80,000**	**$500,000**
TOTAL	**$76,310,000**	**$39,530,000**	**$13,420,000**	**$9,410,000**	**$138,650,000**

In addition, the Hazus-MH model estimates 1,324 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 3,295 people will seek temporary shelter in public shelters.

Coastal Flood

Estimated building losses for the coastal flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.36**).

Table 4.36 Coastal Flood Loss Estimates (100-year Event) - Branford

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$6,840,000	$720,000	$90,000	$20,000	$7,670,000
Contents	$4,250,000	$1,760,000	$210,000	$160,000	$6,380,000
Inventory	$0	$20,000	$10,000	$0	$30,000
Subtotal	**$11,090,000**	**$2,500,000**	**$310,000**	**$180,000**	**$14,080,000**
Business Interruption					
Income	$0	$10,000	$0	$0	$10,000
Relocation	$10,000	$0	$0	$0	$10,000
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$10,000	$0	$0	$10,000
Subtotal	**$10,000**	**$20,000**	**$0**	**$0**	**$30,000**
TOTAL	**$11,100,000**	**$2,520,000**	**$310,000**	**$180,000**	**$14,110,000**

In addition, the Hazus-MH model estimates 136 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 192 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.37** and **4.38**.

Table 4.37 Number of Buildings Damaged - Branford

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	14	1	0	0	15
50-year	292	27	1	0	320
100-year	1,252	187	8	3	1,450
200-year	2,746	704	59	29	3,538
500-year	4,125	1,924	390	221	6,660
1,000-year	4,207	2,949	1,000	622	8,778

Table 4.38 Building-Related Economic Losses - Branford

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$764,860	$54,770	$18,390	$6,740	$844,760
50-year	$10,250,950	$486,990	$113,250	$51,550	$10,902,740
100-year	$30,135,430	$2,735,800	$905,000	$453,420	$34,229,650
200-year	$83,693,110	$11,651,510	$4,993,450	$1,863,840	$102,201,910
500-year	$269,725,490	$42,195,060	$17,468,280	$5,816,860	$335,205,690
1,000-year	$554,913,270	$107,536,680	$39,730,270	$12,870,080	$715,050,300

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annalized Loss Estimates

Table 4.39 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.39 Annualized Loss Estimates by Hazard - Branford

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$2,914,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Coastal Erosion[146]	Unknown
Dam Failure	Negligible
Drought	Negligible
Flood (Riverine)	$1,525,180
Flood (Coastal)	$4,515,440
Sea Level Rise	N/A
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Branford

Table 4.40 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Branford. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

[146] Data does not currently exist to determine annualized losses for the coastal erosion hazard.

Table 4.40 Problem Statements - Branford

Primary Hazards of Concern
• Tree-related hazards are among the Town's most significant recurring and widespread issues, particularly the downing of electric and communication lines during **hurricane/tropical storm** and **severe winter storm** events. ➢ Potential solutions/mitigation actions: • Coordinate with local businesses to acquire backup generators so they can stay open following hazard events. • Prioritize areas for power restoration through the development of microgrid distributed energy generation. • Conduct survey and develop inventory of hazard trees, and prepare long-term maintenance plan for trees owned by the Town.
• **Coastal flooding** (storm-related and often resulting from high tides), **coastal erosion** and **sea level rise**.
• **Coastal and inland flooding of roadways** in low-lying areas throughout town, resulting in potential isolation of numerous properties (further described below).
• **Dam failure** in North Branford – failure of the Lake Gaillard Dam would cause severe downstream flooding in Branford.
• Moderate concerns with **wildfire** due to the large amount of open space and potential for ignitions to occur along railways.
Geographic Areas of Concern
• Drainage in some low-lying areas is deemed very inadequate, resulting in some frequent but temporary roadway flooding. Access to these low-lying areas which become isolated following flood events remains a significant concern for the Town. • Primary areas of concern include Hickory Road, Burban Drive, Tabor Drive, Beckett Avenue, Meadow Street, Sunset Beach, Riverside Drive, Summer Island Road, Waverly Park Area, Thimble Island Road, Shore Drive (Route 142), Limewood Avenue (146), Island View Avenue, Club Parkway, School Ground Road. ➢ Potential solutions/mitigation actions: • Elevating roadways. • Stormwater drainage improvements (upgrades underway for Hickory Road). • Flood gates (Beckett Avenue).
• Linden Avenue is an area of significant concern for coastal flooding and coastal erosion. Existing revetment has been damaged and repaired multiple times. Separate taxing district was created to assist with erosion control.
• 100 homes located on offshore islands (mostly second "summer" homes).
Vulnerable Community Assets
• Water treatment plant is located in an area that becomes isolated following flood events (but facility is protected to BFE for 1 percent annual chance event).
• Numerous pump stations do not have backup generators (estimated that 25 out of 50 stations are below BFE and considered vulnerable to flooding).
• Shelters – many are located in potential storm surge inundation areas.
• The Connecticut Hospice (100 Double Beach Road) – located in coastal flood hazard area. Large windows with no storm shutters. No backup generator power available. Evacuation plan in place but wasn't executed during recent event due to communications failure.

• Many cellular towers lack backup generator power, which is deemed a critical life/safety threat for people without landlines (no way to call 911).
• Large concentration of businesses located along Commercial Street and Route 139 in north side of town are deemed potentially vulnerable to flooding of nearby Branford River.
• 1 fire station is located in the 1-percent-annual-chance floodplain.

Hamden

Vulnerable Assets—Hamden

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.41**.

Table 4.41 Vulnerable Assets by Hazard - Hamden

Hazard	Number of Parcels[147]	Number of Buildings [148]	Critical Facilities [149]	Historic Assets[150]	Population [151]
Extreme Temperatures	0	0	0	N/A	9,171
Hurricane/Tropical Storm	16,742	26,607	32	N/A	60,960
Severe Thunderstorm	16,742	26,607	32	N/A	60,960
Severe Winter Storm/Nor'easter	16,742	26,607	32	N/A	60,960
Tornado	16,742	26,607	32	N/A	60,960
Dam Failure[152]					
High Hazard	16	16	0	N/A	435
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[153]					
1-Percent-Annual-Chance	959	532	3	N/A	23,955
0.2-Percent-Annual-Chance	617	353	0	N/A	17,677
Category 1 Storm Surge	33	15	0	N/A	751

[147] Based on data provided by the Town of Hamden.

[148] Based on data provided by the Town of Hamden.

[149] Based on a combination of data provided by the Town of Hamden and Hazus-MH.

[150] Data for historic assets was not available at the time of this analysis.

[151] Based on population numbers from 2010 census data.

[152] Dam failure inundation mapping was available for Whitney Lake Dam. Inundation mapping was not available for 23 other dams located in the Town of Hamden.

[153] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Number of Parcels[147]	Number of Buildings [148]	Critical Facilities [149]	Historic Assets[150]	Population [151]
Category 2 Storm Surge	121	115	0	N/A	1,771
Category 3 Storm Surge	244	235	0	N/A	3,362
Category 4 Storm Surge	236	216	0	N/A	3,858
Sea Level Rise	91	57	0	N/A	1,236
Earthquake	16,742	26,607	32	N/A	60,960
Wildfire	10,941	16,668	19	N/A	46,651

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Hamden also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.42**).[154]

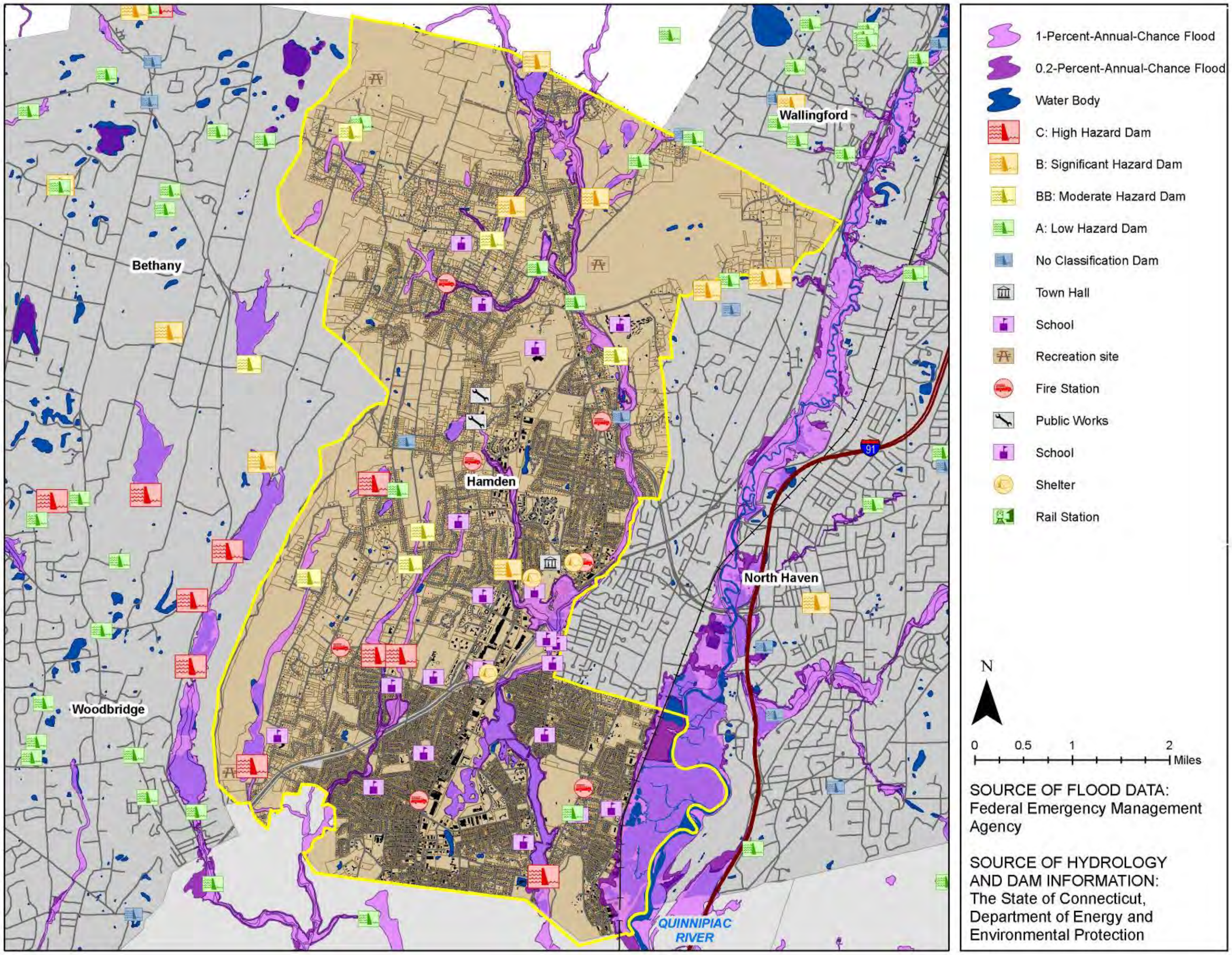
Table 4.42 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Hamden

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	162	50	$1,538,194	$726,884	$2,265,078
Severe Repetitive Loss	38	2	$937,732	$52,462	$990,194

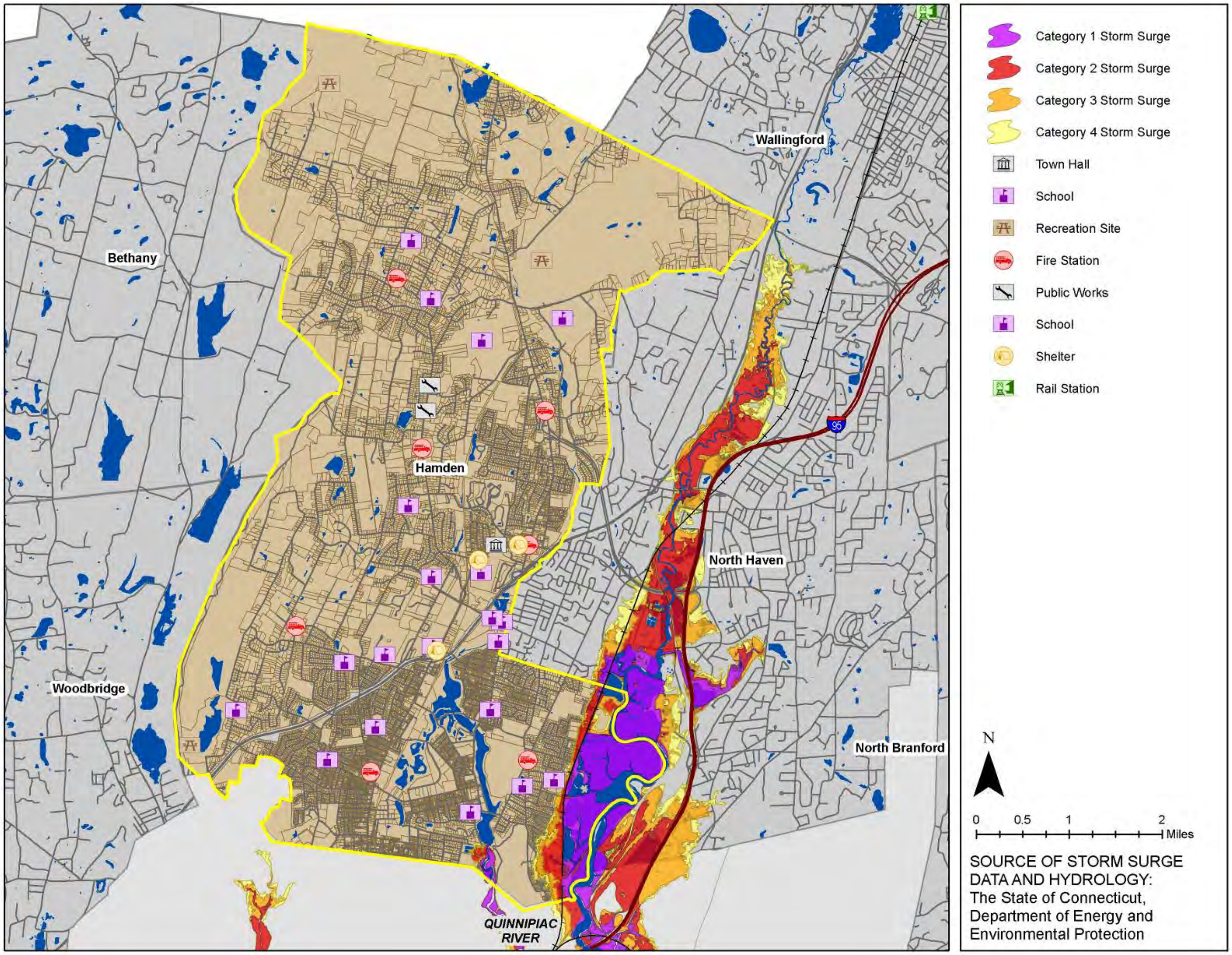
As of December 31, 2012, the Town of Hamden had a total of 536 claims totaling $3,331,391 in losses for all NFIP-insured structures.

Maps 4.17 through **4.20** show flood, storm surge, sea level rise, and wildfire hazard areas within the Town of Hamden.

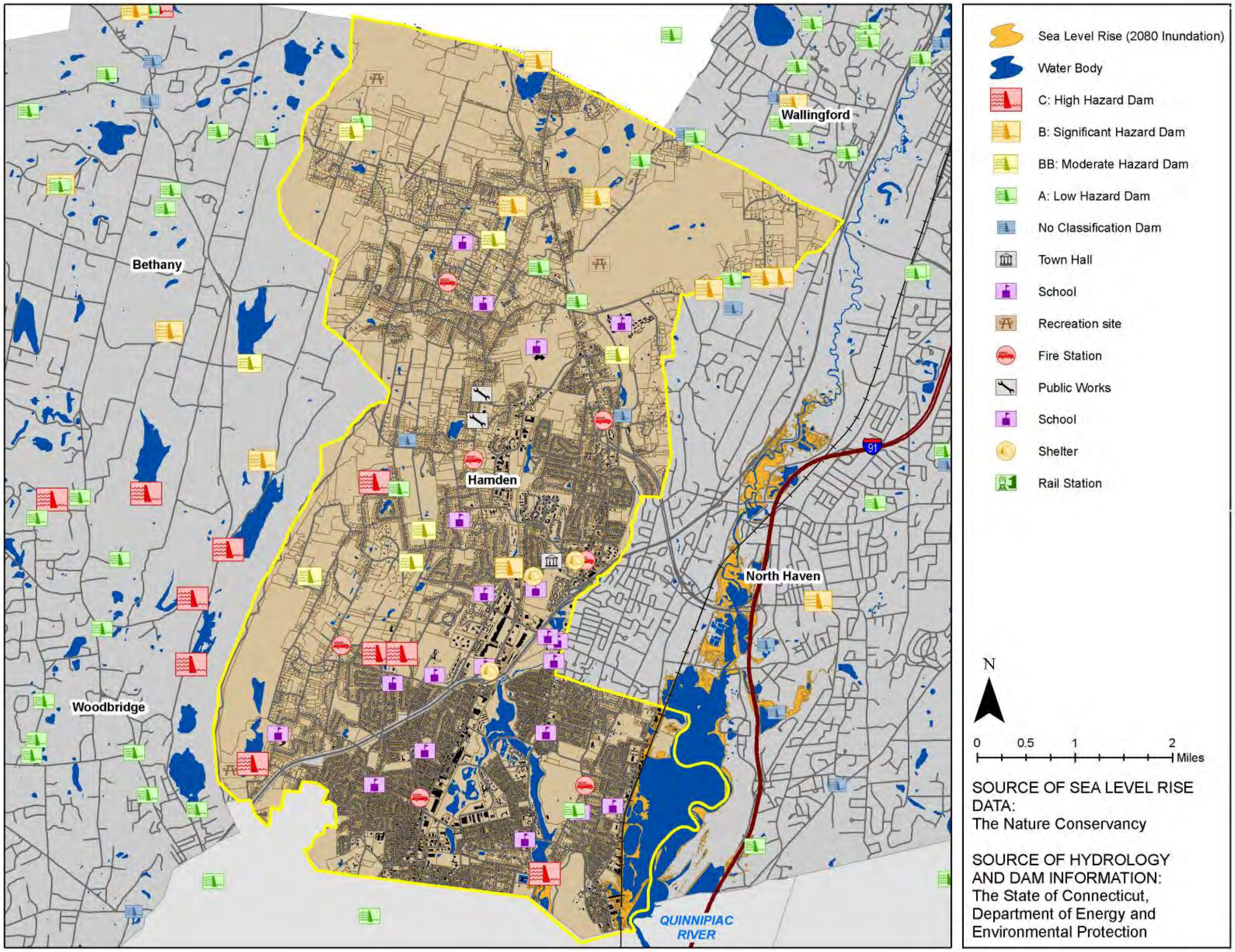
[154] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



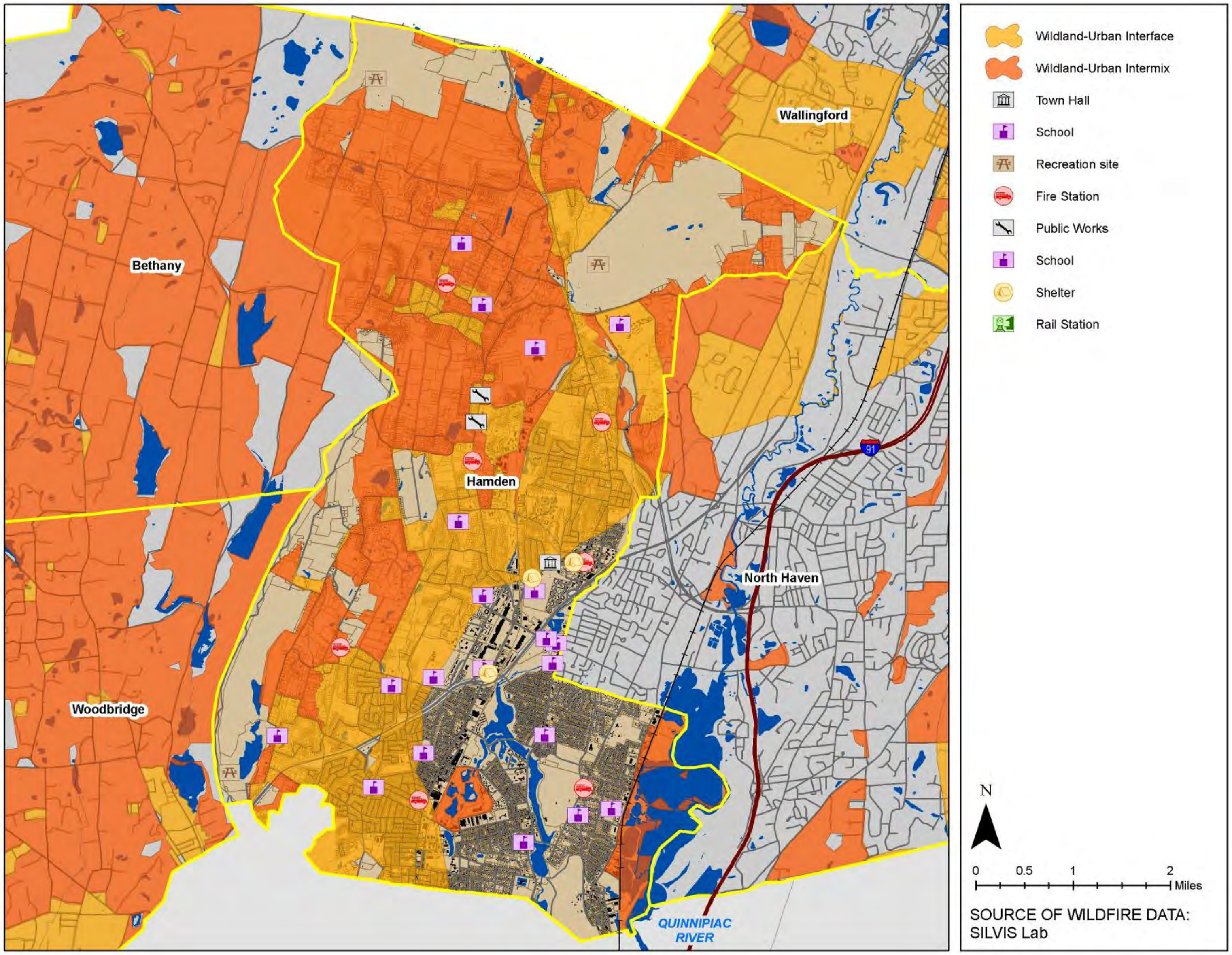
MAP 4.17 Flood Hazard Areas - Hamden



MAP 4.18 Storm Surge Hazard Areas - Hamden



MAP 4.19 Sea Level Rise Hazard Areas - Hamden



MAP 4.20 Wildfire Hazard Areas - Hamden

Potential Impacts—Hamden

Table 4.43 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.43 Potential Impacts by Hazard - Hamden

Hazard	Value of At-Risk Parcels[155]	Value of At-Risk Critical Facilities	Value of At-Risk Historic Assets
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$5,609,313,000	Unknown	Unknown
Severe Thunderstorm	$5,609,313,000	Unknown	Unknown
Severe Winter Storm/Nor'easter	$5,609,313,000	Unknown	Unknown
Tornado	$5,609,313,000	Unknown	Unknown
Dam Failure			
High Hazard	$114,915,000	Unknown	Unknown
Significant Hazard	$0	Unknown	Unknown
Drought	$0	$0	$0
Flood[156]			
1-Percent-Annual-Chance	$3,003,609,000	Unknown	Unknown
0.2-Percent-Annual-Chance	$2,099,807,000	$0	Unknown
Category 1 Storm Surge	$289,393,000	$0	Unknown
Category 2 Storm Surge	$462,223,000	$0	Unknown
Category 3 Storm Surge	$501,777,000	$0	Unknown
Category 4 Storm Surge	$547,341,000	$0	Unknown
Sea Level Rise	$268,984,000	$0	Unknown
Earthquake	$5,609,313,000	Unknown	Unknown
Wildfire	$3,892,285,000	Unknown	Unknown

[155] Based on estimated exposure values from Hazus-MH (building values only).

[156] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Hamden

Detailed Hazus-MH Loss Estimates

Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.44**).

Table 4.44 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Hamden

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$22,180,000	$7,950,000	$1,080,000	$4,930,000	$36,130,000
Contents	$14,450,000	$20,250,000	$2,950,000	$26,270,000	$63,910,000
Inventory	$0	$720,000	$2,020,000	$20,000	$2,760,000
Subtotal	**$36,630,000**	**$28,920,000**	**$6,050,000**	**$31,220,000**	**$102,800,000**
Business Interruption					
Income	$0	$120,000	$10,000	$10,000	$140,000
Relocation	$20,000	$40,000	$10,000	$0	$60,000
Rental Income	$10,000	$20,000	$0	$0	$30,000
Wage	$10,000	$200,000	$10,000	$90,000	$300,000
Subtotal	**$40,000**	**$380,000**	**$30,000**	**$100,000**	**$530,000**
TOTAL	**$36,670,000**	**$29,300,000**	**$6,080,000**	**$31,320,000**	**$103,330,000**

In addition, the Hazus-MH model estimates 693 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1,467 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.45** and **4.46**.

Table 4.45 Number of Buildings Damaged - Hamden

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	17	1	0	0	18
50-year	234	19	1	0	254
100-year	1,289	177	5	1	1,472
200-year	3,057	694	36	19	3,806
500-year	5,230	2,199	301	165	7,895
1,000-year	5,827	3,654	879	508	10,868

Table 4.46 Building-Related Economic Losses - Hamden

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$529,690	$0	$0	$0	$529,690
50-year	$12,063,540	$225,500	$14,410	$198,480	$12,501,930
100-year	$39,271,380	$2,351,920	$183,600	$1,579,380	$43,386,280
200-year	$103,094,250	$8,634,550	$1,007,160	$6,795,490	$119,531,450
500-year	$352,618,530	$32,024,940	$4,889,820	$32,540,960	$422,074,250
1,000-year	$771,717,370	$86,160,890	$11,243,330	$80,375,980	$949,497,570

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annalized Loss Estimates

Table 4.47 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.47 Annualized Loss Estimates by Hazard - Hamden

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$3,873,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$4,017,080
Sea Level Rise	N/A
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Hamden

Table 4.48 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Hamden. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.48 Problem Statements - Hamden

Primary Hazards of Concern
• Tree-related hazards are a recurring issue for the area of town, which is densely forested. Downed trees and power lines during **hurricane/tropical storm** and **severe winter storm** events cause widespread issues for the town due to impacts to transportation and communication infrastructure. ➢ Potential solutions/mitigation actions: • Tree pruning, which is routinely being done through the United Illuminating Company's tree service contractor. • Underground utility lines for central business district and densely developed commercial corridors.
• **Riverine flooding** – large number of rivers, streams and wetlands across town that cause varying degrees of flooding concerns – mostly associated with roadway flooding. Very little new development in floodplain areas per regulations. ➢ Potential solutions/mitigation actions: • Update FEMA Flood Study to more accurately reflect actual flooding conditions. • Raise Paradise Avenue.
• **Urban flooding** – lots of areas subject to stormwater flooding, including along many older watercourses that were filled in over time. ➢ Potential solutions/mitigation actions: perform engineering studies of problem areas and implement recommended solutions.

Geographic Areas of Concern
• Many of the cul-de-sacs across town are in heavily forested areas that are susceptible to being isolated due to downed trees during high wind events, posing life-safety threats due to no emergency access.
• Meadowbrook Park and low-lying areas along Worth Avenue and Centerbrook Road have repeatedly experienced past flooding issues. The Town maintains a flood control system (diversion/dikes) and pump stations to alleviate flooding issues and to protect Meadowbrook Co-op housing (pre-FIRM structures). ➢ Potential solutions/mitigation actions: routinely clearing diversion channel.
• Floodplain area south of Woodin Street experiences occasional flooding, especially along Thorpe Drive. ➢ Potential solutions/mitigation actions: routinely clearing stream channel.
• Culvert pipes between School Street and Austen Road have caused repetitive flooding problems. ➢ Potential solutions/mitigation actions: • Clearing diversion channel. • Extend box culvert from south of School Street to Austen Road.
• Most wildfires occur in Sleeping Giant State Park, which provides some difficulties related to access for fire suppression equipment but does not threaten any structures. Other heavily forested areas in the West and North parts of town are susceptible, including Naugatuck State Forest, Brooksvale Recreation Park and SCCRWA watershed lands which are similarly undeveloped.
• State Street area (mostly industrial) deemed most at risk to the flooding impacts associated with sea level rise.

Vulnerable Community Assets
• Farmington Canal Heritage Trail – water follows the old canal bed because it's not filled in, and spreads sideways along channel due to backflow. ➢ Potential solutions/mitigation actions: address hydraulic effects of former canal in updated FEMA Flood Study and when replacing bridges and culverts.
• Large number of bridges throughout town crossing waterways (66 that are owned/maintained by Town).
• Cellular towers that aren't connected to backup generator power (AT&T brought in generators during recent events).
• Town buildings are potentially at risk due to heavy snow loads, especially older buildings and those with flat roofs. Needs further study to determine vulnerability, standards for when snow removal is required, and/or where to require more roof pitching.
• Hamden Mart shopping center potentially at risk to flooding – has been evacuated in the past.
• Quinnipiac University is a significant local asset to the community but not particularly at risk (has served as community shelter).
• The emergency back-up generator at the Public Works Garage is old and does not function. ➢ Potential solutions/mitigation actions: replace the emergency back-up generator.
• 13 critical facilities are within close proximity to either a high hazard or a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact any or all of these facilities.

Madison

Vulnerable Assets—Madison

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.49**.

Table 4.49 Vulnerable Assets by Hazard - Madison

Hazard	Number of Parcels[157]	Number of Housing Units[158]	Critical Facilities [159]	Historic Assets[160]	Population [161]
Extreme Temperatures	0	0	0	N/A	3,318
Hurricane/Tropical Storm	7,692	8,049	21	N/A	18,269
Severe Thunderstorm	7,692	8,049	21	N/A	18,269
Severe Winter Storm/Nor'easter	7,692	8,049	21	N/A	18,269
Tornado	7,692	8,049	21	N/A	18,269
Coastal Erosion[162]	Unknown	Unknown	Unknown	N/A	Unknown
Dam Failure[163]					
High Hazard	239	1,208	0	N/A	2,932
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	N/A	0
Flood[164]					
1-Percent-Annual-Chance	1,767	6,391	0	N/A	14,439

[157] Based on data provided by the Town of Madison.

[158] Based on housing unit numbers from 2010 census data.

[159] Based on a combination of data from Hazus-MH and SCRCOG.

[160] Data for historic assets was not available at the time of this analysis.

[161] Based on population numbers from 2010 census data.

[162] Data does not currently exist to determine vulnerable assets to the coastal erosion hazard.

[163] Dam failure inundation mapping was only available for Hammonasset Dam. Inundation mapping was not available for 18 other dams located in the Town of Madison.

[164] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Number of Parcels[157]	Number of Housing Units[158]	Critical Facilities [159]	Historic Assets[160]	Population [161]
0.2-Percent-Annual-Chance	905	4,970	0	N/A	10,520
Zone VE	423	1,116	0	N/A	1,478
Category 1 Storm Surge	761	1,741	0	N/A	2,681
Category 2 Storm Surge	1,022	3,033	0	N/A	5,114
Category 3 Storm Surge	1,150	3,220	0	N/A	5,470
Category 4 Storm Surge	1,114	3,402	1	N/A	5,751
Sea Level Rise	968	2,830	0	N/A	5,391
Earthquake	7,692	8,049	21	N/A	18,269
Wildfire	7,357	8,049	18	N/A	18,269

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Madison also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.50**).[165]

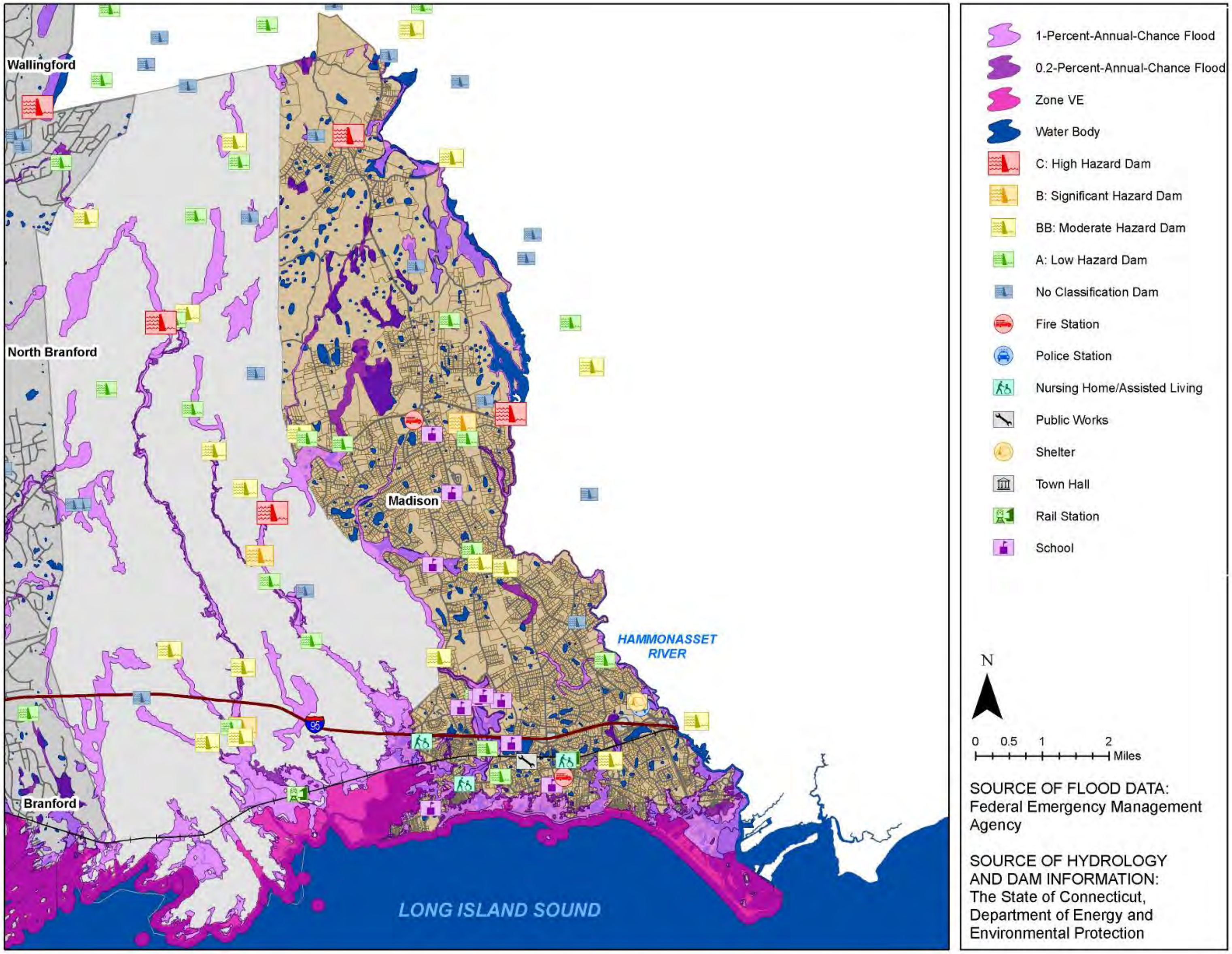
Table 4.50 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Madison

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	81	25	$2,289,967	$269,049	$2,559,016
Severe Repetitive Loss	12	3	$767,465	$130,179	$897,644

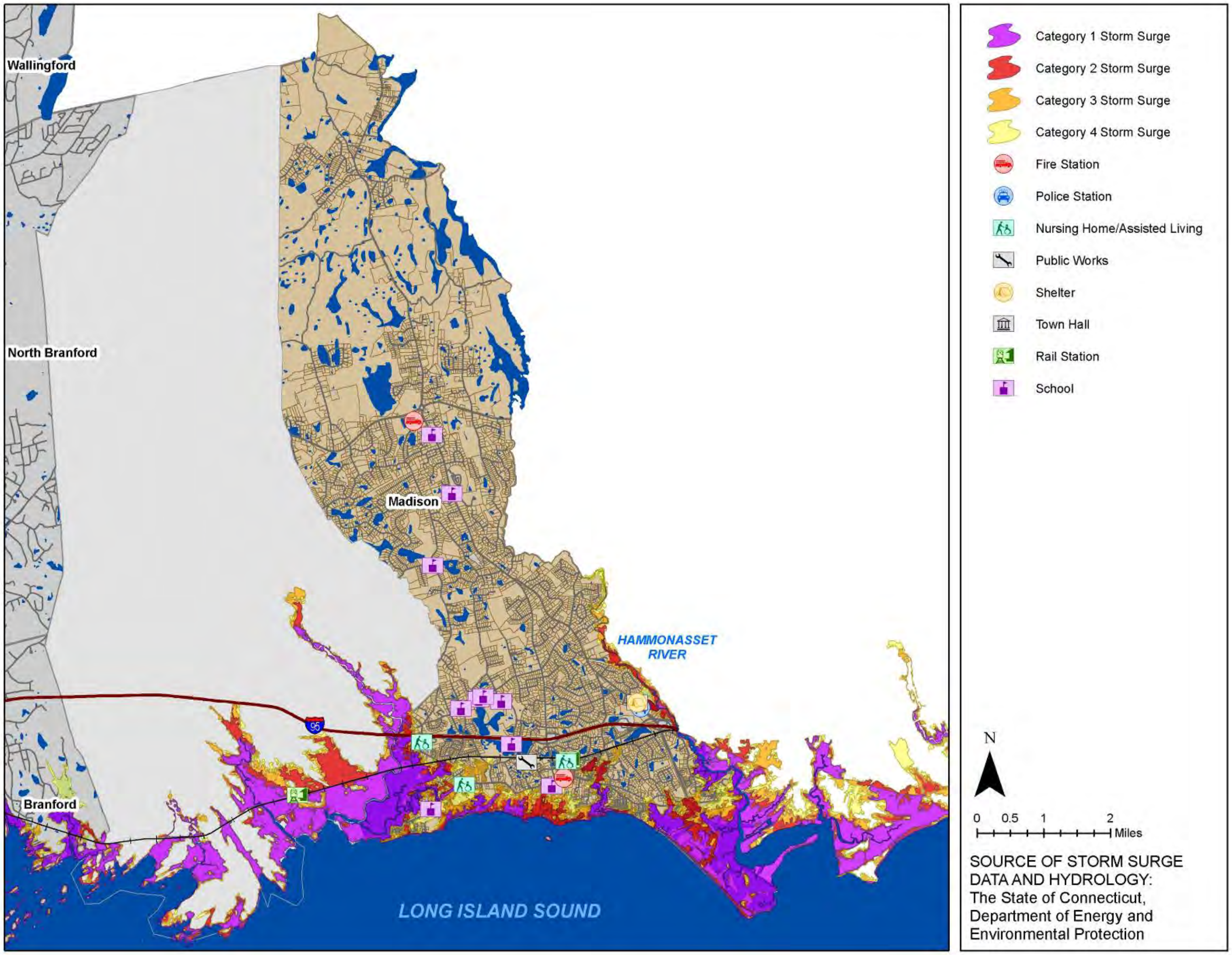
As of December 31, 2012, the Town of Madison had a total of 573 claims totaling $8,689,427 in losses for all NFIP-insured structures.

Maps 4.21 through **4.24** show flood, storm surge, sea level rise, and wildfire hazard areas within the Town of Madison.

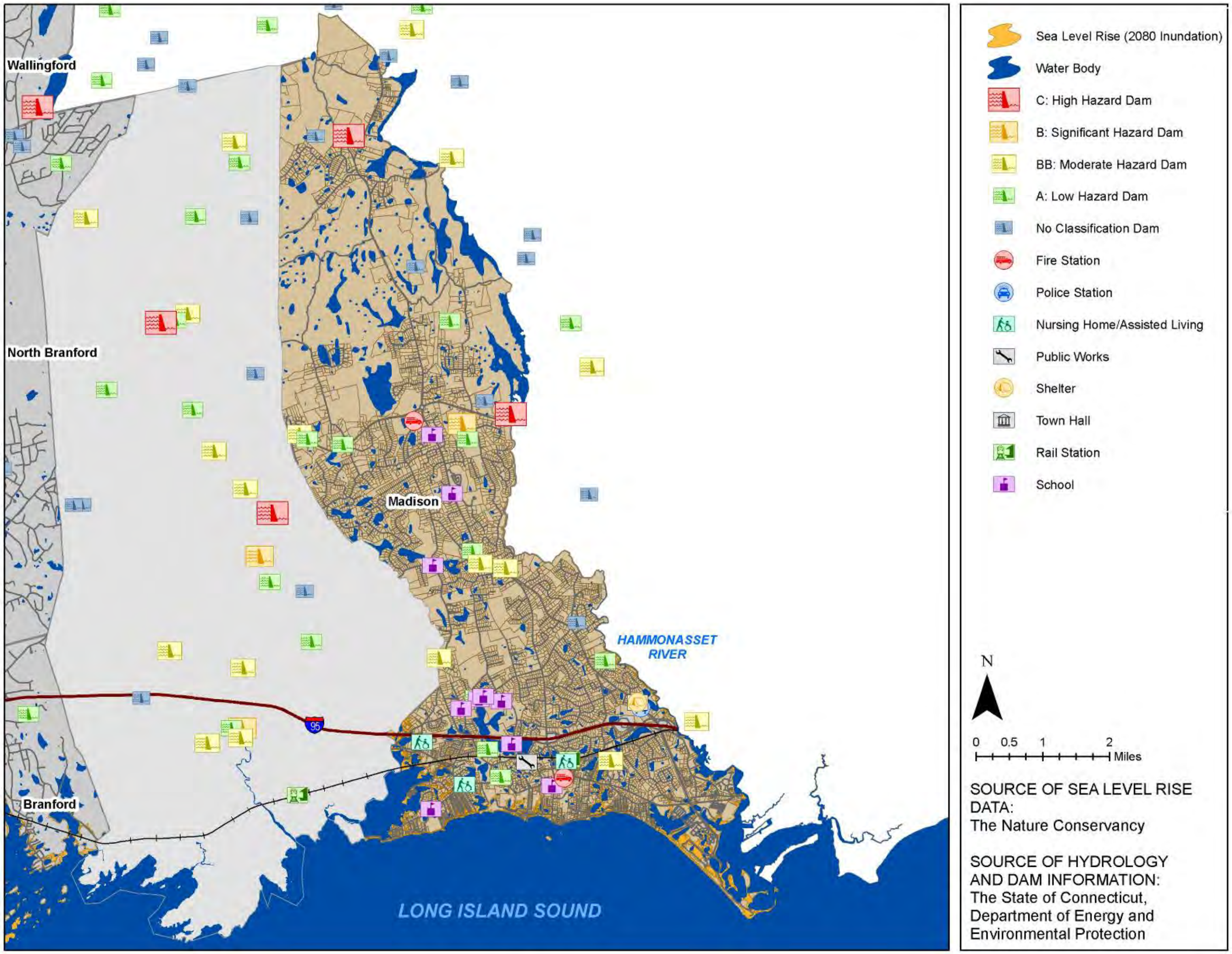
[165] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



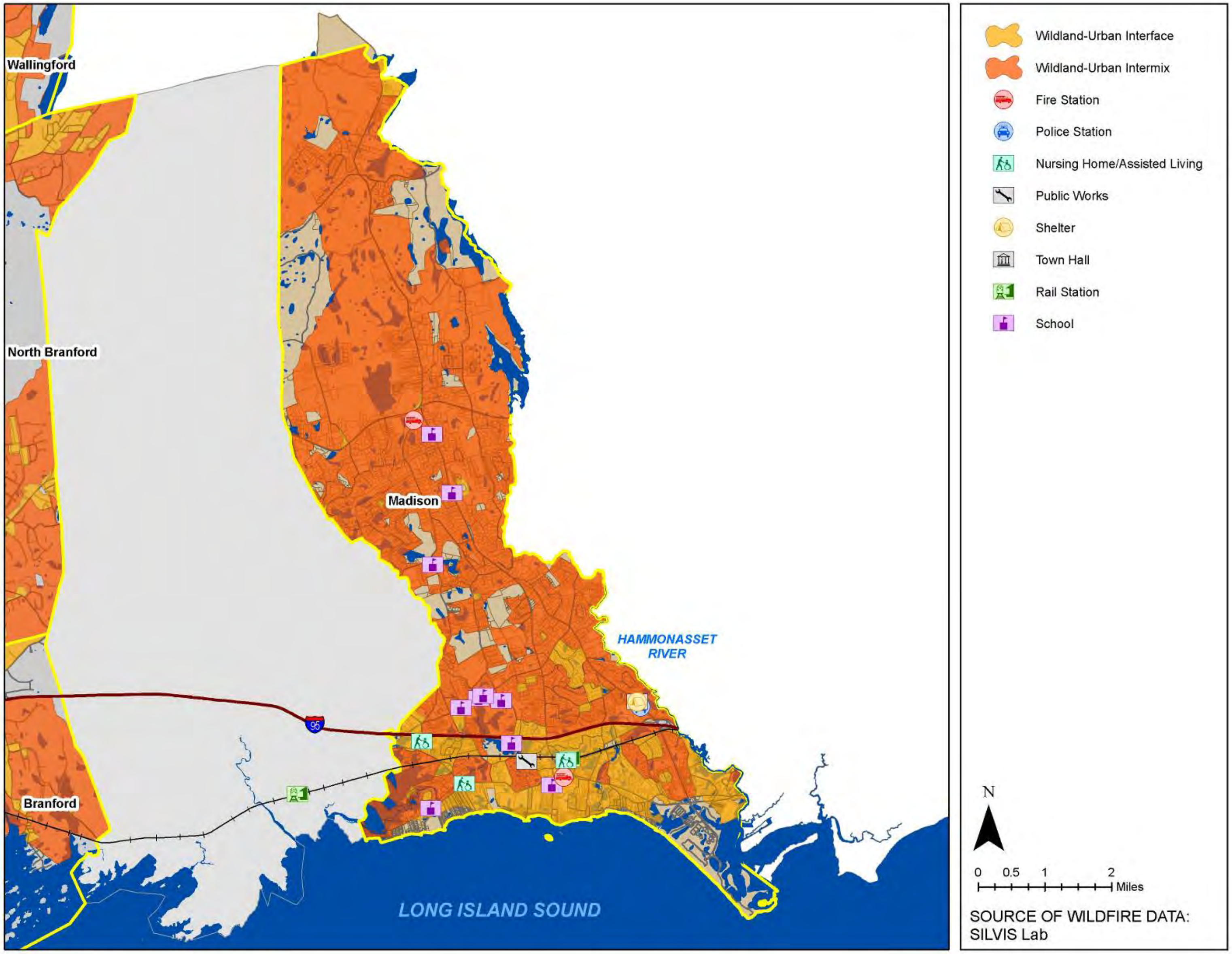
MAP 4.21 Flood Hazard Areas - Madison



MAP 4.22 Storm Surge Hazard Areas - Madison



MAP 4.23 Sea Level Rise Hazard Areas - Madison



MAP 4.24 Wildfire Hazard Areas - Madison

Potential Impacts—Madison

Table 4.51 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.51 Potential Impacts by Hazard - Madison

Hazard	Value of At-Risk Parcels[166]	Value of At-Risk Critical Facilities[167]	Value of At-Risk Historic Assets
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$2,028,795,000	$1,264,491,508	N/A
Severe Thunderstorm	$2,028,795,000	$1,264,491,508	N/A
Severe Winter Storm/Nor'easter	$2,028,795,000	$1,264,491,508	N/A
Tornado	$2,028,795,000	$1,264,491,508	N/A
Coastal Erosion[168]	Unknown	Unknown	N/A
Dam Failure			
High Hazard	$263,796,000	$0	N/A
Significant Hazard	$0	$0	N/A
Drought	$0	$0	$0
Flood[169]			
1-Percent-Annual-Chance	$1,548,455,000	$0	N/A
0.2-Percent-Annual-Chance	$1,328,689,000	$0	N/A
Zone VE	$298,679,000	$0	N/A
Category 1 Storm Surge	$523,653,000	$0	N/A
Category 2 Storm Surge	$731,935,000	$0	N/A
Category 3 Storm Surge	$803,922,000	$0	N/A
Category 4 Storm Surge	$868,791,000	$1,610,000	N/A
Sea Level Rise	$641,899,000	$0	N/A
Earthquake	$2,028,795,000	$1,264,491,508	N/A
Wildfire	$2,023,289,000	$108,384,986	N/A

166 Based on estimated exposure values from Hazus-MH (building values only).

167 Based on estimated building values from Hazus-MH.

168 Data does not currently exist to determine potential impacts from the coastal erosion hazard.

169 Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Madison

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.52**).

Table 4.52 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Madison

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$17,760,000	$5,070,000	$750,000	$690,000	$24,270,000
Contents	$9,660,000	$14,930,000	$1,420,000	$3,590,000	$29,600,000
Inventory	$0	$460,000	$180,000	$30,000	$670,000
Subtotal	**$27,420,000**	**$20,460,000**	**$2,350,000**	**$4,310,000**	**$54,540,000**
Business Interruption					
Income	$0	$70,000	$0	$10,000	$80,000
Relocation	$20,000	$20,000	$0	$0	$40,000
Rental Income	$0	$10,000	$0	$0	$10,000
Wage	$0	$70,000	$0	$80,000	$150,000
Subtotal	**$20,000**	**$170,000**	**$0**	**$90,000**	**$280,000**
TOTAL	**$27,440,000**	**$20,630,000**	**$2,350,000**	**$4,400,000**	**$54,820,000**

In addition, the Hazus-MH model estimates 676 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1,329 people will seek temporary shelter in public shelters.

Coastal Flood

Estimated building losses for the coastal flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.53**).

Table 4.53 Coastal Flood Loss Estimates (100-year Event) - Madison

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$3,370,000	$330,000	$20,000	$20,000	$3,740,000
Contents	$2,290,000	$830,000	$460,000	$180,000	$3,760,000
Inventory	$0	$10,000	$60,000	$0	$70,000
Subtotal	**$5,660,000**	**$1,170,000**	**$540,000**	**$200,000**	**$7,570,000**
Business Interruption					
Income	$0	$20,000	$0	$0	$20,000
Relocation	$10,000	$0	$0	$0	$10,000
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$20,000	$0	$0	$20,000
Subtotal	**$10,000**	**$40,000**	**$0**	**$0**	**$50,000**
TOTAL	**$5,670,000**	**$1,210,000**	**$540,000**	**$200,000**	**$7,620,000**

In addition, the Hazus-MH model estimates 90 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 140 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm

- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.54** and **4.55**.

Table 4.54 Number of Buildings Damaged - Madison

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	7	0	0	0	7
50-year	225	11	0	0	236
100-year	914	101	5	2	1,022
200-year	1,887	422	51	30	2,390
500-year	2,897	1,179	290	176	4,542
1,000-year	3,046	1,779	641	424	5,890

Table 4.55 Building-Related Economic Losses - Madison

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$1,016,050	$37,840	$5,280	$5,130	$1,064,300
50-year	$9,451,150	$434,070	$36,860	$59,510	$9,981,590
100-year	$23,781,290	$1,987,070	$244,510	$337,830	$26,350,700
200-year	$67,209,750	$7,644,630	$1,231,800	$1,310,180	$77,396,360
500-year	$208,661,100	$27,964,810	$4,661,670	$3,949,300	$245,236,880
1,000-year	$396,124,810	$57,885,210	$9,347,220	$7,580,060	$470,937,300

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annalized Loss Estimates

Table 4.56 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.56 Annualized Loss Estimates by Hazard - Madison

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$2,046,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Coastal Erosion[170]	Unknown
Dam Failure	Negligible
Drought	Negligible
Flood (Riverine)	$898,070
Flood (Coastal)	$4,199,730
Sea Level Rise	N/A
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Madison

Table 4.57 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Madison. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

170 Data does not currently exist to determine annualized losses for the coastal erosion hazard.

Table 4.57 Problem Statements - Madison

Primary Hazards of Concern
• **Coastal flooding** (storm-related and often resulting from high tides), **coastal erosion** and **sea level rise**. Recurring coastal flood problems cause many low-lying areas to be cut off and isolated from rest of community. The Town maintains a list of pre-identified areas of concern. Homes constructed or rebuilt to new FEMA standards have done well in recent storm events (breakaway walls functioned as designed, no finished floor flooding).
• **Hurricane/tropical storm** hazards pose significant issues for the Town related to coastal flood damages (to homes and infrastructure, including seawalls), street flooding, and inland wind damages to trees, power lines, and communications (e.g., cell towers). ➢ Potential solutions/mitigation actions: strengthen communication networks, including provision of back-up generator power for cell towers.
• **Severe winter storms/ice storms** are a significant concern, especially when causing power failures during period of extreme cold (life/safety threat) and when downing trees (transportation/access concerns, with potential for many isolated residents). Roof collapse due to heavy snow loads is also a potential threat for some structures.
Geographic Areas of Concern
• Circle Beach Road – numerous homes at risk to regular coastal/tidal flooding and storm surge. Many have been damaged or destroyed in past storms, and most of those remaining or that were rebuilt are elevated with breakaway walls in accordance with FEMA standards.
• Middle Beach Road – area susceptible to coastal flooding and storm surge. Protected by 800 foot armored stone wall that was heavily damaged following Hurricane Irene in 2011. Town is applying for repair/redesign and reconstruction of revetment through FEMA grants (Public Assistance).
• Hammonasset State Park – can double the Town's population on a summer weekend day, creating life/safety concerns with regard to severe thunderstorms and tornadoes. ➢ Potential solutions/mitigation actions: • Town has adopted policies to clear the beach. • Town has lightning prediction/alarm system in place. • Training/exercising
• Hartford Avenue – significant erosion concern for bluffs along the Sound
• Tibbals Bridge Road – occasional flooding of basements (approx. 30 homes in area).
• Low-lying neighborhoods that frequently become isolated by tidal/coastal flooding occurrences include areas along Neck Road, the west end of Green Hill Road, Harbor Avenue, and Circle Beach Road.
Vulnerable Community Assets
• Surf Club (Town-owned beach and recreation area) – 45-acre park is vulnerable to coastal flooding and storm surge. Failure of seawall and loss of primary frontal dunes during Irene. ➢ Potential solutions/mitigation actions: beach dune restoration (ongoing).
• Town Campus (Town Hall, Police, EOC, community shelter, etc.) is a critical lifeline for the continuity of government for the Town. Area is in proximity to special flood hazard area for Hammonasset River and is downstream from Lake Hammonasset Dam (high hazard dam, owned by RWA). Should be considered for possible mitigation actions.

• Town Archives are currently located in basement of Memorial Town Hall and have historic value.
• Deacon John Graves House
• Town's school bus parking facility is located in special flood hazard area.
• 2 critical facilities are within close proximity to a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact either or both of these facilities. • 1 critical facility is located in a Category 4 storm surge inundation zone.

North Branford

Vulnerable Assets—North Branford

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.58**.

Table 4.58 Vulnerable Assets by Hazard - North Branford

Hazard	Number of Parcels[171]	Number of Buildings[172]	Critical Facilities[173]	Historic Assets[174]	Population[175]
Extreme Temperatures	0	0	0	0	2,522
Hurricane/Tropical Storm	5,721	8,470	16	2	14,407
Severe Thunderstorm	5,721	8,470	16	2	14,407
Severe Winter Storm/Nor'easter	5,721	8,470	16	2	14,407
Tornado	5,721	8,470	16	2	14,407
Dam Failure[176]					
High Hazard	701	609	0	0	4,200
Significant Hazard	0	0	0	0	0
Drought	0	0	0	0	0
Flood[177]					
1-Percent-Annual-Chance	735	372	0	2	11,417
0.2-Percent-Annual-Chance	424	138	0	2	8,312
Earthquake	5,721	8,470	16	2	14,407
Wildfire	5,721	8,470	16	2	14,407

[171] Based on data provided by the Town of North Branford.

[172] Based on data provided by the Town of North Branford.

[173] Based on data from Hazus-MH.

[174] Based on data provided by the Town of North Branford.

[175] Based on population numbers from 2010 census data.

[176] Dam failure inundation mapping was available for the Pistapaug Reservoir and Lake Gaillard Dam. Inundation mapping was not available for 13 other dams located in the Town of North Branford.

[177] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of North Branford also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.59**).[178]

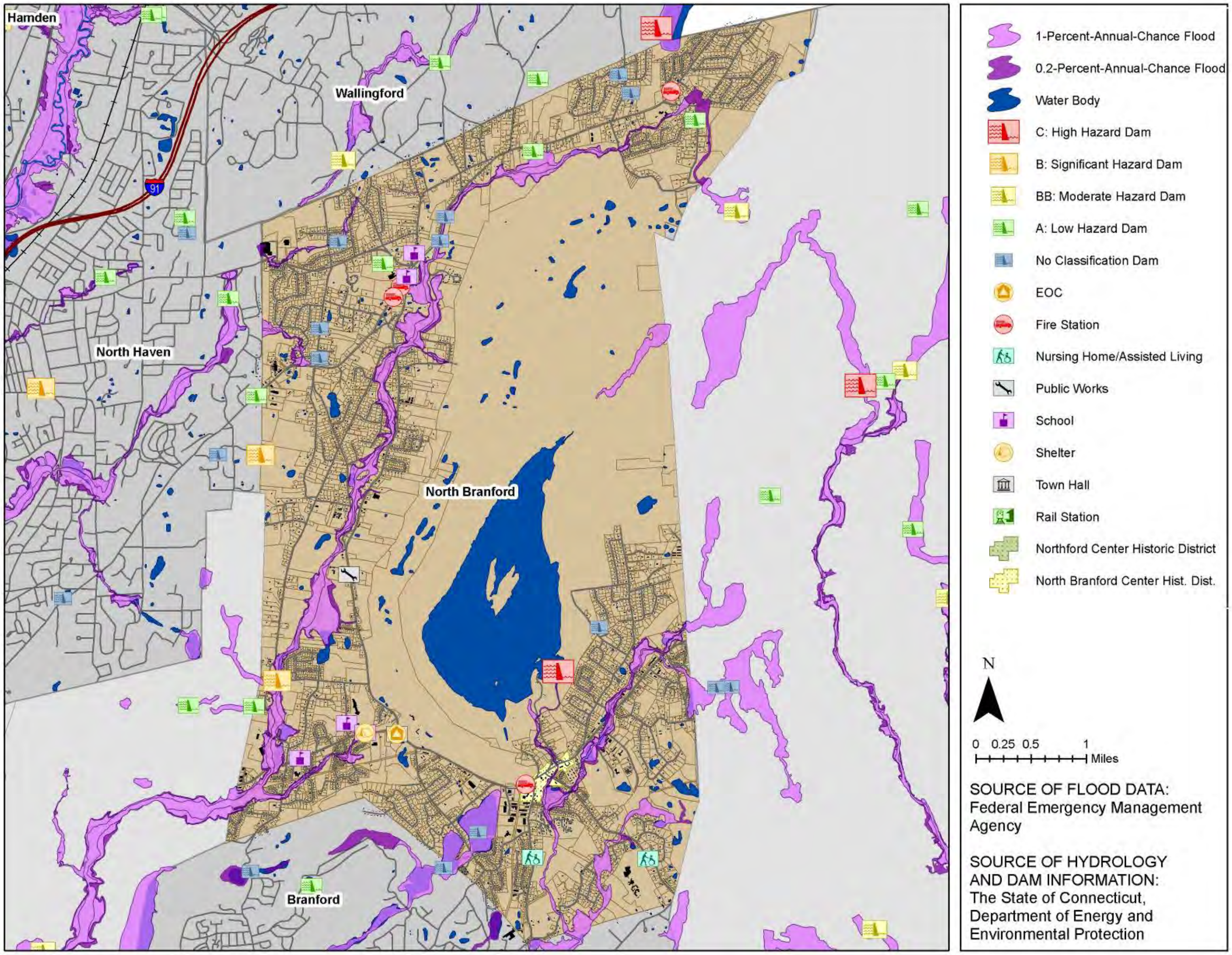
Table 4.59 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - North Branford

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	22	9	$245,849	$119,219	$365,068
Severe Repetitive Loss	0	0	$0	$0	$0

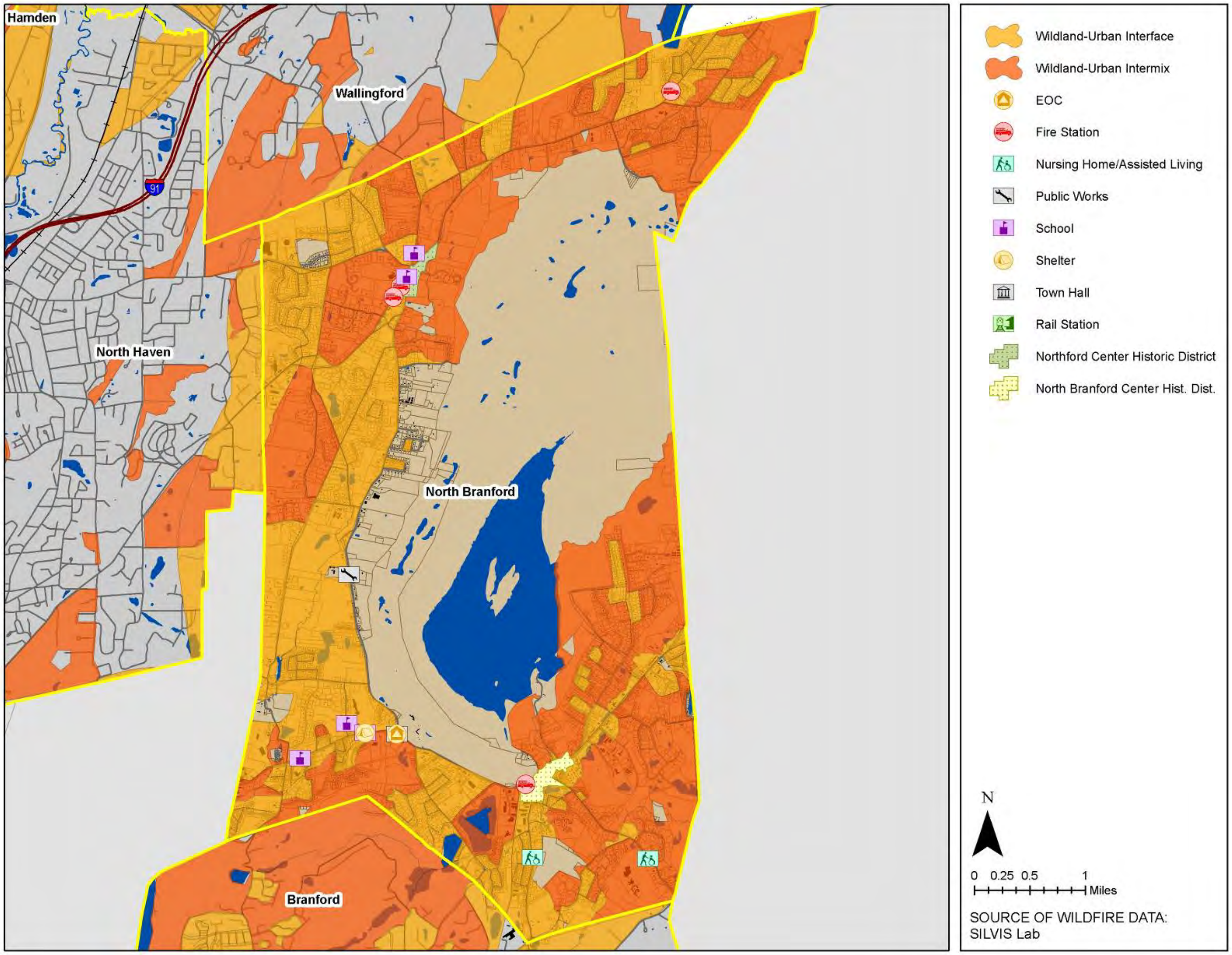
As of December 31, 2012, the Town of North Branford had a total of 68 claims totaling $457,504 in losses for all NFIP-insured structures.

Maps 4.25 and **4.26** show flood and wildfire hazard areas within the Town of North Branford.

[178] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



MAP 4.25 Flood Hazard Areas - North Branford



MAP 4.26 Wildfire Hazard Areas - North Branford

Potential Impacts—North Branford

Table 4.60 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.60 Potential Impacts by Hazard - North Branford

Hazard	Value of At-Risk Parcels[179]	Value of At-Risk Critical Facilities[180]	Value of At-Risk Historic Assets
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$1,186,250,000	$152,751,162	Unknown
Severe Thunderstorm	$1,186,250,000	$152,751,162	Unknown
Severe Winter Storm/Nor'easter	$1,186,250,000	$152,751,162	Unknown
Tornado	$1,186,250,000	$152,751,162	Unknown
Dam Failure			
High Hazard	$362,998,000	$0	$0
Significant Hazard	$0	$0	$0
Drought	$0	$0	$0
Flood[181]			
1-Percent-Annual-Chance	$864,946,000	$0	Unknown
0.2-Percent-Annual-Chance	$773,400,000	$0	Unknown
Earthquake	$1,186,250,000	$152,751,162	Unknown
Wildfire	$1,186,250,000	$152,751,162	Unknown

[179] Based on estimated exposure values from Hazus-MH (building values only).

[180] Based on estimated building values from Hazus-MH.

[181] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—North Branford

<u>Detailed Hazus-MH Loss Estimates</u>

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.61**).

Table 4.61 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - North Branford

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$10,170,000	$2,690,000	$2,040,000	$250,000	$15,150,000
Contents	$5,370,000	$8,530,000	$4,030,000	$1,100,000	$19,030,000
Inventory	$0	$180,000	$480,000	$50,000	$710,000
Subtotal	**$15,540,000**	**$11,400,000**	**$6,550,000**	**$1,400,000**	**$34,890,000**
Business Interruption					
Income	$0	$20,000	$0	$0	$20,000
Relocation	$10,000	$0	$0	$0	$10,000
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$20,000	$0	$40,000	$60,000
Subtotal	**$10,000**	**$40,000**	**$0**	**$40,000**	**$90,000**
TOTAL	**$15,540,000**	**$11,440,000**	**$6,550,000**	**$1,450,000**	**$34,980,000**

In addition, the Hazus-MH model estimates 341 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 585 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.62** and **4.63**.

Table 4.62 Number of Buildings Damaged - North Branford

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	4	0	0	0	4
50-year	99	8	0	0	107
100-year	434	54	2	0	490
200-year	1,062	218	15	7	1,302
500-year	1,825	686	122	68	2,701
1,000-year	2,006	1,110	329	203	3,648

Table 4.63 Building-Related Economic Losses - North Branford

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$110,110	$9,340	$4,900	$1,160	$125,510
50-year	$2,924,340	$78,850	$31,750	$13,800	$3,048,740
100-year	$8,248,300	$487,730	$246,050	$98,250	$9,080,330
200-year	$23,901,970	$2,036,080	$1,271,890	$498,840	$27,708,780
500-year	$87,550,610	$7,593,780	$5,537,870	$1,728,200	$102,410,460
1,000-year	$184,750,300	$18,947,540	$12,792,980	$3,875,030	$220,365,850

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annualized Loss Estimates

Table 4.64 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.64 Annualized Loss Estimates by Hazard - North Branford

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$898,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$1,517,940
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—North Branford

Table 4.65 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of North Branford. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.65 Problem Statements - North Branford

Primary Hazards of Concern
• Inland/**riverine flooding** is the greatest concern. Whole town is a watershed, and the South Central CT Regional Water Authority owns 1/3 of the land surrounding, and especially north, of Lake Gaillard (major reservoir). Older, pre-FIRM structures are occasionally impacted by minor flooding following heavy rains. Last major flood was in 1992. Existing floodplain maps are deemed accurate based on past experience.
• Tree-related hazards are a big concern during **hurricane/tropical storm** and **severe winter storm** events, particularly downing electrical lines, and when falling and blocking roads that isolate many rural areas throughout town and pose life/safety threat due to no emergency access. This is a specific concern for schools / school bus routes.
• **Drought** is of some concern to North Branford, which is a farming community with many commercial vegetable farms.
• **Dam failure** – failure of the Lake Gaillard Dam would cause severe downstream flooding in North Branford and Branford. RWA operates Lake Gaillard Dam, which impacts Branford River and Farm River.
Geographic Areas of Concern
• Foxon Road @ Farm River – flash flooding potential after heavy rains (5-6 inches) has caused minor damage in past. Attributed to possible debris blockage issue for culvert under roadway. ➢ Potential solutions/mitigation actions: upstream impoundment and/or additional floodplain storage/stream restoration, which would alleviate flooding in this area.
• Harrison Road/ Lea Road/ Circle Drive @ Branford River and Munger Brook – flooding results from upstream spillway at Lake Gaillard Dam, which affects homes every 10-20 years (mostly garage, some basement flooding). All homes are pre-FIRM, constructed in 1950s-1960s. Dam has undergone some recent improvements.
• Foxon Road @ Munger Brook – occasional flooding along roadway between Fowler Road and W. Pond Road (south of Grant Oak Shopping Center).
• Valley Road @ Notch Hill Brook (including Hemlock Drive, Crossfield Road, Norwill Drive) – susceptible to occasional flooding.
• Residential areas along Walnut Lane, between Reeds Gap Road and Lanes Pond Road – occasional nuisance flooding and ponding along roadways from Farm River, requiring debris clean up.
Vulnerable Community Assets
• Town Hall not equipped with generator or quick-connects for backup generator power. EOC has been relocated back to Police Station.

• Evergreen Woods – senior living center @ 88 Notch Hill Road. 240 units on large campus setting, resulting in high concentration of senior citizens that may have special needs before, during or after major disaster events. Hospital is on generator but not residential housing units.
• 2 critical facilities are within close proximity to a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact either or both of these facilities.

North Haven

Vulnerable Assets—North Haven

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.66**.

Table 4.66 Vulnerable Assets by Hazard - North Haven

Hazard	Number of Parcels[182]	Number of Housing Units[183]	Critical Facilities[184]	Historic Assets[185]	Population[186]
Extreme Temperatures	0	0	0	0	4,792
Hurricane/Tropical Storm	8,992	9,491	17	N/A	24,093
Severe Thunderstorm	8,992	9,491	17	N/A	24,093
Severe Winter Storm/Nor'easter	8,992	9,491	17	N/A	24,093
Tornado	8,992	9,491	17	N/A	24,093
Dam Failure[187]					
High Hazard	0	0	0	N/A	0
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[188]					
1-Percent-Annual-Chance	487	2,674	0	N/A	6,628
0.2-Percent-Annual-Chance	393	2,363	0	N/A	5,843
Category 1 Storm Surge	36	129	0	N/A	189
Category 2 Storm Surge	137	319	0	N/A	574
Category 3 Storm Surge	234	1,009	1	N/A	1,975
Category 4 Storm Surge	269	1,319	0	N/A	2,647

[182] Based on data provided by the Town of North Haven.

[183] Based on housing unit numbers from 2010 census data.

[184] Based on data from Hazus-MH.

[185] Data for historic assets was not available at the time of this analysis.

[186] Based on population numbers from 2010 census data.

[187] Dam failure inundation mapping was not available for any of the 19 dams located in the Town of North Haven.

[188] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Number of Parcels[182]	Number of Housing Units[183]	Critical Facilities[184]	Historic Assets[185]	Population[186]
Sea Level Rise	183	662	0	N/A	1,415
Earthquake	8,992	9,491	17	N/A	24,093
Wildfire	2,154	4,660	1	N/A	14,132

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of North Haven also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.67**).[189]

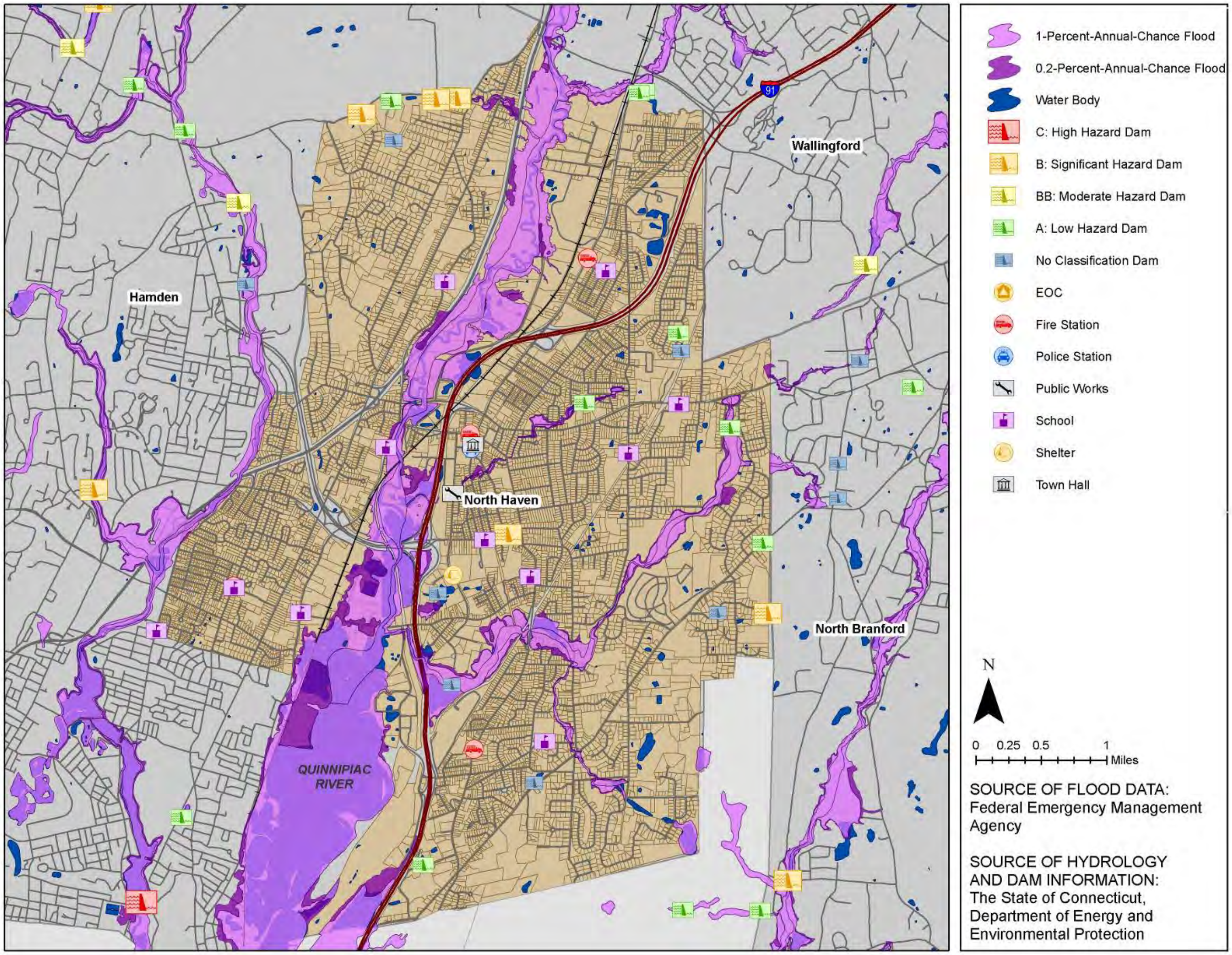
Table 4.67 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - North Haven

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	73	20	$906,629	$282,461	$1,189,090
Severe Repetitive Loss	23	4	$343,327	$148,505	$491,832

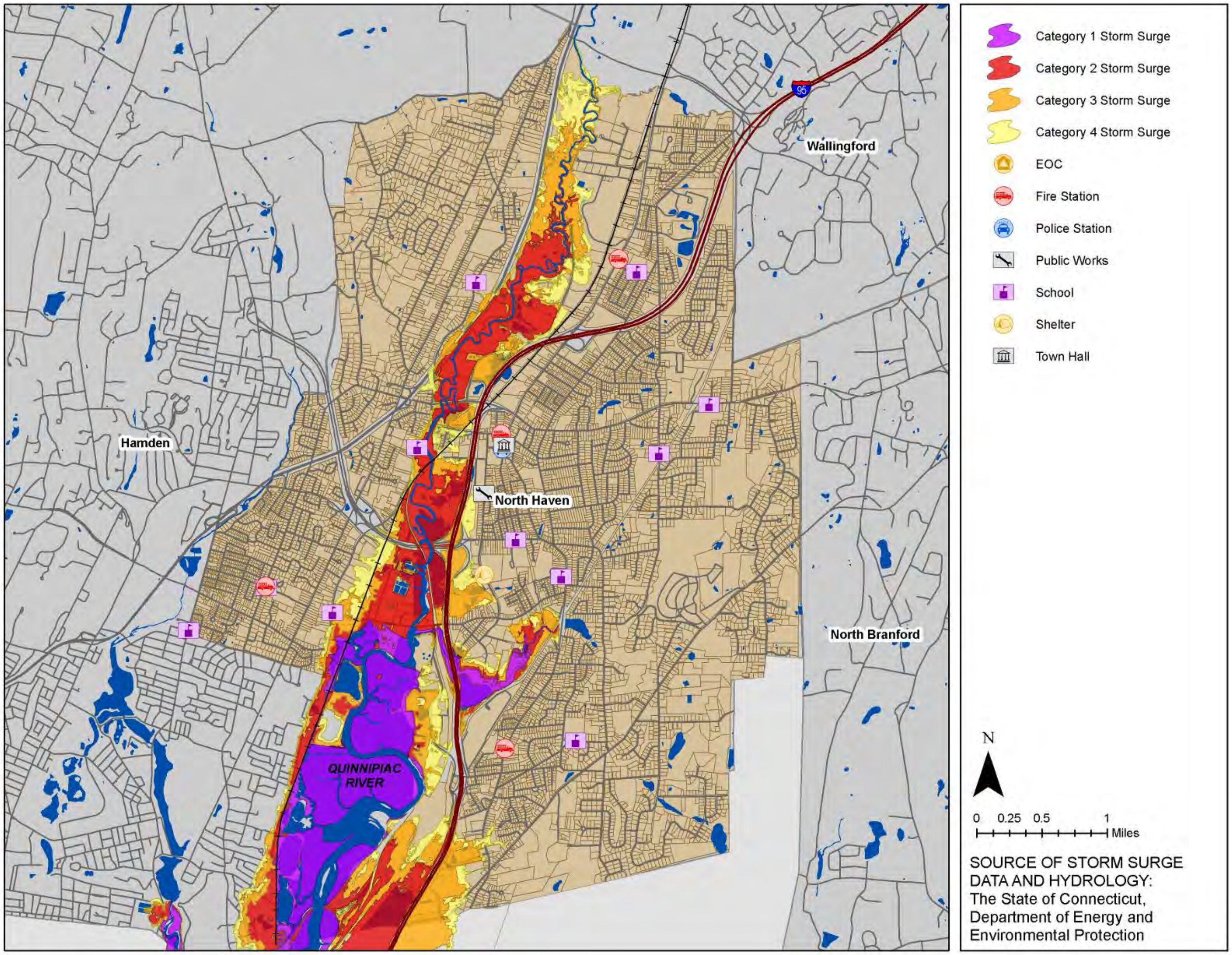
As of December 31, 2012, the Town of North Haven had a total of 150 claims totaling $1,547,692 in losses for all NFIP-insured structures.

Maps 4.27 through **4.30** show flood, storm surge, sea level rise, and wildfire hazard areas within the Town of North Haven.

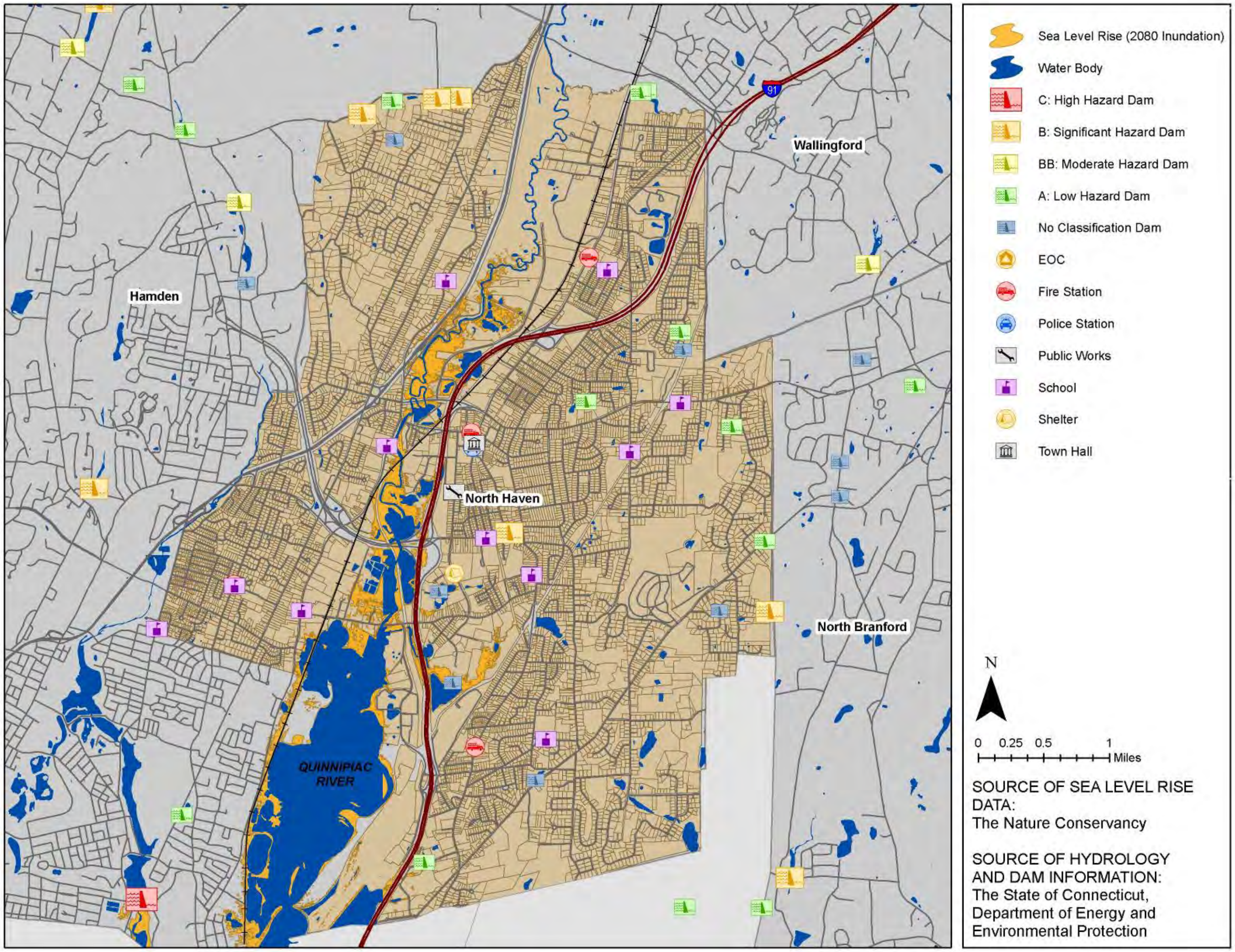
[189] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



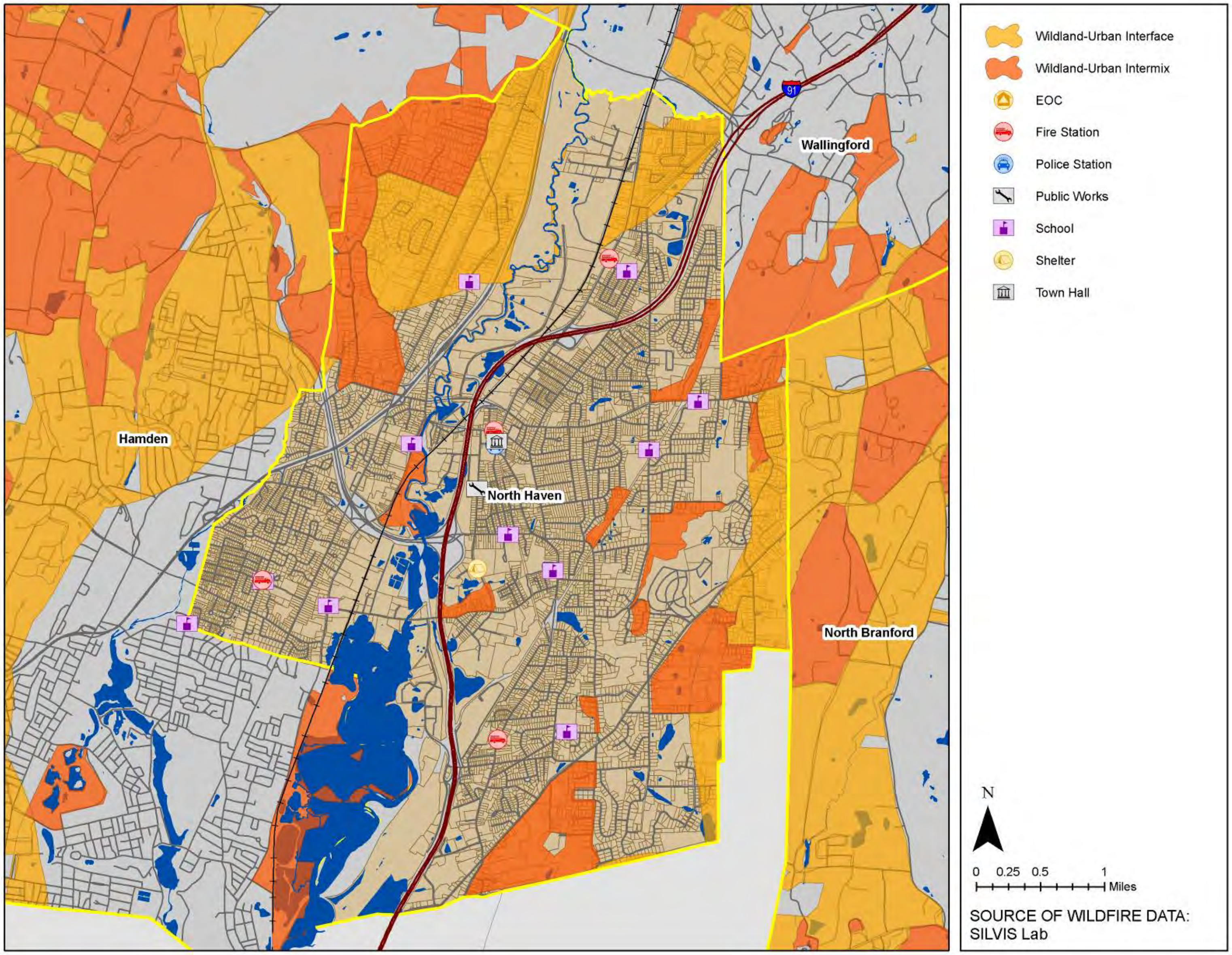
MAP 4.27 Flood Hazard Areas - North Haven



MAP 4.28 Storm Surge Hazard Areas - North Haven



MAP 4.29 Sea Level Rise Hazard Areas - North Haven



MAP 4.30 Wildfire Hazard Areas - North Haven

Potential Impacts—North Haven

Table 4.68 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.68 Potential Impacts by Hazard - North Haven

Hazard	Value of At-Risk Parcels[190]	Value of At-Risk Critical Facilities[191]	Value of At-Risk Historic Assets[192]
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$2,176,034,010	$91,463,654	N/A
Severe Thunderstorm	$2,176,034,010	$91,463,654	N/A
Severe Winter Storm/Nor'easter	$2,176,034,010	$91,463,654	N/A
Tornado	$2,176,034,010	$91,463,654	N/A
Dam Failure			
High Hazard	$0	$0	N/A
Significant Hazard	$0	$0	N/A
Drought	$0	$0	$0
Flood[193]			
1-Percent-Annual-Chance	$167,582,450	$0	N/A
0.2-Percent-Annual-Chance	$130,302,120	$0	N/A
Category 1 Storm Surge	$53,826,000	$0	N/A
Category 2 Storm Surge	$103,724,700	$0	N/A
Category 3 Storm Surge	$237,687,302	$225,273	N/A
Category 4 Storm Surge	$308,797,502	$0	N/A
Sea Level Rise	$181,166,800	$0	N/A
Earthquake	$2,176,034,010	$91,463,654	N/A
Wildfire	$493,490,110	$8,925,823	N/A

[190] Based on data provided by the Town of North Haven.

[191] Based on data provided by the Town of North Haven.

[192] Data for historic assets was not available at the time of this analysis.

[193] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—North Haven

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.69**).

Table 4.69 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - North Haven

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$6,750,000	$5,790,000	$8,230,000	$100,000	$20,870,000
Contents	$3,430,000	$14,250,000	$23,080,000	$460,000	$41,220,000
Inventory	$0	$560,000	$3,450,000	$20,000	$4,030,000
Subtotal	**$10,180,000**	**$20,600,000**	**$34,760,000**	**$580,000**	**$66,120,000**
Business Interruption					
Income	$0	$80,000	$10,000	$0	$90,000
Relocation	$10,000	$20,000	$0	$0	$30,000
Rental Income	$0	$10,000	$0	$0	$10,000
Wage	$0	$70,000	$0	$0	$70,000
Subtotal	**$10,000**	**$180,000**	**$10,000**	**$0**	**$200,000**
TOTAL	**$10,190,000**	**$20,780,000**	**$34,770,000**	**$580,000**	**$66,320,000**

In addition, the Hazus-MH model estimates 199 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 302 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.70** and **4.71**.

Table 4.70 Number of Buildings Damaged - North Haven

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	6	0	0	0	6
50-year	149	8	0	0	157
100-year	814	82	3	1	900
200-year	1,912	364	29	16	2,321
500-year	3,192	1,186	233	137	4,748
1,000-year	3,480	2,006	676	438	6,600

Table 4.71 Building-Related Economic Losses - North Haven

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$427,700	$0	$0	$0	$427,700
50-year	$6,437,960	$309,670	$88,010	$26,970	$6,862,610
100-year	$18,452,030	$2,481,380	$820,430	$323,580	$22,077,420
200-year	$47,594,050	$8,965,620	$4,036,600	$1,164,830	$61,761,100

Return Period	Residential	Commercial	Industrial	Others	Total
500-year	$166,376,220	$35,554,650	$18,099,890	$3,779,390	$223,810,150
1,000-year	$374,734,160	$93,197,840	$43,642,420	$8,807,250	$520,381,670

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

<u>Annualized Loss Estimates</u>

Table 4.72 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.72 Annualized Loss Estimates by Hazard - North Haven

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$2,033,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$6,568,380
Sea Level Rise	N/A
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—North Haven

Table 4.73 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of North Haven. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.73 Problem Statements - North Haven

Primary Hazards of Concern
• Inland/**riverine flooding** is greatest concern, especially along Muddy River, and also along tidal influenced Quinnipiac River.
• Power outages caused by **hurricane/tropical storms** and **severe winter storms** are major local issue. The Town fields many calls from residents that need to go to United Illuminating Co.
• **Urban flooding** is a significant concern in isolated areas due to undersized stormwater drainage systems as well as debris/blockages.
Geographic Areas of Concern
• **Muddy River** – many areas/roads along river are impacted by flooding following heavy rain events, mostly attributed to sediment build up in channel, along with downed trees, beaver dams, etc. (unable to remove due to CT DEEP permitting process). Specific areas of concern are listed separately below. ➢ Potential solutions/mitigation actions: • Focus on older development, as new construction is already not allowed in proximity to the river. • Continue to coordinate with Town of Wallingford on upstream dredging and flood control (Town-owned dams/ reservoir). • Continue to examine ways to dredge/remove sediment build up in known problem areas.
• **Route 103 (Quinnipiac Avenue) @ Muddy River** (near intersection with railroad) – Specific areas of concern in proximity include: • **Old Maple Avenue** – very frequent flooding occurrences for commercial properties along Muddy River. On average this area floods twice per year, with as much as 2 feet of water (threatens mechanical equipment). • **Pine River Road** – frequent flooding concerns for residential properties south of the Muddy River (floods homes and in-ground pools). Town receives many calls from residents for even 2-3" rain/snow events. • **Potter Road / Ansonia Drive** – residential area south of Muddy River. Historical flooding issues, though much has been abated through recent upstream dredging and sediment control in Wallingford.
• **Sheffield Drive** – residences on east side of street are prone to flooding from the Muddy River.
• **Bishop Drive @ State Street** – flooding concerns from Quinnipiac River (4 feet of flood water on roadway during 1992 event).
• **Patten Road** – roadway flooding from Muddy River. Possible threat to approx. 5 new lots/homes in the area, especially if upstream reservoir is full combined with heavy rains.
• **Spring Road @ Fitch Street** – flooding concerns from Fivemile Brook (tributary to Muddy River). Roadway and several residential properties along the brook are at risk, though to date only experienced yard flooding.
• **Spring Road @ Potter Road –** flooding concerns from Muddy River (roadway and several residential properties).
• **Todd Drive** – flooding concerns from Quinnipiac River (residential properties) when water crosses Route 15. Have had to use boats to evacuate residents during past events.
• **Timothy Drive** – stormwater/urban flooding concerns for residential area, with history of some damage to homes.
• **Whitney Ridge** area (west side of town, between Whitney Avenue and Ridge Road) – residential area with stormwater/urban flooding concern near junction of multiple storm drains, exacerbated by undersized drainage system and debris accumulation (leaves, sediment, etc.).

• **Sacket Point Road, Margo Circle, and Old Broadway Street** – these distinct areas have historically been impacted by past sewer backups/overflows and blown manhole covers.
• More than 2,200 catch basins across town that can't be cleaned out with Town's limited resources alone. ➢ Potential solutions/mitigation actions: contract for outside assistance with cleaning drainage structures.
• Many sanitary sewers are located in isolated wooded areas throughout town, including private property, but not all infiltration sources are inventoried or mapped (in addition to miles of underground sewer lines).
Vulnerable Community Assets
• Pump stations – many are susceptible to power failure due to lack of permanent backup generator power.
• 3 critical facilities are within close proximity to a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact these facilities.

Orange

Vulnerable Assets—Orange

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.74**.

Table 4.74 Vulnerable Assets by Hazard - Orange

Hazard	Number of Parcels[194]	Number of Housing Units[195]	Critical Facilities [196]	Historic Assets[197]	Population [198]
Extreme Temperatures	0	0	0	0	2,664
Hurricane/Tropical Storm	5,402	5,345	12	N/A	13,956
Severe Thunderstorm	5,402	5,345	12	N/A	13,956
Severe Winter Storm/Nor'easter	5,402	5,345	12	N/A	13,956
Tornado	5,402	5,345	12	N/A	13,956
Dam Failure[199]					
High Hazard	10	358	0	N/A	890
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[200]					
1-Percent-Annual-Chance	464	3,149	0	N/A	7,760
0.2-Percent-Annual-Chance	554	3,193	0	N/A	7,885
Earthquake	5,402	5,345	12	N/A	13,956
Wildfire	1,306	3,997	3	N/A	10,052

[194] Based on data provided by the Town of Orange.

[195] Based on housing unit numbers from 2010 census data.

[196] Based on data from Hazus-MH.

[197] Data for historic assets was not available at the time of this analysis.

[198] Based on population numbers from 2010 census data.

[199] Dam failure inundation mapping was available for Shepaug Dam. Inundation mapping was not available for the 14 dams located in the Town of Orange.

[200] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Orange also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.75**).[201]

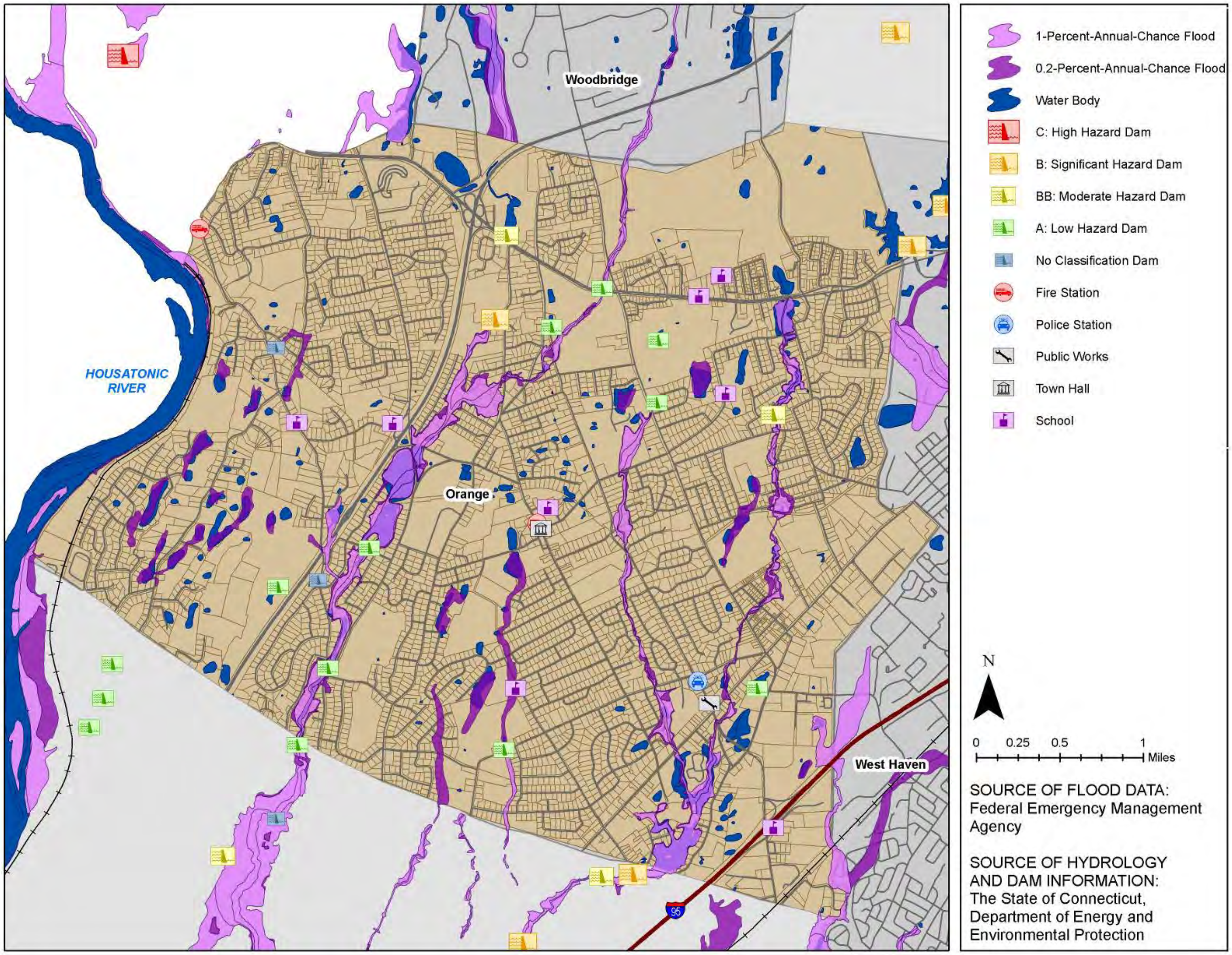
Table 4.75 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Orange

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	64	16	$529,294	$305,046	$834,340
Severe Repetitive Loss	25	4	$265,815	$128,115	$393,930

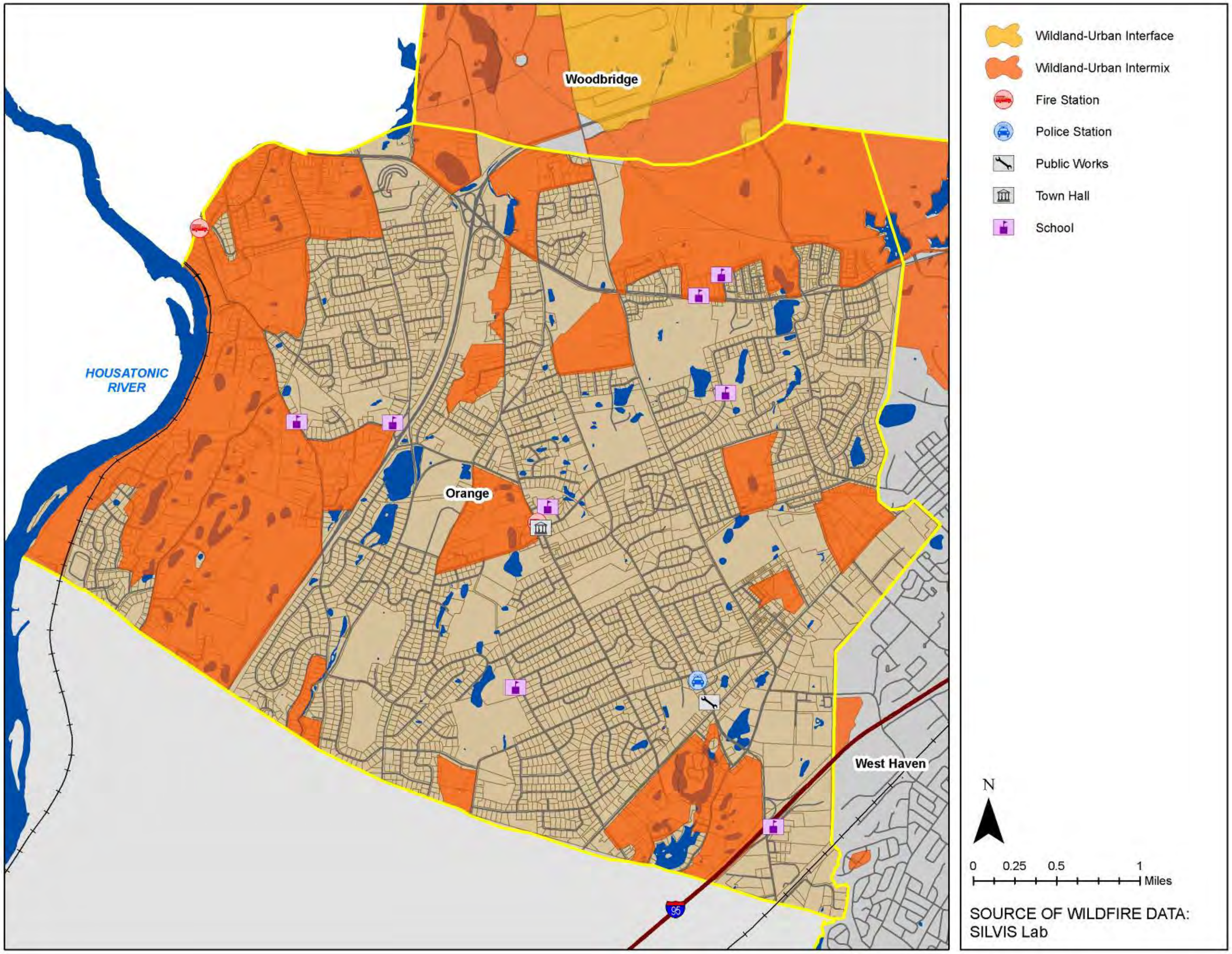
As of December 31, 2012, the Town of Orange had a total of 131 claims totaling $1,244,981 in losses for all NFIP-insured structures.

Maps 4.31 and **4.32** show flood and wildfire hazard areas within the Town of Orange.

[201] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



MAP 4.31 Flood Hazard Areas - Orange



MAP 4.32 Wildfire Hazard Areas - Orange

Potential Impacts—Orange

Table 4.76 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.76 Potential Impacts by Hazard - Orange

Hazard	Value of At-Risk Parcels[202]	Value of At-Risk Critical Facilities[203]	Value of At-Risk Historic Assets
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$1,556,388,000	$52,086,217	Unknown
Severe Thunderstorm	$1,556,388,000	$52,086,217	Unknown
Severe Winter Storm/Nor'easter	$1,556,388,000	$52,086,217	Unknown
Tornado	$1,556,388,000	$52,086,217	Unknown
Dam Failure			
High Hazard	$57,705,000	$0	Unknown
Significant Hazard	$0	$0	$0
Drought	$0	$0	$0
Flood[204]			
1-Percent-Annual-Chance	$626,118,000	$0	Unknown
0.2-Percent-Annual-Chance	$691,693,000	$0	Unknown
Earthquake	$1,556,388,000	$52,086,217	Unknown
Wildfire	$230,460,000	$17,105,742	Unknown

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[202] Based on estimated exposure values from Hazus-MH (building values only).

[203] Based on estimated building values from Hazus-MH.

[204] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Orange

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.77**).

Table 4.77 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Orange

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$3,740,000	$1,650,000	$1,040,000	$90,000	$6,520,000
Contents	$2,060,000	$4,820,000	$2,830,000	$620,000	$10,330,000
Inventory	$0	$120,000	$330,000	$0	$450,000
Subtotal	**$5,800,000**	**$6,590,000**	**$4,200,000**	**$710,000**	**$17,300,000**
Business Interruption					
Income	$0	$10,000	$0	$0	$10,000
Relocation	$0	$0	$0	$0	$0
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$20,000	$0	$50,000	$70,000
Subtotal	**$0**	**$30,000**	**$0**	**$50,000**	**$80,000**
TOTAL	**$5,800,000**	**$6,620,000**	**$4,200,000**	**$760,000**	**$17,380,000**

In addition, the Hazus-MH model estimates 160 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 220 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.78** and **4.79**.

Table 4.78 Number of Buildings Damaged - Orange

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	3	0	0	0	3
50-year	60	2	0	0	62
100-year	398	32	1	0	431
200-year	976	155	11	5	1,147
500-year	1,845	595	101	55	2,596
1,000-year	2,142	1,070	315	187	3,714

Table 4.79 Building-Related Economic Losses - Orange

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$16,550,000	$0	$0	$0	$16,550,000
50-year	$2,042,490	$134,530	$23,250	$11,550	$2,211,820
100-year	$6,708,700	$1,180,440	$220,800	$115,670	$8,225,610
200-year	$17,923,370	$5,357,370	$1,180,650	$719,240	$25,180,630
500-year	$72,235,770	$20,427,860	$5,382,790	$2,043,970	$100,090,390
1,000-year	$170,867,410	$56,074,780	$13,782,830	$4,668,310	$245,393,330

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annalized Loss Estimates

Table 4.80 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.80 Annualized Loss Estimates by Hazard - Orange

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$947,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$963,040
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Orange

Table 4.81 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Orange. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.81 Problem Statements - Orange

Primary Hazards of Concern
• Tree-related hazards identified as #1 hazard related concern for Town. Post-storm issues are widespread during **hurricane/tropical storm** and **severe winter storm** events, particularly downing electrical lines, and when falling and blocking roads. Town has found it difficult to manage removal and storage of vegetative debris following recent events. ➢ Potential solutions/mitigation actions: brush truck and chipper for Town would help clear vegetative debris and stumps off the roads more quickly (currently no Town-owned equipment in place).
• **Inland/riverine flooding** is most critical hazard of concern, particular with regard to roadways and isolation of residents.
• **Urban flooding** hazards due to undersized drainage structures as well as debris/blockages.
Geographic Areas of Concern
• **South Greenbrier Drive** – flooding concerns from Wepawaug River, just south of Lake Wepawaug Dam/ pump house. Attributed to accumulation of sediment, brush, and other debris at the dam.

• **Old Grassy Hill Road** – frequent flooding of roadway @ bridge over Wepawaug River, especially following heavy rains (depths of up to 3-4" observed in past). Existing culvert pipe under roadways is deemed inadequate, making the roadway act as a dam, causing recurring scouring/flooding issues. ➢ Potential solutions/mitigation actions: • Culvert widening • Upstream sediment control • Dredging / sediment removal • The best solution is raising the roadway.
• **Grassy Hill Road @ Derby Milford Road** – flooding concerns believed to be caused by the buildup of sediment, brush, and debris at Clarktown Pond Dam, which is in place for irrigation purposes. ➢ Potential solutions/mitigation actions: remediation through general cleanup (debris removal and sediment control), but all located on private property (no Town access), so options are limited and must be coordinated with owners – possibly along with possibly CT DEEP and USACE.
• **Route 1 (Boston Post Road)** – subject to urban/stormwater flooding issues around 190-200 block due to inadequately sized drainage structures, starting near Air National Guard station. Flooding issues occur after nearly every heavy rainfall event, including deposit of large rocks and sediment along roadway.
• **Mallard Drive –** recurring street flooding along Indian Lake, causing access/isolation issues for up to 30 residential properties in the area. Indian River Dam is located downstream in Milford (privately owned), but noted for cause of flooding along upstream lake areas.
• **Lindy Street** – flooding concerns along Trout Brook (limited to street flooding, causing access/isolation issues).
• **Lambert Drive @ Sunset Drive** – flooding concerns from Indian River, likely caused by undersized culvert under Lambert Road (old masonry tunnel).
• **Surrey Drive** – flooding concerns for low-density residential area along Race Brook.
• **Brookside Road** – flooding concerns for low-density residential area.
Vulnerable Community Assets
• Turkey Hill School – no backup power ➢ Potential solutions/mitigation actions: standby power for antennas /communication upgrades.
• Cell tower located off Wilbur Cross Parkway @ Old Grassy Hill Road is subject to flooding. ➢ Potential solutions/mitigation actions: should be addressed through solutions proposed for mitigation of flooding at Old Grassy Hill Road bridge over Wepawaug River.
• 1 critical facility is within close proximity to a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact this facility.

Wallingford

Vulnerable Assets—Wallingford

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.82**.

Table 4.82 Vulnerable Assets by Hazard - Wallingford

Hazard	Number of Parcels[205]	Number of Housing Units[206]	Critical Facilities[207]	Historic Assets[208]	Population[209]
Extreme Temperatures	0	0	0	0	7,436
Hurricane/Tropical Storm	13,851	18,945	38	N/A	45,135
Severe Thunderstorm	13,851	18,945	38	N/A	45,135
Severe Winter Storm/Nor'easter	13,851	18,945	38	N/A	45,135
Tornado	13,851	18,945	38	N/A	45,135
Dam Failure[210]					
High Hazard	420	1,807	0	N/A	3,799
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[211]					
1-Percent-Annual-Chance	857	7,241	0	N/A	17,405
0.2-Percent-Annual-Chance	513	5,247	0	N/A	11,783
Earthquake	13,851	18,945	38	N/A	45,135
Wildfire	3,987	10,126	3	N/A	25,104

[205] Based on data provided by the Town of Wallingford.

[206] Based on housing unit numbers from 2010 census data.

[207] Based on a combination of data from the Town of Wallingford, SCRCOG, and Hazus-MH.

[208] Data on historic assets was not available at the time of this analysis.

[209] Based on population numbers from 2010 census data.

[210] Dam failure inundation mapping was available for Broad Brook Reservoir Dam, Ulbrich Reservoir, and Pistapaug Reservoir. Inundation mapping was not available for 37 other dams located in the Town of Wallingford.

[211] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Wallingford also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.83**).[212]

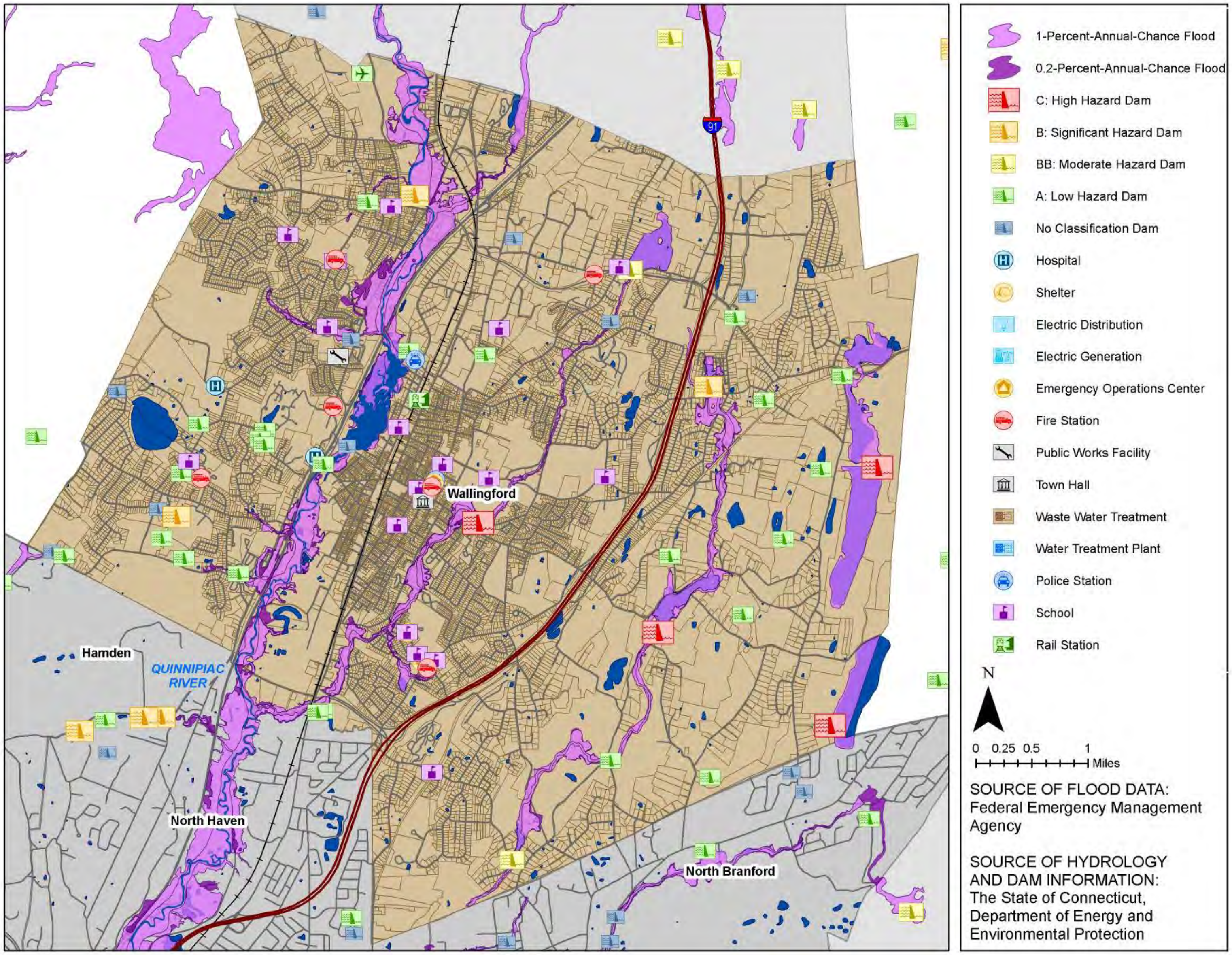
Table 4.83 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Wallingford

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	25	11	$166,169	$286,711	$452,880
Severe Repetitive Loss	0	0	$0	$0	$0

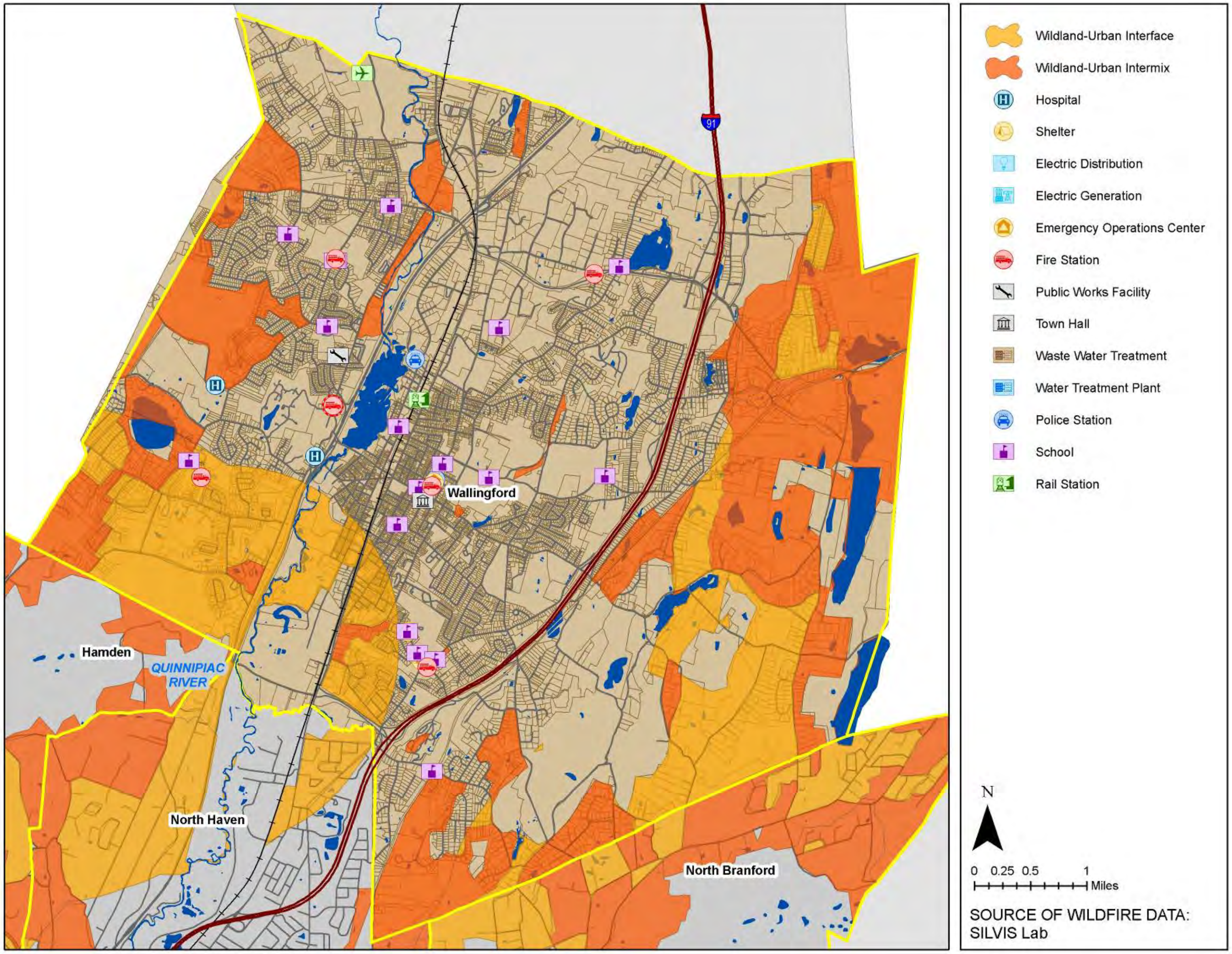
As of December 31, 2012, the Town of Wallingford had a total of 125 claims totaling $888,218 in losses for all NFIP-insured structures.

Maps 4.33 and **4.34** show flood and wildfire hazard areas within the Town of Wallingford.

[212] Based on information provided by the Federal Emergency Management Agency current as of 11/30/2012.



MAP 4.33 Flood Hazard Areas - Wallingford



MAP 4.34 Wildfire Hazard Areas - Wallingford

Potential Impacts—Wallingford

Table 4.84 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.84 Potential Impacts by Hazard - Wallingford

Hazard	Value of At-Risk Parcels[213]	Value of At-Risk Critical Facilities[214]	Value of At-Risk Historic Assets[215]
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$4,290,912,000	$171,132,870	N/A
Severe Thunderstorm	$4,290,912,000	$171,132,870	N/A
Severe Winter Storm/Nor'easter	$4,290,912,000	$171,132,870	N/A
Tornado	$4,290,912,000	$171,132,870	N/A
Dam Failure			
High Hazard	$683,199,000	$0	N/A
Significant Hazard	$0	$0	N/A
Drought	$0	$0	$0
Flood[216]			
1-Percent-Annual-Chance	$2,014,548,000	$0	N/A
0.2-Percent-Annual-Chance	$1,614,647,000	$0	N/A
Earthquake	$4,290,912,000	$171,132,870	N/A
Wildfire	$2,098,412,000	$9,290,265	N/A

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[213] Based on estimated exposure values from Hazus-MH (building values only).

[214] Based on estimated building values from Hazus-MH.

[215] Information on historic assets was not available at the time of this analysis.

[216] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Wallingford

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.85**).

Table 4.85 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Wallingford

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$10,160,000	$8,660,000	$12,100,000	$2,220,000	$33,140,000
Contents	$5,260,000	$21,020,000	$29,300,000	$13,310,000	$68,890,000
Inventory	$0	$520,000	$3,630,000	$20,000	$4,170,000
Subtotal	**$15,420,000**	**$30,200,000**	**$45,030,000**	**$15,550,000**	**$106,200,000**
Business Interruption					
Income	$0	$130,000	$10,000	$70,000	$210,000
Relocation	$10,000	$30,000	$10,000	$30,000	$80,000
Rental Income	$0	$20,000	$0	$0	$20,000
Wage	$0	$100,000	$10,000	$190,000	$300,000
Subtotal	**$10,000**	**$280,000**	**$30,000**	**$290,000**	**$610,000**
TOTAL	**$15,430,000**	**$30,480,000**	**$45,060,000**	**$15,840,000**	**$106,810,000**

In addition, the Hazus-MH model estimates 505 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1,057 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.86** and **4.87**.

Table 4.86 Number of Buildings Damaged - Wallingford

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	15	1	0	0	16
50-year	224	17	1	0	242
100-year	1,189	144	5	1	1,339
200-year	2,939	604	42	19	3,604
500-year	5,094	1,977	314	161	7,546
1,000-year	5,775	3,354	907	499	10,535

Table 4.87 Building-Related Economic Losses - Wallingford

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$357,160	$0	$0	$0	$357,160
50-year	$8,372,060	$399,240	$135,570	$81,760	$8,988,630
100-year	$26,975,040	$3,283,570	$1,187,270	$692,400	$32,138,280
200-year	$71,226,270	$12,333,190	$5,888,160	$3,496,240	$92,943,860
500-year	$233,928,070	$48,875,240	$27,126,790	$11,607,120	$321,537,220
1,000-year	$506,213,070	$124,731,460	$63,411,650	$31,979,440	$726,335,620

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annualized Loss Estimates

Table 4.88 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.88 Annualized Loss Estimates by Hazard - Wallingford

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$2,925,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$9,614,590
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Wallingford

Table 4.89 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Wallingford. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.89 Problem Statements - Wallingford

Primary Hazards of Concern
• **Hurricane/tropical storm** identified as #1 hazard by Town officials.
• **Riverine flooding** is also a major concern, especially along the Quinnipiac River and its tributaries which does result in flooding of homes (not just roadways).
• **Urban flooding** is periodically a problem in certain isolated areas.
• Tree-related hazards are among the Town's most significant recurring and widespread issues, particularly the downing of electric and communication lines during **hurricane/tropical storm** and **severe winter storm** events. ➢ Potential solutions/mitigation actions: regular tree pruning activities are in place, and the Town has made a lot of investments in protecting communications infrastructure from less severe and more frequent events, but impacts from large-scale events will be felt across a wide area.
• **Severe winter storms** have caused many concerns with regard to roof collapses. The Town does not have resident engineering expertise with regard to snow loads. ➢ Potential solutions/mitigation actions: educational material for building owners on steps to be taken with regard to assessing and minimizing threats to roofs from snow loads.
Geographic Areas of Concern
• **Gopians Mobile Home Park** (approx. 210-220 block of Main Street) – recurring severe/velocity flooding of mobile homes immediately adjacent to Quinnipiac River, located behind non-engineered earthen berm. Many residents are elderly and have had to be evacuated on multiple occasions. History of major damages and still deemed high risk area. ➢ Potential solutions/mitigation actions: • Acquisition/relocation was considered in past but not deemed cost-effective (will not pass FEMA's Benefit-Cost Analysis requirements). • Some elevations have been completed. • Pump system in place at berm, but deemed inadequate.
• **Center Street (Rt. 150) @ Wharton Brook** (near 550 block) – history of flash flood events that have flooded commercial buildings and residences along Center Street. Roadway flooding presents severe life/safety threat (multiple rescues and one past fatality). Believed to be a brush/debris issue associated with culverts and drainage system.
• **North Turnpike Road @ River Road** (near Fitness 4000) – past flooding of basements and some first floors in this area.
• **Fritz Place** – periodic flooding reported.

• **West Dayton Hill Road @ Dayton Pond Dam** – reported periodic flooding in areas surrounding of dam (classified as moderate hazard potential).
• **S. Colony Road @ S. Elm Street** – periodic flooding of intersection
• **N. Main Street Ext. @ Beaumont Road** – reported flooding issues surrounding existing detention basin.
• **Hampton Trail @ Grieb Trail** (area north of Spring Lake) – concerns with periodic flooding of Muddy River.
• **Mapleview Road @ Wharton Brook** – very periodic and isolated flooding.
Vulnerable Community Assets
• The Town's most significant current issue is the lack of adequate shelter capacity. Existing schools aren't able to serve as full-time shelters (no backup power supply). Town is far from meeting State's expectations for sheltering (ability to shelter and feed 10% of population, or 4,500 residents, for 72 hours). • The Central Fire HQ has a 40-year-old generator, which is need of replacement. • The Public Works Operation Center does not have an emergency generator.
• 13 critical facilities are within close proximity to either a high hazard or a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact any or all of these facilities.

West Haven

Vulnerable Assets—West Haven

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographic data with known hazard boundaries to determine the number of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.90**.

Table 4.90 Vulnerable Assets by Hazard - West Haven

Hazard	Number of Parcels[217]	Number of Buildings[218]	Critical Facilities[219]	Historic Assets[220]	Population[221]
Extreme Temperatures	0	0	0	0	6,912
Hurricane/Tropical Storm	14,434	20,634	36	N/A	55,564
Severe Thunderstorm	14,434	20,634	36	N/A	55,564
Severe Winter Storm/Nor'easter	14,434	20,634	36	N/A	55,564
Tornado	14,434	20,634	36	N/A	55,564
Coastal Erosion[222]	Unknown	Unknown	Unknown	N/A	Unknown
Dam Failure					
High Hazard	136	79	0	N/A	1,547
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[223]					
1-Percent-Annual-Chance	1,734	1,496	4	N/A	20,221
0.2-Percent-Annual-Chance	271	196	0	N/A	6,535
Zone VE	180	58	0	N/A	2,283
Category 1 Storm Surge	524	231	1	N/A	4,457
Category 2 Storm Surge	1,582	1,420	2	N/A	14,040

[217] Based on data provided by the City of West Haven.

[218] Based on data provided by the City of West Haven.

[219] Based on data provided by the City of West Haven.

[220] Data for historic assets was not available at the time of this analysis.

[221] Based on population numbers from 2010 census data.

[222] Data does not currently exist to determine vulnerable assets to the coastal erosion hazard.

[223] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Number of Parcels[217]	Number of Buildings[218]	Critical Facilities[219]	Historic Assets[220]	Population[221]
Category 3 Storm Surge	2,179	2,452	5	N/A	18,343
Category 4 Storm Surge	2,076	2,222	3	N/A	17,821
Sea Level Rise	979	640	2	N/A	12,012
Earthquake	14,434	20,634	36	N/A	55,564
Wildfire	299	267	2	N/A	3,860

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the City of West Haven also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.91**).[224]

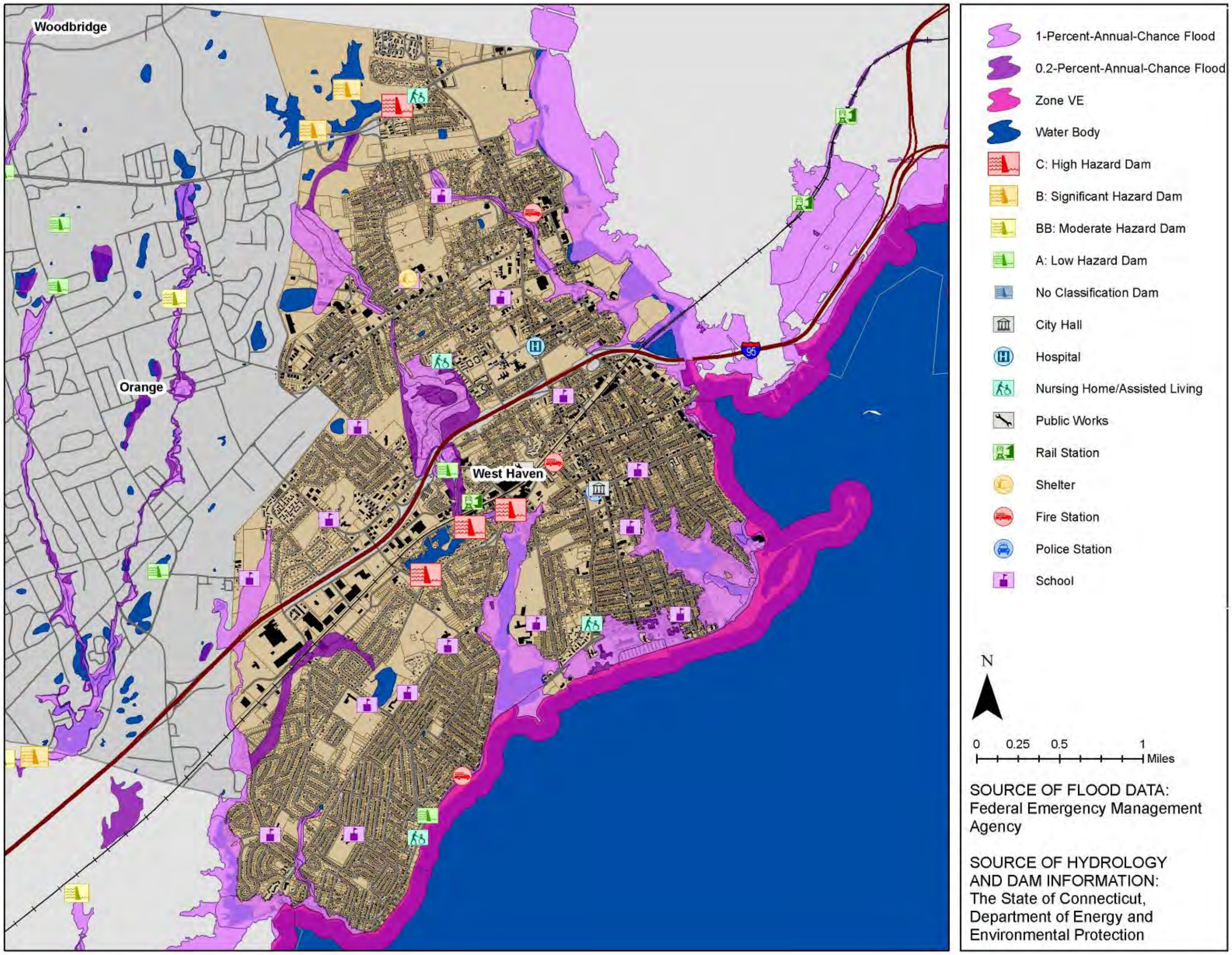
Table 4.91 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - West Haven

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	69	22	$1,112,901	$131,176	$1,244,077
Severe Repetitive Loss	22	2	$830,472	$0	$830,472

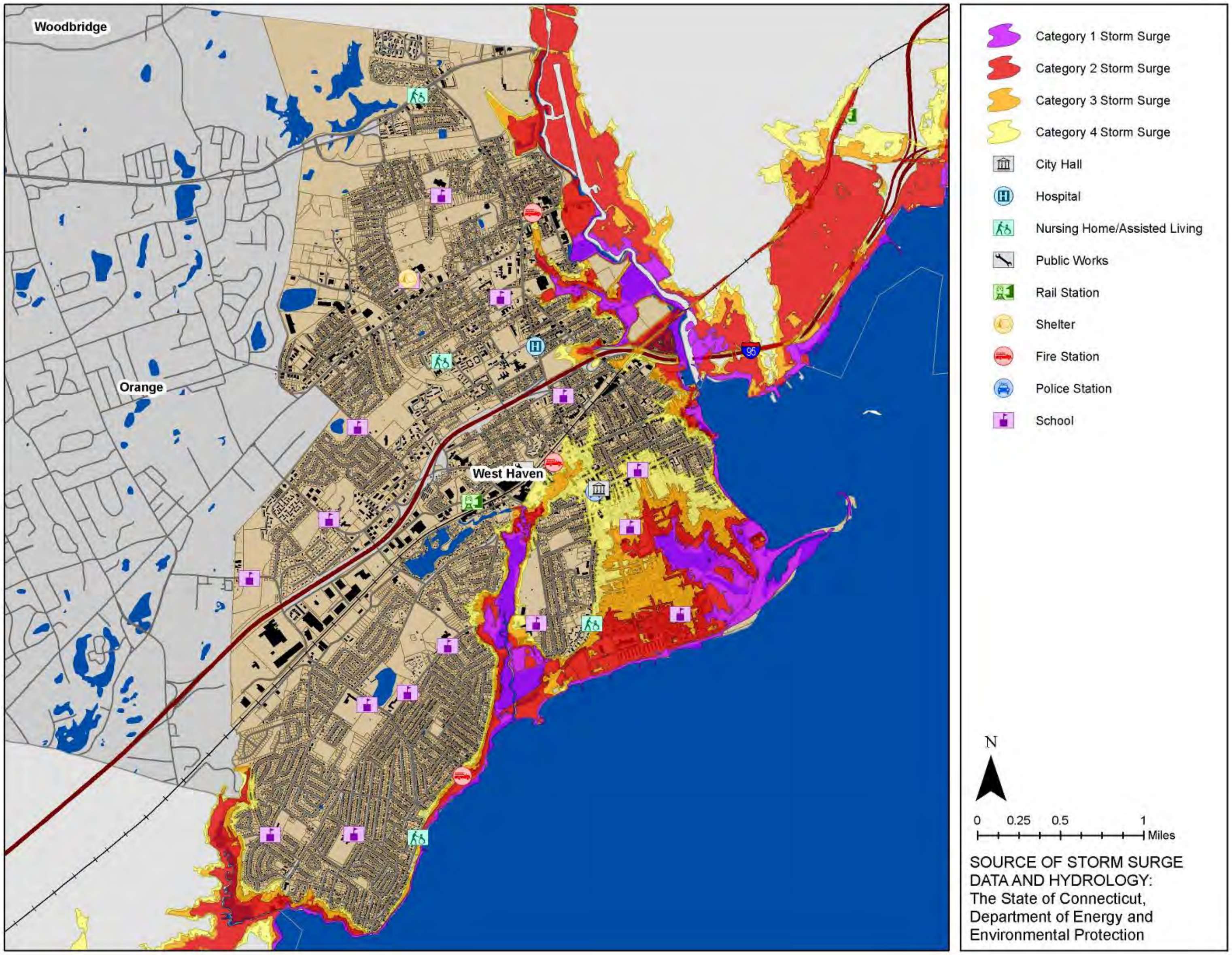
As of December 31, 2012, the City of West Haven had a total of 490 claims totaling $3,506,261 in losses for all NFIP-insured structures.

Maps 4.35 through **4.38** show flood, storm surge, sea level rise, and wildfire hazard areas within the City of West Haven.

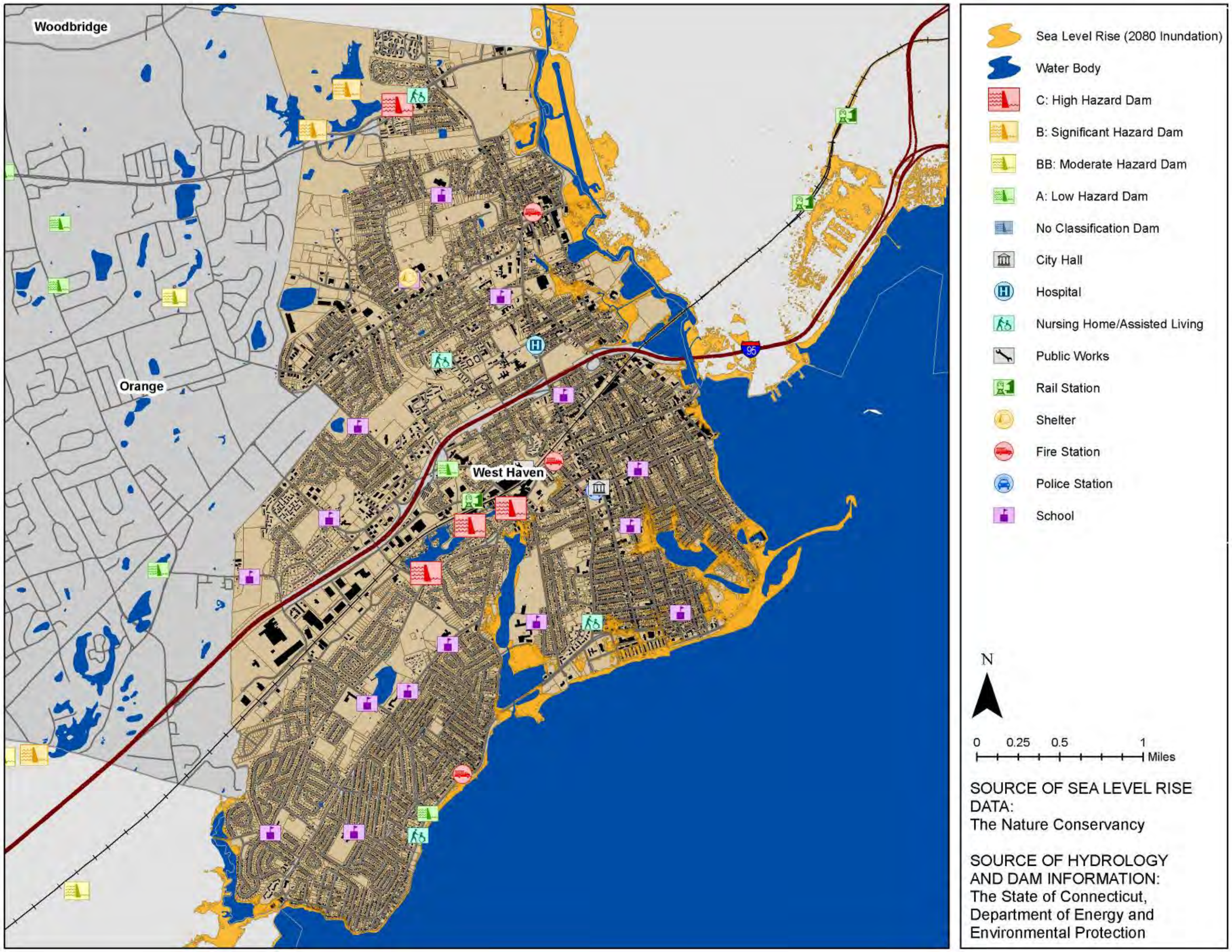
[224] Based on information provided by the Federal Emergency Management Agency current as of 12/31/2012.



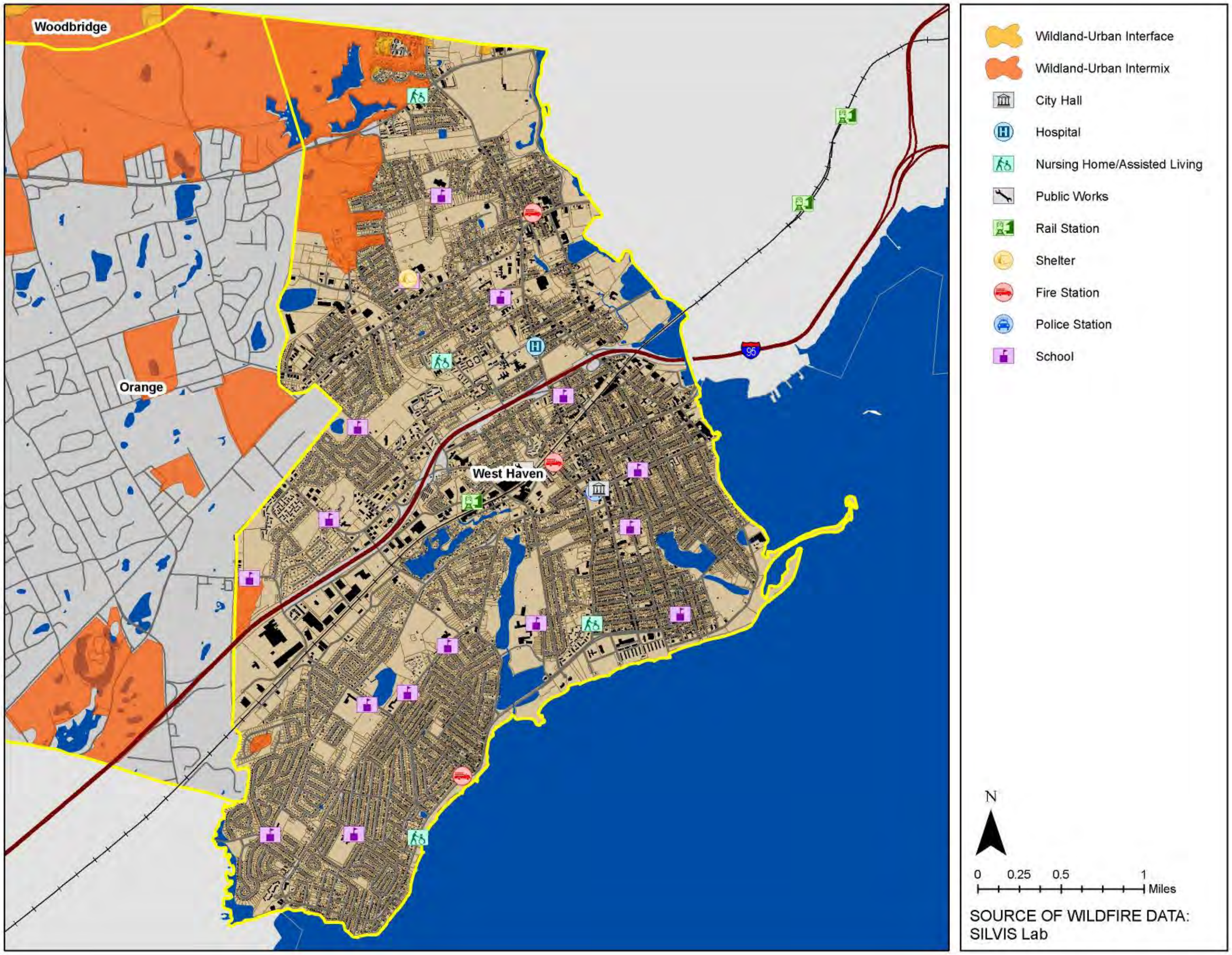
MAP 4.35 Flood Hazard Areas - West Haven



MAP 4.36 Storm Surge Hazard Areas - West Haven



MAP 4.37 Sea Level Rise Hazard Areas - West Haven



MAP 4.38 Wildfire Hazard Areas - West Haven

Potential Impacts – West Haven

Table 4.92 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.92 Potential Impacts by Hazard - West Haven

Hazard	Value of At-Risk Buildings[225]	Value of At-Risk Critical Facilities[226]	Value of At-Risk Historic Assets[227]
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$5,087,842,970	$469,286,790	N/A
Severe Thunderstorm	$5,087,842,970	$469,286,790	N/A
Severe Winter Storm/Nor'easter	$5,087,842,970	$469,286,790	N/A
Tornado	$5,087,842,970	$469,286,790	N/A
Coastal Erosion[228]	Unknown	Unknown	N/A
Dam Failure			
High Hazard	$4,745,580	$0	N/A
Significant Hazard	$0	$0	N/A
Drought	$0	$0	$0
Flood[229]			
1-Percent-Annual-Chance	$286,090,910	$20,126,330	N/A
0.2-Percent-Annual-Chance	$76,436,150	$0	N/A
Zone VE	$4,766,090	$0	N/A
Category 1 Storm Surge	$60,408,530	$15,485,890	N/A
Category 2 Storm Surge	$194,427,240	$15,868,860	N/A
Category 3 Storm Surge	$189,247,800	$26,335,050	N/A
Category 4 Storm Surge	$169,593,340	$19,338,678	N/A
Sea Level Rise	$164,380,510	$15,868,860	N/A

[225] Based on data provided by the City of West Haven.

[226] Based on data provided by the City of West Haven.

[227] Data for historic assets was not available at the time of this analysis.

[228] Data does not currently exist to determine potential impacts from the coastal erosion hazard.

[229] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Hazard	Value of At-Risk Buildings[225]	Value of At-Risk Critical Facilities[226]	Value of At-Risk Historic Assets[227]
Earthquake	$5,087,842,970	$469,286,790	N/A
Wildfire	$20,386,240	$165,970	N/A

Loss Estimates—West Haven

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.93**).

Table 4.93 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - West Haven

	Residential	Commercial	Industrial	Others	Total
Building Loss					
Building	$18,002,000	$2,690,000	$1,530,000	$630,000	$22,870,000
Contents	$11,790,000	$6,790,000	$3,730,000	$3,670,000	$25,980,000
Inventory	$0	$200,000	$670,000	$0	$870,000
Subtotal	**$29,810,000**	**$9,680,000**	**$5,930,000**	**$4,300,000**	**$49,720,000**
Business Interruption					
Income	$0	$60,000	$0	$10,000	$70,000
Relocation	$30,000	$10,000	$0	$0	$40,000
Rental Income	$10,000	$10,000	$0	$0	$20,000
Wage	$0	$60,000	$0	$13,000	$73,000
Subtotal	**$40,000**	**$140,000**	**$0**	**$23,000**	**$203,000**
TOTAL	**$29,850,000**	**$9,820,000**	**$5,930,000**	**$4,323,000**	**$49,923,000**

In addition, the Hazus-MH model estimates 1,840 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 4,852 people will seek temporary shelter in public shelters.

Coastal Flood

Estimated building losses for the coastal flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.94**).

Table 4.94 Coastal Flood Loss Estimates (100-year Event) - West Haven

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$5,350,000	$750,000	$130,000	$10,000	$6,240,000
Contents	$3,610,000	$1,660,000	$190,000	$50,000	$5,510,000
Inventory	$0	$30,000	$30,000	$0	$60,000
Subtotal	**$8,960,000**	**$2,440,000**	**$350,000**	**$60,000**	**$11,810,000**
Business Interruption					
Income	$0	$20,000	$0	$0	$20,000
Relocation	$10,000	$0	$0	$0	$10,000
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$10,000	$0	$80,000	$90,000
Subtotal	**$10,000**	**$30,000**	**$0**	**$80,000**	**$120,000**
TOTAL	**$8,970,000**	**$2,470,000**	**$350,000**	**$140,000**	**$11,930,000**

In addition, the Hazus-MH model estimates 201 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 445 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.95** and **4.96**.

Table 4.95 Number of Buildings Damaged - West Haven

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	24	1	0	0	25
50-year	327	37	1	0	365
100-year	1,590	273	11	2	1,876
200-year	3,550	963	69	29	4,611
500-year	5,622	2,760	481	238	9,101
1,000-year	5,806	4,251	1,270	690	12,017

Table 4.96 Building-Related Economic Losses - West Haven

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$882,340	$0	$0	$0	$882,340
50-year	$12,573,620	$296,860	$84,530	$48,450	$13,003,460
100-year	$42,928,810	$2,685,070	$906,910	$627,750	$47,148,540
200-year	$108,316,340	$10,653,770	$4,561,720	$2,547,740	$126,079,570
500-year	$345,118,290	$45,710,010	$19,828,250	$8,885,470	$419,542,020
1,000-year	$709,616,980	$115,139,360	$43,690,920	$19,257,130	$887,704,390

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annalized Loss Estimates

Table 4.97 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.97 Annualized Loss Estimates by Hazard - West Haven

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$3,643,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Coastal Erosion[230]	Unknown
Dam Failure	Negligible
Drought	Negligible
Flood (Riverine)	$1,457,500
Flood (Coastal)	$3,114,990
Sea Level Rise	N/A
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—West Haven

Table 4.98 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the City of West Haven. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.98 Problem Statements - West Haven

Primary Hazards of Concern
• Tree-related hazards are cited as the City's biggest concern, particularly the downing of electric and communication lines during **hurricane/tropical storm** and **severe winter storm** events.
• **Urban flooding** is also a widespread concern, with major stormwater drainage issues in many localized areas across the City that are exacerbated by riverine and coastal sources of flood inundation along much of the City's borders, and backflow from existing stormwater systems caused by bottlenecks and inadequate detention/retention areas. ➢ Potential solutions/mitigation actions: update stormwater management / master drainage study and plan

[230] Data does not currently exist to determine annualized losses from the coastal erosion hazard.

• **Coastal flooding** (storm-related and often resulting from high tides) and **sea level rise**.
• **Coastal Erosion** – constant, recurring erosion along shoreline in addition to episodic storm events. Sand is replaced every year. Existing granite/rock structures along shoreline have exacerbated coastal erosion problems.
Geographic Areas of Concern
• **Morgan Lane @ Railroad Underpass** (between Heffernan Drive and Island Lane, near Yale West) – frequent and severe flash flooding concern with one recorded fatality.
• **Allingtown area (Route 1 @ Campbell Avenue, near University of New Haven)** – very frequent urban flooding problems across area (2-3 times per year) caused by inadequate drainage, and backflow from existing stormwater system. Has resulted in flooding to dormitories, vehicles, etc.
• **West Main Street @ Painter Drive** – urban flooding problems, even with minimal rainfall amounts (much of water comes down from Allington area). Some basement flooding reported in area. ➢ Potential solutions/mitigation actions: Elm Street drainage project was designed to alleviate some problems, but hasn't fully done so.
• **West Spring Street (near VA hospital campus)** – area experiences velocity flooding caused by runoff from Veterans Affairs (VA) Hospital site, with impacts to public housing. Problems could get worse with potential paving of adjacent park (major concern for City). Cove River runs between West Spring Street and Coleman Street.
• **Campbell Avenue and Washington Avenue at Railroad Underpasses; Elm Street** – area subject to roadway and intersection flooding
• **Water Street Bulkhead** – ongoing project to extend the bulkhead, but not long enough to protect areas currently planned for future commercial development (brownfield site).
• **Ocean Avenue (areas south of South Street)** – significant concerns with regard to coastal erosion (south of existing shoreline protection structures).
• **Area around 3rd Avenue Extension (Morris Cove area)** – this area includes Court Street, Peck Avenue, and the Old Field Creek floodplain and experiences repetitive residential flooding. There is also an old dump in this area.
Vulnerable Community Assets
• Existing sewage treatment plant located in floodplain, with history of frequent flooding issues at plant and flash flooding of access road. Area can become isolated after even 2-3" of rainfall.
• High school is located in floodplain of Cove River. Facility does not serve as shelter but does house the City's mainframe computer systems.
• Evacuation routes are threatened by flooding, which may quickly become impassable on short notice. • Potential solutions/mitigation actions: Regional evacuation study or plan could address deficiencies in system; must be coordinated with surrounding jurisdictions and State.
• Surfside Senior Housing (200 Oak Street) – located along coast and has required mandatory evacuation during past storms.
• Morrissey Manor Senior Housing (Bayshore Drive) –located along coast and has required mandatory evacuation during past storms.
• A large number of critical facilities are within close proximity to either a high hazard or a significant hazard dam. Further study is necessary to determine if a dam failure could potentially impact any or all of these facilities. • A large number of critical facilities are located in various storm surge inundation areas.

Woodbridge

Vulnerable Assets—Woodbridge

Vulnerable assets were identified by intersecting GIS-based asset inventories and demographics data with known hazard boundaries to determine the numbers of parcels, buildings, critical facilities, historic assets, and populations exposed to each hazard. This results in an estimation of vulnerable assets by hazard as shown in **Table 4.99**.

Table 4.99 Vulnerable Assets by Hazard - Woodbridge

Hazard	Number of Parcels[231]	Number of Buildings[232]	Critical Facilities[233]	Historic Assets[234]	Population[235]
Extreme Temperatures	0	0	0	0	1,718
Hurricane/Tropical Storm	3,585	2,048	10	N/A	8,990
Severe Thunderstorm	3,585	2,048	10	N/A	8,990
Severe Winter Storm/Nor'easter	3,585	2,048	10	N/A	8,990
Tornado	3,585	2,048	10	N/A	8,990
Dam Failure[236]					
High Hazard	326	433	1	N/A	1,666
Significant Hazard	0	0	0	N/A	0
Drought	0	0	0	0	0
Flood[237]					
1-Percent-Annual-Chance	276	81	1	N/A	3,282
0.2-Percent-Annual-Chance	125	34	0	N/A	2,750
Earthquake	3,585	2,048	10	N/A	8,990
Wildfire	3,557	5,366	8	N/A	8,990

[231]Based on data provided by the Town of Woodbridge.

[232]Based on data provided by the Town of Woodbridge.

[233] Based on data from Hazus-MH.

[234] Data for historic assets was not available at the time of this analysis.

[235] Based on population numbers from 2010 census data.

[236] Dam failure inundation mapping was available for Lake Chamberlain Dam, Lake Watrous Dam, and Lake Dawson Dam. Inundation mapping was not available for 18 other dams located in the Town of Woodbridge.

[237] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the Town of Woodbridge also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (see **Table 4.100**).[238]

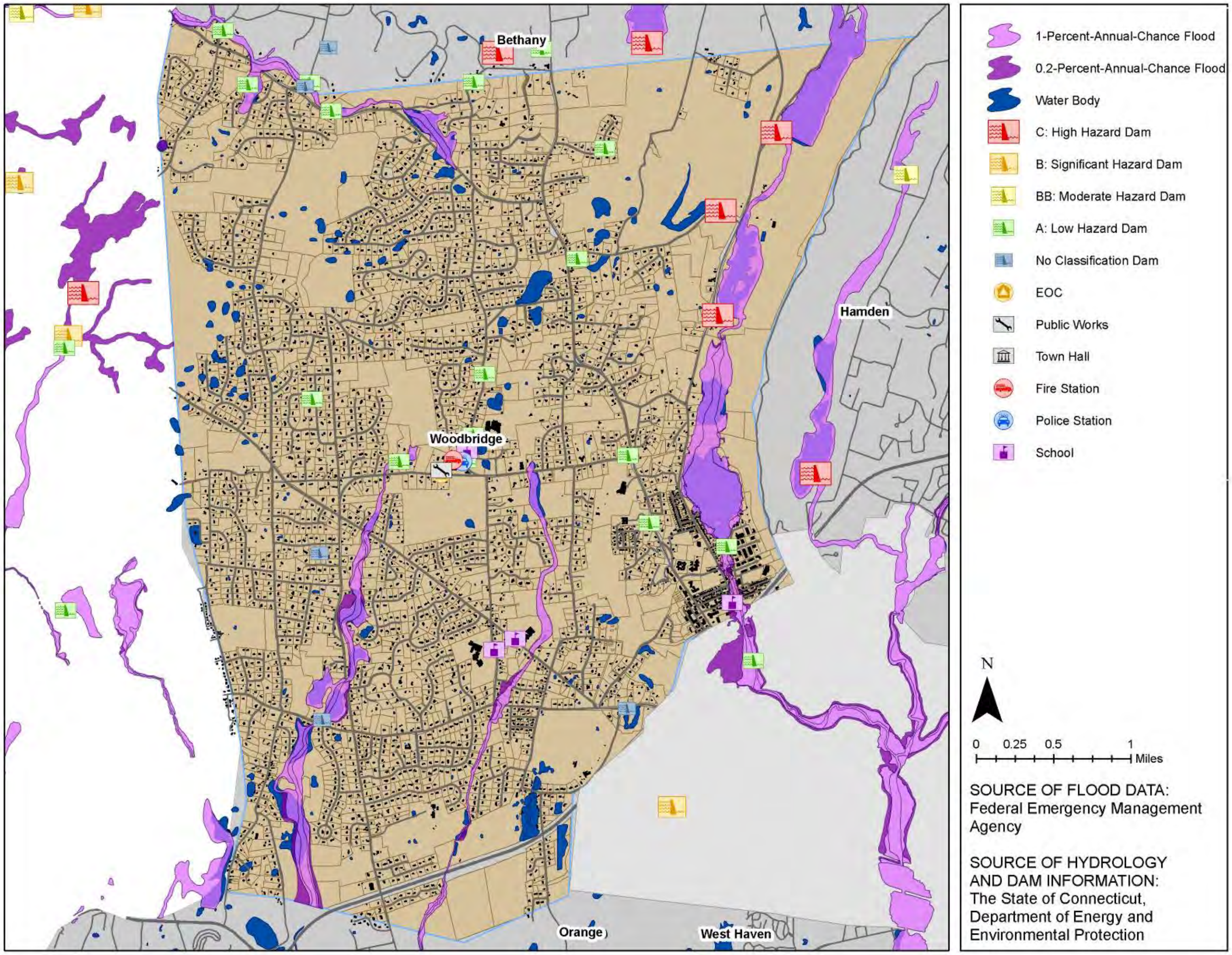
Table 4.100 Repetitive Flood Loss and Severe Repetitive Flood Loss Summary - Woodbridge

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss	27	7	$139,177	$80,994	$220,171
Severe Repetitive Loss	0	0	$0	$0	$0

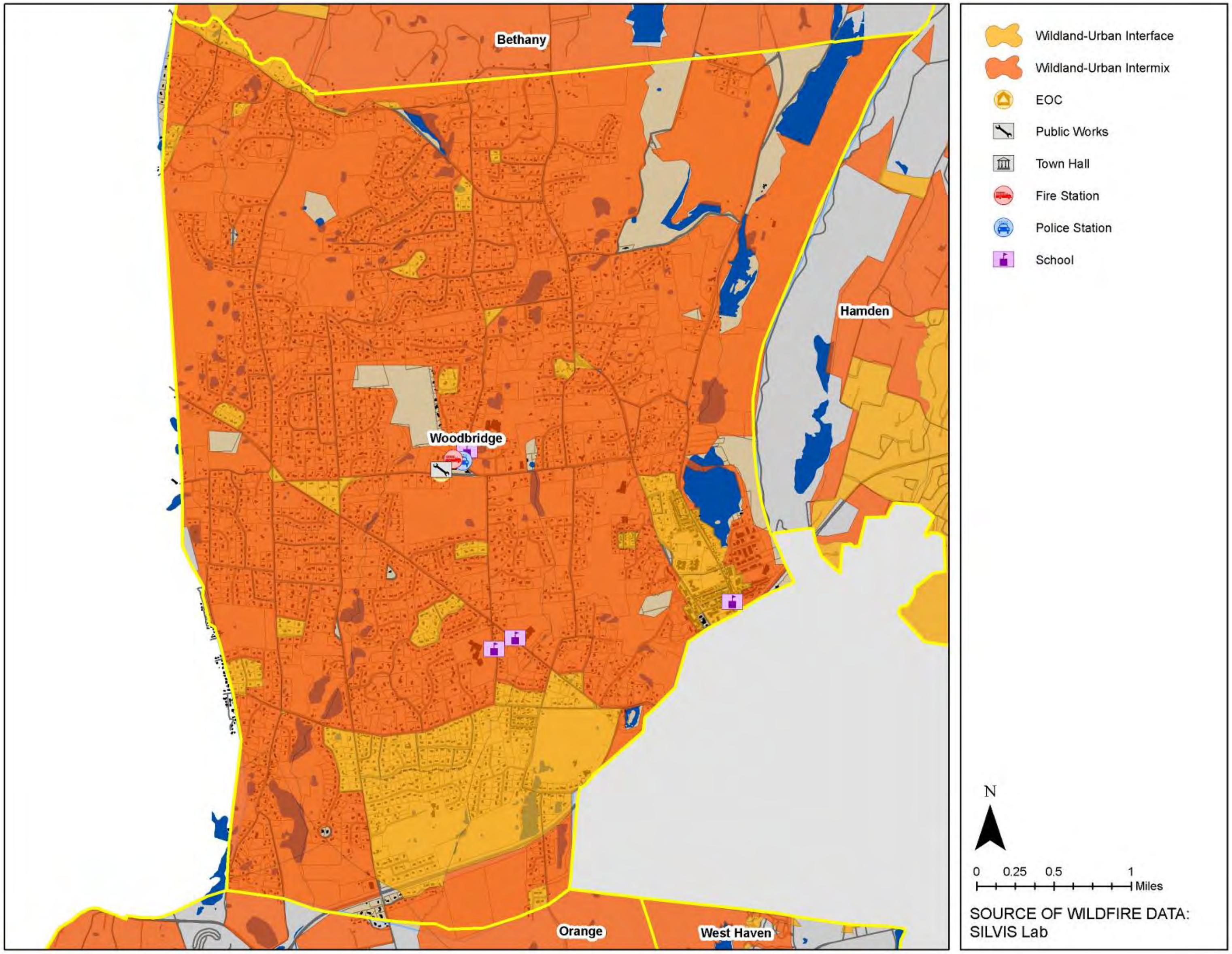
As of December 31, 2012, the Town of Woodbridge had a total of 67 claims totaling $509,909 in losses for all NFIP-insured structures.

Maps 4.39 and **4.40** show flood and wildfire hazard areas within the Town of Woodbridge.

[238] Based on information provided by the Federal Emergency Management Agency current as of 11/30/2012.



MAP 4.39 Flood Hazard Areas - Woodbridge



MAP 4.40 Wildfire Hazard Areas - Woodbridge

Potential Impacts—Woodbridge

Table 4.101 shows the total estimated value of improved parcels (parcels that contain at least one building), critical facilities, and historic assets that intersect with known hazard areas, as an indicator of the potential impacts should a hazard event occur.

Table 4.101 Potential Impacts by Hazard - Woodbridge

Hazard	Value of At-Risk Parcels[239]	Value of At-Risk Critical Facilities[240]	Value of At-Risk Historic Assets[241]
Extreme Temperatures	$0	$0	$0
Hurricane/Tropical Storm	$1,082,895,000	$53,778,136	N/A
Severe Thunderstorm	$1,082,895,000	$53,778,136	N/A
Severe Winter Storm/Nor'easter	$1,082,895,000	$53,778,136	N/A
Tornado	$1,082,895,000	$53,778,136	N/A
Dam Failure			
High Hazard	$320,423,000	$62,576	N/A
Significant Hazard	$0	$0	N/A
Drought	$0	$0	$0
Flood[242]			
1-Percent-Annual-Chance	$600,453,000	$62,576	N/A
0.2-Percent-Annual-Chance	$502,774,000	$0	N/A
Earthquake	$1,082,895,000	$53,778,136	N/A
Wildfire	$1,082,895,000	$43,022,509	N/A

[239] Based on estimated exposure values from Hazus-MH (building values only).

[240] Based on estimated building values from Hazus-MH.

[241] Data for historic assets was not available at the time of this analysis.

[242] Results for the flood hazard are not cumulative. Numbers and values of assets for events of increasing magnitude should be read as "in addition to" the preceding magnitudes.

Loss Estimates—Woodbridge

Detailed Hazus-MH Loss Estimates

Riverine Flood

Estimated building losses for the riverine flood hazard generated by Hazus-MH are broken down 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 the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood (see **Table 4.102**).

Table 4.102 Riverine Flood Loss Estimates (1-Percent-Annual-Chance Flood) - Woodbridge

	Residential	Commercial	Industrial	Others	Total
Direct Building Loss					
Building	$2,420,000	$860,000	$200,000	$300,000	$3,780,000
Contents	$1,400,000	$2,220,000	$460,000	$980,000	$5,070,000
Inventory	$0	$20,000	$60,000	$120,000	$190,000
Subtotal	**$3,820,000**	**$3,100,000**	**$720,000**	**$1,400,000**	**$9,040,000**
Business Interruption					
Income	$0	$30,000	$0	$0	$30,000
Relocation	$0	$0	$0	$0	$0
Rental Income	$0	$0	$0	$0	$0
Wage	$0	$20,000	$0	$10,000	$20,000
Subtotal	**$0**	**$50,000**	**$0**	**$10,000**	**$50,000**
TOTAL	**$3,820,000**	**$3,150,000**	**$720,000**	**$1,410,000**	**$9,100,000**

In addition, the Hazus-MH model estimates 113 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 148 people will seek temporary shelter in public shelters.

Hurricane Wind

Hazus-MH was used to model probabilistic hurricane wind impacts for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year events. These annualized return periods compare to the Saffir-Simpson Scale in the following way:

- 10-year Tropical Depression/Tropical Storm
- 20-year Tropical Storm
- 50-year Tropical Storm/Category 1
- 100-year Category 1/Category 2
- 200-year Category 2
- 500-year Category 3
- 1000-year Category 3

The number of buildings estimated to be damaged and the resulting building-related economic losses are shown in **Tables 4.103** and **4.104**.

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Table 4.103 Number of Buildings Damaged - Woodbridge

Return Period	Minor	Moderate	Severe	Destruction	Total
10-year	0	0	0	0	0
20-year	2	0	0	0	2
50-year	26	1	0	0	27
100-year	184	13	0	0	197
200-year	501	65	3	1	570
500-year	1,043	283	32	15	1,373
1,000-year	1,299	547	114	60	2,020

Table 4.104 Building-Related Economic Losses - Woodbridge

Return Period	Residential	Commercial	Industrial	Others	Total
10-year	$0	$0	$0	$0	$0
20-year	$3,700	$0	$0	$0	$3,700
50-year	$1,418,820	$52,340	$5,540	$12,060	$1,488,760
100-year	$4,703,540	$342,540	$37,180	$102,810	$5,186,070
200-year	$11,676,180	$1,403,340	$181,440	$469,680	$13,730,640
500-year	$41,904,580	$5,003,870	$860,010	$1,613,890	$49,382,350
1,000-year	$97,475,380	$11,850,480	$2,143,410	$3,098,930	$114,568,200

Earthquake

An earthquake scenario was developed using Hazus-MH that models a magnitude 7 probabilistic earthquake with a 100-year return period. The analysis shows no estimated building-related losses within the jurisdiction.

Annualized Loss Estimates

Table 4.105 shows annualized loss estimates for each hazard. Estimates for the hurricane/tropical storm, flood, and earthquake hazards were derived from Hazus-MH results. Estimates for the other hazards are based on historical damages.

Table 4.105 Annualized Loss Estimates by Hazard - Woodbridge

Hazard	Annualized Loss Estimate
Extreme Temperatures	Negligible
Hurricane/Tropical Storm (Wind)	$489,000
Severe Thunderstorm	Negligible
Severe Winter Storm/Nor'easter	$14,375
Tornado	$243,665
Dam Failure	Negligible
Drought	Negligible
Flood	$1,083,620
Earthquake	Negligible
Wildfire	Negligible

Problem Statements—Woodbridge

Table 4.106 provides statements of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets within the Town of Woodbridge. If applicable, any noted potential solutions or mitigation actions are discussed with the problem statements.

Table 4.106 Problem Statements - Woodbridge

Primary Hazards of Concern
• Atmospheric hazards are of greatest concern to the Town, especially **hurricane/tropical storm**, and **severe winter storm/nor'easter** – particularly with regard to power outages and disruptions to communications systems. Elderly residents throughout the Town have also identified potential roof collapses due to heavy snow loads as significant concern.
• **Riverine flood** is also a significant concern in localized areas – mostly occurs along private property, developed prior to floodplain mapping and Town floodplain management regulations. Occasional isolation of some residential properties can be problematic.
• **Wildfire** is a moderate hazard of concern, as the Town owns 1,000+ acres of open land but maintains aggressive fuels management program and most fires are quickly identified and contained or suppressed. • Potential solutions/mitigation actions: bolster wildfire planning efforts for periods of extreme drought
Geographic Areas of Concern
• **Litchfield Turnpike (Route 69) @ Warren Road** – floodwaters from Konolds Pond reach roadway during severe rainfall events. Approximately 5 residential properties are considered by Town to be potentially at risk. ➢ Potential solutions/mitigation actions: sediment removal from lake to increase storage capacity.
• **Litchfield Turnpike @ Bradley Road** (West River Bridge) – area experiences velocity flows and flooding along West River, upstream and downstream of bridge. This is home to residential and commercial properties. ➢ Potential solutions/mitigation actions: channel improvements and removal of downstream Pond Lily Dam at Lily Pond in New Haven should alleviate flooding. The Town of Woodbridge has completed studies and has received grant funding to support the design of the dam removal project, which is being done for flood mitigation and habitat restoration purposes. The Connecticut Fund for the Environment has assumed a leadership role in the final design and permitting study, which is nearly complete. The Town is also working with the New Haven Land Trust, American Rivers, Solar Youth, and other non-profit organizations in addition to CT DEEP's Bureau of Natural Resources on the project.
• **Litchfield Turnpike @ Lucy Street / Merritt Avenue** – Merritt Avenue Bridge replacement has created flooding problems along the West River at 10+ year return period event. Several homes have experienced minor flooding in this area, north and south of the Merritt Parkway, and some businesses have been impacted. Scouring at bridge site has also been reported. ➢ Potential solutions/mitigation actions: • Replacement of the Merritt Avenue Bridge with a new bridge that is designed to convey increased flows along the West River. • Channel improvements and removal of downstream Pond Lily Dam at Lily Pond in New Haven (described above) should alleviate flooding. • Routine sediment control and debris removal at bridge.
• **Seymour Road** area in far northwest area of town (at confluence of Bladens River and Black Brook) – experiences occasional nuisance flooding to roads in low-density residential area. No structural flood damages reported.
• **West Rock Ridge State Park** – area of concern for wildfire ignitions (campers/hikers may start fires here).

Vulnerable Community Assets
• Telephone communications – land lines and cellular towers are vulnerable to wind/tree damage and have gone down in the past, leaving the Town without good ways to communicate with residents (used pamphlets after recent storms).
• 1 of 3 extended care facilities does not have backup generator power (Emeritus at Woodbridge).
• One critical facility is within close proximity to a high hazard dam. Further study is necessary to determine if a dam failure could potentially impact any or all of these facilities. • One critical facility is located in the 1-percent-annual-chance floodplain.

Conclusions on Hazard Risk

The vulnerability assessments completed for each participating jurisdiction include both quantitative and qualitative information to help determine the potential impact of each identified hazard on community assets. These findings were used in combination with the information included in the *Hazard Analysis* section to prioritize hazard risks for the South Central Region.

To assist in this process, the Advisory Committee developed and applied a "Priority Risk Index" (PRI). The PRI is a tool designed to (1) summarize relevant hazard profile information and (2) measure the degree of relative risk each hazard poses to the planning area based on that information. The PRI was used to assist the Advisory Committee in ranking and prioritizing hazards based on a variety of characteristics including location, probability, potential impact, warning time, and duration.

The PRI results in numerical values that allow identified hazards to be ranked against one another – the higher the PRI value, the greater the hazard risk. PRI values are obtained by assigning varying degrees of risk to each of the five characteristics, or categories. Each degree of risk has been assigned an index value (1 to 4) and an agreed upon weighting factor, as summarized in **Table 4.107**.

To calculate the PRI value for a given hazard, the assigned index value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the below equation:

PRI VALUE =

(LOCATION x .20) + (PROBABILITY x .30) + (POTENTIAL IMPACT x .30) + (WARNING TIME x .10) + (DURATION x .10)

According to the weighting scheme applied for the South Central Region, the highest possible PRI value is 4.0. Prior to being finalized, PRI values for each hazard were reviewed and accepted by the Advisory Committee.

Table 4.107 Priority Risk Index

PRI Category	Degree of Risk			Assigned Weighting Factor
	Level	Criteria	Index Value	
Location	Negligible	Less than 1% of planning area affected	1	20%
	Small	1-10% of planning area affected	2	
	Moderate	10-50% of planning area affected	3	
	Large	50-100% of planning area affected	4	
Probability	Unlikely	Less than 1% annual probability	1	30%
	Occasional	1-10% annual probability	2	
	Likely	10-90% annual probability	3	
	Highly Likely	90-100% annual probability	4	
Potential Impact *	Minor	Very few injuries, if any. Only minor property damage and minimal disruption to quality of life. Partial or complete shutdown of critical facilities for less than one day.	1	30%
	Limited	Minor injuries only. 10-25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple fatalities/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of fatalities/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one month.	4	
Warning Time	More than 24 hours		1	10%
	12 to 24 hours		2	
	6 to 12 hours		3	
	Less than 6 hours		4	

Duration	Less than 6 hours	1	10%
	6 to 24 hours	2	
	1 to 7 days	3	
	More than 1 week	4	

* Potential impact is based upon the estimated *maximum probable extent* (magnitude/severity) for each hazard based on historic events or future probability data, as shown in **Table 4.108**.

Table 4.108 Estimated Maximum Probable Extent

Hazard	Maximum Probable Extent
Extreme Temperatures	5 consecutive days with a heat index exceeding 100° or wind chill of less than 20°
Hurricane/Tropical Storm	Category 3 hurricane on Saffir-Simpson Hurricane Wind Scale
Severe Thunderstorm	Winds gusts in excess of 50 knots, hail measuring at least three-quarters of an inch in diameter, or tornado occurrence
Severe Winter Storm/Nor'easter	Intensity Index Category 3 on Classification Scale for Severe Winter Storms/Nor'easters
Tornado	EF-3 Rating on Enhanced Fujita Scale
Coastal Erosion	Long-term erosion rate of 2+ feet per year
Dam Failure	Complete failure of high hazard dam (Class C)
Drought	PDSI Value of -4.0 (Extreme Drought) on Palmer Drought Severity Index
Flood (3 Types):	
Riverine Flood	1 Percent Annual Chance Flood for <u>all</u> inland FEMA Special Flood Hazard Areas
Coastal Flood	Worst Case Storm Surge Inundation for Category 2 Hurricane
Urban Flood	10-year Design Storm Event
Sea Level Rise	1-meter SLR scenario for 2080s, no storm, medium inundation zone as mapped by The Nature Conservancy
Earthquake	Intensity VII on Modified Mercalli Intensity scale
Wildfire	100 acres burned along urban/wildland interface

Table 4.109 summarizes the degree of risk assigned for all identified hazards in the South Central Region based on the application of the PRI tool, along with the calculated PRI values.

Table 4.109 Summary of PRI Results

Hazard	Category/Degree Of Risk					PRI Value
	Location	Probability	Potential Impact*	Warning Time	Duration	
Extreme Temperatures	Large	Likely	Minor	More than 24 hours	1 to 7 days	**2.4**
Hurricane/Tropical Storm	Large	Likely	Catastrophic	More than 24 hours	6 to 24 hours	**3.2**
Severe Thunderstorm	Small	Highly Likely	Minor	Less than 6 hours	Less than 6 hours	**2.4**
Severe Winter Storm/Nor'easter	Large	Highly Likely	Critical	More than 24 hours	1 to 7 days	**3.3**
Tornado	Small	Occasional	Catastrophic	Less than 6 hours	Less than 6 hours	**2.7**
Coastal Erosion	Small	Highly Likely	Limited	More than 24 hours	More than 1 week	**2.7**
Dam Failure	Small	Unlikely	Critical	Less than 6 hours	6 to 24 hours	**2.2**
Drought	Large	Occasional	Minor	More than 24 hours	More than 1 week	**2.2**
Flood (3 Types):						
Riverine Flood	Moderate	Occasional	Catastrophic	More than 24 hours	1 to 7 days	**2.8**
Coastal Flood	Moderate	Likely	Catastrophic	More than 24 hours	6 to 24 hours	**3.0**
Urban Flood	Small	Highly Likely	Minor	Less than 6 hours	Less than 6 hours	**2.4**
Sea Level Rise	Small	Highly Likely	Limited	More than 24 hours	More than 1 week	**2.7**
Earthquake	Large	Occasional	Minor	Less than 6 hours	Less than 6 hours	**2.2**
Wildfire	Negligible	Highly Likely	Minor	Less than 6 hours	6 to 24 hours	**2.3**

The calculated PRI values were used to classify each hazard according to three defined risk levels (low, moderate, or high) as shown in **Table 4.110**. It should be noted that although some hazards are classified as posing "low" risk, their occurrence of varying or unprecedented magnitudes is still possible and will continue to be evaluated by each participating jurisdiction and during future plan updates.

Table 4.110 Conclusions on Hazard Risk

HIGH RISK	Severe Winter Storm/Nor'easter Hurricane/Tropical Storm Coastal Flood Riverine Flood
MODERATE RISK	Tornado Coastal Erosion Sea Level Rise Extreme Temperatures Severe Thunderstorm Urban Flood
LOW RISK	Wildfire Dam Failure Drought Earthquake

CHAPTER 5. CAPABILITY ASSESSMENT

Purpose

FEMA Requirement §201.6(c)(3)

Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs?

The purpose of conducting the capability assessment is to identify the strengths, weaknesses, gaps and opportunities for local governments within the planning area in terms of mitigating risks. The capability assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for the mitigation plan, but it ensures that those goals and objectives are realistically achievable under given local conditions.

The capability assessment must answer two questions:

1. Does the Plan document each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs?[243]
2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?[244]

The capability assessment includes a comprehensive examination of the following capabilities as summarized in **Table 5.111**.

Table 5.111 Capability Assessment Components

Components	Description
Planning and Regulatory Capabilities	Does the jurisdiction have plans in place that include natural hazards? Do the plans identify mitigation projects? Can the plan be used to implement mitigation actions?
Administrative and Technical Capabilities	What skills does the jurisdiction have and can they be used for mitigation planning?
NFIP Participation	What is the level of participation in each jurisdiction?
Financial Capabilities	Is the jurisdiction eligible for or have access to funding sources for hazard mitigation?
Education and Outreach Capabilities	What education and outreach programs are currently in place to communicate hazard-related information?
Safe Growth Analysis	Evaluates the extent to which each jurisdiction is positioned to grow safely relative to its natural hazards. Included are the following topical areas:

[243] 44 CFR 201.6(c)(3)

[244] 44 CFR 201.6(c)(3)(ii)

Components	Description
	• Land Use • Transportation • Environmental Management • Public Safety • Zoning Ordinance • Subdivision Regulations • Capital Improvement Program and Infrastructure Policies
Capability Assessment Conclusions	A summary of capability findings.

Review and Incorporation of Existing Plans

FEMA Requirement §201.6(b)(3)

[The planning process shall include] review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

The first step in the capability assessment was to gather and review existing plans to gain an understanding of the region's ability to mitigate risk.

Connecticut's 2010 Natural Hazard Mitigation Plan Update

The State of Connecticut, Department of Energy and Environmental Protection, with assistance from the Connecticut Department of Emergency Management and Homeland Security (DEMHS), prepared the 2010 state level Natural Hazard Mitigation Plan. This Plan was thoroughly reviewed for the purpose of ensuring consistency with this regional plan. For instance, the state placed some emphasis on the inclusion of climate change, something that has been replicated in this Plan. The SCRCOG Plan also includes Coastal Erosion and Sea Level Rise because of their potential impact to the region, something that may be included in future updates to the state level plan.

SCRCOG Jurisdiction Hazard Mitigation Plans

Five jurisdictions within the SCRCOG region have previously developed local hazard mitigation plans. SCRCOG staff intends to offer mitigation planning support to each of these jurisdictions as their plans expire. The SCRCOG vision is to create one fifteen-municipality multi-jurisdiction plan. The following four plans were reviewed for information relevant to the region.

1. Town of East Haven Hazard Mitigation Plan Update 2012, Town of East Haven, May 1, 2012
2. Town of Guilford Natural Hazard Mitigation Plan, Guilford, CT June 4, 2012
3. Natural Hazard Mitigation Plan, City of Milford, CT, April 12, 2007
4. City of New Haven Natural Hazard Mitigation Plan Update, June 15, 2011

Initial Draft of the 2013-2018 Conservation and Development Policies Plan for Connecticut, December 5, 2011

Review of this draft plan indicates the mitigation plan aligns with the priorities of the state. Two of the six growth management principles in this draft plan directly relate to mitigation and risk management.

1. Conserve and restore the natural environment, cultural and historic resources, and traditional rural lands.
2. Protect and ensure the integrity of environmental assets critical to public health and safety.

Plan of Conservation and Development, SCRCOG, July 2009

The South Central Regional Plan of Conservation and Development is a general guide for land use conservation and development for the fifteen-municipality region comprised of Bethany, Branford, East Haven, Guilford, Hamden, Madison, Meriden, Milford, New Haven, North Branford, North Haven, Orange, Wallingford, West Haven, and Woodbridge. The plan was developed and reviewed extensively with planning staff in each jurisdiction and by each jurisdiction's representative to the Regional Planning Commission (RPC) in coordination with their chief elected officials. For the purposes of this mitigation plan, the Plan of Conservation and Development was used for information regarding demographics, land use, transportation and general emergency management information.

Participating Jurisdictions Plans of Conservation and Development

The following plans were reviewed in detail. This mitigation Plan is consistent with the intent of each jurisdiction's plan of conservation and development. Information particularly relevant to the mitigation plan is included below.

1. Town of Bethany, Town Plan of Conservation and Development, January 1, 1999
2. Branford's Window to the Future, 2008 Plan of Conservation and Development
    - Branford's Plan includes several areas that are especially relevant to the mitigation plan; including sea level rise preparation, stormwater management and flooding. It mentions how sea level rise will increase flooding and may impact emergency services. The named action is "be cognizant and vigilant about how global sea level rise may affect existing and future development in coastal areas."[245]
    - To address stormwater the plan calls for continued "resources (time and money) to addressing and managing drainage issues."[246]
    - The flooding section is more detailed. It specifically names the Meadow Street, Totoket Road and Briarwood Lane as areas of concern. The plan mentions considering participation in the Community Rating System (CRS) program to access credit for floodplain management."[247]

[245] Branford's Window to the Future, 2008 Plan of Conservation and Development, December 15, 2008. P.23.

[246] Branford's Window to the Future, 2008 Plan of Conservation and Development, December 15, 2008. P.88.

[247] Branford's Window to the Future, 2008 Plan of Conservation and Development, December 15, 2008. P.89.

3. Hamden Plan of Conservation and Development, September 1, 2004
   - Flood Control is a category in the Hamden Plan of Conservation and Development. The scope of this section is limited but does mention participation in FEMA's National Flood Insurance Program (NFIP).[248]
4. A Guide to Madison's Future, Madison Plan of Conservation & Development, 2000
   - This plan includes coastal management throughout. According to Connecticut State statute coastal resources includes "the coastal waters of the state, their natural resources, related marine and wildlife habitat and adjacent shorelands, both developed and undeveloped, that together form an integrated terrestrial and estuarine ecosystem."[249]
5. Town of North Branford, Plan of Conservation and Development, December 21, 2009
6. The Town of North Haven Plan of Conservation and Development, April 15, 2005
   - This plan names six areas of concern in terms of flooding due to stormwater. These are:
     1. Pine Brook
     2. Route 22 and the Hartford Turnpike
     3. Elm Street & Stoddard Avenue
     4. Muddy River (Sheffield Road to Patten Road)
     5. Muddy River (Spring Road to Old Maple)
     6. Little River (Harten's Pond to Palmer Road)
   - The plan names many objectives under the goal "Balance of Conservation and Preservation of Natural Resources as Part of Future Development Activity," that directly relate to flooding and stormwater management.[250]
7. City of West Haven Plan of Conservation and Development, February 2004
   - This plan mentions that most of West Haven has already been developed. Therefore, a "balance between conservation, preservation and development" is necessary for the City of West Haven to meet their land use objectives.
8. Envision Wallingford 2015, Plan of Conservation and Development, 2004
   - This plan mentions the need for a "town-wide comprehensive infrastructure plan (water, sewer, electric, traffic, etc.) Consisting of:
     1. A needs assessment to determine what improvements will be necessary to accommodate anticipated growth during a 10-20 year period.
     2. Specific plans to best implement those capital improvements.
     3. A capital funding plan to finance the necessary construction."[251]

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[248] Hamden Plan of Conservation and Development, September 1, 2004, p.47.
[249] Madison Plan of Conservation & Development, 2000, p.66.

[250] Town of North Haven, Plan of Conservation and Development, April 15, 2005, p.91.

[251] Town of Wallingford, Plan of Conservation and Development 2004, p.20.

9. Town of Woodbridge Plan of Conservation and Development
    - This plan does not specifically address natural hazards. However, one of the named Road Goals is, "that the Town adopt a policy promoting tree canopy growth over roadways consistent with and mindful of public safety considerations. Line-of-sight ordinances and regulations meant to address the growth of trees and shrubs should be reviewed with special consideration for safety concerns."[252]

Regional Emergency Support Plan
The Federal Government and the State of Connecticut have divided the State's emergency management efforts into five geographic areas. The South Central Region is part of DEMHS[253] Region 2. This 30-jurisdiction area encompasses all of the South Central Region jurisdictions, the Valley Council of Governments (Shelton, Derby, Ansonia and Seymour), and jurisdictions in other regional planning agencies including Cheshire, Middlefield, Durham, Haddam, Killingworth, Clinton, Chester, Deep River, Essex, Westbrook and Old Saybrook. Each DEMHS Region, working with their Regional Emergency Planning Team, made up of representatives from all public safety disciplines and planning organizations, releases its own Emergency Support Plan and Public Safety documents. Region 2 updated its Regional Emergency Support Plan in 2012.

Data Gathering Methods

To facilitate data gathering from the participating jurisdictions, two capability assessment surveys were produced. The consulting team used one internally during the Municipality meetings, which served as a checklist for the consulting team. The other was distributed to each jurisdiction via the Advisory Committee. Advisory Committee members were asked to complete the survey with assistance from other members of their jurisdiction. A blank Capability Assessment Questionnaire appears in Appendix I.

The Capability Assessment Data Gathering survey included the following six sections:

1. Planning and Regulatory Capabilities
2. Administrative and Technical Resources
3. Financial Resources
4. Education and Outreach Capabilities
5. Floodplain Management
6. Safe Growth Analysis

[252] Town of Woodbridge, Plan of Conservation and Development, 2005, p.52.
[253] CT Department of Emergency Services and Public Protection (DESPP), Division of Emergency Management and Homeland Security (DEMHS).

Planning and Regulatory Findings

Planning and regulatory capability is based on what plans or programs exist and how they are implemented. Their existence and use indicates a jurisdiction's commitment and ability to manage development and disasters in a safe and effective manner.

Table 5.112 indicates with a check mark the positive responses each jurisdiction made to the question of existence of each of the plans listed in the first column. Many of the positive responses indicate compliance with state standards. Also, for some of the smaller jurisdictions their plans may overlap. For instance, land use planning may in fact be covered in the comprehensive master plan.

Table 5.112 Planning & Regulatory Capabilities

	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
Comprehensive Master Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Capital Improvements Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Economic Development Plan	✓	✓	✓	✓			✓	✓		✓
Local Emergency Operations Plan	✓	✓	✓	✓	✓		✓	✓	✓	✓
Continuity of Operations Plan	✓		✓			✓	✓	✓	✓	
Transportation Plan	✓	✓						✓	✓	
Stormwater Management Plan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Community Wildfire Protection Plan										
Disaster Recovery Plan					✓		✓			✓
Coastal Zone Management Plan		✓				✓	✓		✓	
Climate Change Adaptation Plan							✓			
Building Codes Adequately Enforced	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zoning Ordinance Adequately Enforced	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Land Use Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zoning Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
Subdivision Ordinance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Natural Hazard Specific Ordinance	✓				✓		✓			✓
Acquisition of Land for Open Space & Recreation	✓	✓	✓	✓	✓		✓		✓	✓

Any additional notes provided by a jurisdiction are included in Table 5.113.

Table 5.113 Planning & Regulatory Capability Comments

Jurisdiction	Comments
Bethany	Regulation revisions regarding stormwater, low impact development practices and minimizing impervious area are covered in new regulations; more comprehensive planning and regulatory enforcement are desired
Branford	Comprehensive plan does not address hazard mitigation
Hamden	Comprehensive plan addresses flooding only and does not specify any mitigation projects; stormwater management plan focuses on water quality only

Table 5.114, from Connecticut's 2010 Natural Hazard Mitigation Plan Update, shows how local jurisdictions implement state and federal regulations.

Table 5.114 Local Plans and Regulations Used by Jurisdictions

Plan or Regulations	Significance to Hazard Mitigation
Emergency Management Plans	Assist local jurisdictions in the preparation and implementation of resources prior to and during an emergency, including natural hazard events. The plans help local jurisdictions assess the locations of vulnerable areas within their communities and how to handle these areas during an emergency. This plan may be a good source of information for local risk assessment activities.
Floodplain Management Regulations/ Ordinance	These regulations assist a jurisdiction in effectively managing its floodplain areas. These regulations are usually part of a jurisdiction's land use regulations. However depending on the jurisdiction, they may take the form of a stand-alone municipal ordinance. These regulations may also require specific minimum design/construction/or development elements, which must be complied with for health and safety reasons.

Plan or Regulations	Significance to Hazard Mitigation
Land Use Regulations (e.g., zoning regulations, subdivision regulations, stormwater regulations)	Primary tool for jurisdiction for shaping the character and development of a community. Land use regulations may restrict particular uses or structures from being located in hazard vulnerable areas in a jurisdiction. These regulations may also require specific minimum design/construction/or development elements, which must be complied with for health and safety reasons.
Wetland Regulations	Helps a jurisdiction maintain and protection the integrity of its wetland resources. Local wetland areas often coincide with FEMA delineated floodplain areas in a jurisdiction.
Local Building Codes	Critical to maintain adequate safety and building integrity factors in construction. In addition, these codes may limit structure size, type or place additional requirements in the construction of structures located in an identified hazard area (i.e., high wind, coastal, floodplain, wild land/urban interface area, etc.).
Local Plan of Conservation and Development	Primary plan that helps guide a jurisdiction in its land use and management decisions with regard to development and conservation and/or preservation of open space.
Local Coastal Management Programs	Assists local coastal jurisdictions ensure compliant development and management of coastal resources and to prevent adverse impacts on coastal resources.

During the Municipality meetings, the following points regarding planning and regulatory capabilities were gathered:

- Branford is undergoing significant development around their highway exits and updating zoning and subdivision regulations as a part of the Town Master Plan.
- Bethany reports that new development is not permitted in the floodplain.
- Madison reports that their Comprehensive Plan does address sea level rise. They do not plan to limit development in high hazard areas although most of these areas are already developed. Madison has a significant number of seasonal homes and many of these are self-insured.
- West Haven reports having approximately one hundred acres of undeveloped land that they intend to build on.

Administrative and Technical Findings

Administrative and technical resources are an indication of a jurisdiction's ability to implement hazard mitigation actions. This was measured by examining existing staff resources and interagency agreements. Administrative capability indicates how mitigation activities may be designated to specific departments, and technical capability indicates the level of knowledge or expertise held by jurisdiction employees. This section of the survey asks about administrative and technical resources in place to mitigate risks. The check marks in **Table 5.115** indicate a positive response on the survey.

Table 5.115 Administrative and Technical Capabilities

	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
Planning Commission	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Maintenance Programs to Reduce Risk	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mutual Aid Agreements	✓	✓	✓	✓	✓		✓	✓	✓	✓
Chief Building Official	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Floodplain Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Emergency Manager	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Community Planner	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Civil Engineer	✓	✓	✓	✓	✓	✓	✓	✓	✓	
GIS Coordinator	✓	✓	✓	✓	✓	✓			✓	✓
Warning Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hazard Data	✓	✓			✓					
Hazus Analysis										

Nine out of the ten jurisdictions have a Planning Commission in place. All of the jurisdictions have mutual aid agreements for their first responders. The majority of them have an emergency manager, community planner and floodplain manager. Only three of the jurisdictions record having specific hazard data and none of them have the ability to do Hazus-MH risk analysis. **Table 5.116** shows comments from several jurisdictions regarding their administrative and technical capabilities.

Table 5.116 Administrative and Technical Capability Comments

Jurisdiction	Comments
Bethany	Capabilities are adequate; regional planning and mitigation efforts could be expanded and increased
Branford	DPW maintains drainage system and tree trimming
Hamden	Zoning Commission has no expertise or focus on natural hazard mitigation; would like to see maintenance programs and mutual aid agreements increased
Madison	DPW performs drainage and tree maintenance
North Branford	Effective drainage and tree maintenance limited by budgetary restraints
North Haven	Mutual aid agreements exist with DPW and first responders, but coordination efforts are ineffective
Orange	Planning Commission has future drainage improvement projects; Highway Department and private utility company handle tree clearing

The following comments regarding administrative and technical capabilities were gathered in the Municipality meetings.

- Branford reports that they do not have a grant writer on staff.
- Bethany reports interest in hiring a grant writer. They also report having limited staff, but it is sufficient enough to "get the job done." They report having a lack of shelters that are able to accommodate those in need of an overnight stay. The two schools being utilized as shelters are reported as being "severely underrated," but capable of sheltering pets.
- Hamden reports the intention of hiring a new grant writer. The Town agrees that Quinnipiac University is a big asset to the community.
- Madison reports that employees of the Town are often responsible for doing the work of several additional positions outside of their own.
- North Branford reports having no GIS or IT trained experts on staff. They also report having no dedicated Finance Director and the Emergency Manager position is currently vacant and being temporarily filled by the interim Town Manager. The Town shelter is being converted to the regional shelter.
- Wallingford reports having no ability to temporarily provide shelter to their citizens. They also report having their own utilities provider as advantageous because they have power when other towns do not; they can offer goods and services that other towns cannot offer during outages.
- West Haven reports that Hurricane Irene proved that city agencies are capable of successfully working together. They also report that they do not have a system for communicating with citizens who use cell phones instead of landlines. They recognize that measures need to be taken to improve communications with those who may be adversely affected by this inadequacy – namely university students.

Financial Findings

The ability for a local government to implement mitigation actions is closely tied to the amount of money available to them. This availability is based on access to state and federal funding and the ability to levy taxes. **Table 5.117** indicates with check marks positive responses to the ability to access the types of funding in the first column. **Table 5.118** indicates comments made by jurisdictions.

Table 5.117 Financial Capabilities

	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
Capital improvement project funding	✓	✓	✓	✓	✓	✓	✓		✓	✓
Authority to levy taxes for specific purposes		✓	✓	✓		✓			✓	✓
Fees for water, sewer, gas, or electric services		✓			✓	✓		✓	✓	✓
Impact fees for development		✓								✓
Storm water utility fee										
Community Development Block Grant	✓	✓	✓		✓	✓		✓	✓	✓
Federal Funding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State Funding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 5.118 Financial Capability Comments

Jurisdiction	Comments
Bethany	Capital improvement funds used for repairs and upgrades to existing infrastructure; enable state legislation to allow towns to form stormwater/hazard mitigation districts for the purpose of acquiring funding
Branford	Sewer fees only; impact fees for development includes open space set aside for subdivisions (10%); capital improvements budget used for stormwater drainage system upgrades/annual Seawall repair budget
Hamden	Has used capital improvements funding and state and federal funding for flood control projects and emergency response equipment
Madison	Has utilized capital improvements funding for seawall repair

Jurisdiction	Comments
North Branford	Capital improvement funds used to improve drainage/stormwater maintenance; collect only sewer fees; have used federal funding for land acquisition and demolition project; state funding utilized for drainage improvements; would like to find ways to increase funding from sources outside of municipal service fees and taxation
North Haven	Fees collected for sewer services only

The following comments regarding financial capabilities were gathered in the Municipality meetings.

- Branford reports having a Triple A bond rating and a good debt management plan.
- North Branford reports the Town Council's resistance to raising taxes.
- Woodbridge reports having doubled their tree removal budget. They also report being proactive in terms of land acquisition.

Education and Outreach Findings

Frequently, education and outreach activities can be cost-effective mitigation actions that are often overlooked by local jurisdictions. **Table 5.119** indicates which opportunities the jurisdictions have incorporated. The scarcity of check marks confirms that many jurisdictions have not utilized education and outreach as mitigation actions.

Table 5.119 Education and Outreach Capabilities

	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
CERT Team	✓		✓				✓	✓	✓	
Public Education Program	✓	✓		✓						
Natural Disaster Program in Schools	✓									
Citizen Group or Nonprofit Focused on Emergency Preparedness	✓									
Public-Private Partnership for Disaster Issues		✓		✓				✓		

Table 5.120 indicates any comments made by the jurisdictions.

Table 5.120 Education and Outreach Capability Comments

Jurisdiction	Comments
Bethany	CERT has twenty plus active members; CERT/OEM teams offer disaster preparedness training to public
Branford	Public outreach with Emergency Preparedness booklet and use of Be-Informed notification system. Comprehensive website with floodplain management info and emergency preparedness info as well as interactive GIS for public use.
Madison	Supplies generators to local gas station and works with local contractors
Orange	Has critical need for public education and natural disaster training and emergency preparedness programs
Wallingford	MRC team assists with disaster, but is limited in mitigation role; town has partnership that assists with food and shelter (warming station) during time of disaster

The following comments regarding education and outreach capabilities were gathered in the Municipality meetings.

- Branford reports conducting considerable public outreach and utilizing the "Be Informed" program, which is similar to a reverse 911 system.
- Bethany reports the use of a "Code Red" system to notify residents of imminent hazardous events.
- Orange reports having interest in conducting more public outreach and education.
- West Haven reports being involved with an Economic Development Committee that meets monthly and includes members from Yale University and The University of New Haven.
- Woodbridge reports that every resident receives emergency preparedness information with his or her tax bills.

Floodplain Management Findings

FEMA Requirement §201.6(c)(3)(ii)

Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?

Flooding represents the greatest and costliest natural hazard facing communities across the nation. At the same time, the tools available to reduce the impacts associated with flooding are among the most developed when compared to other hazard-specific mitigation techniques.

Capabilities for conducting community floodplain management and flood mitigation activities are typically guided, evaluated and enhanced through participation in the National Flood Insurance

Program (NFIP). In addition to approaches that cut across hazards, such as education, outreach and the training of local officials, participation in the NFIP requires specific regulatory and administrative measures that enable government officials to determine where and how growth occurs relative to flood hazards. Participation in the NFIP is voluntary, but is promoted by FEMA as a crucial means to implement and sustain an effective flood hazard mitigation program. Community participation in the NFIP also enables property owners within the community to purchase federally backed flood insurance for buildings and personal belongings.

All jurisdictions in the South Central Region actively participate in the NFIP and are in good standing with FEMA. **Table 5.121** summarizes NFIP participation and policy statistics for each jurisdiction in the planning area as of September 30, 2012. Statistics on past flood losses and claims payment is provided in the Hazard Analysis section (under *Flood*) and more site specific information on at-risk structures and repetitive loss properties is provided in the Risk Analysis section.

Table 5.121 NFIP Participation and Policy Statistics (FEMA September 30, 2012)

Jurisdiction	NFIP Entry Date	Current Effective Map	Number of Policies	Amount of Premiums	Amount of Coverage
Bethany	08/23/1977	12/17/10	7	$5,695	$2,235,900
Branford	12/15/1977	12/17/10	1,168	$1,326,225	$259,980,300
Hamden	06/15/1979	12/17/10	296	$331,313	$67,734,100
Madison	09/15/1978	12/17/10	545	$877,690	$152,516,600
North Branford	07/03/1978	12/17/10	100	$120,160	$23,979,800
North Haven	09/17/1980	12/17/10	133	$180,818	$38,762,200
Orange	03/18/1980	12/17/10	75	$73,683	$19,861,200
Wallingford	09/15/1978	12/17/10	234	$248,179	$53,022,500
West Haven	01/17/1979	12/17/10	1,047	$993,448	$185,881,200
Woodbridge	03/16/1981	12/17/10	74	$52,907	$20,160,300
Total			**3,679**	**$4,210,118**	**$824,134,100**

In order for a jurisdiction to participate in the NFIP, they must adopt a local flood damage prevention ordinance that requires jurisdictions to follow established minimum building standards in the floodplain. These standards require that all new buildings and substantial improvements to existing buildings will be protected from damage by the flood having a 1-percent- annual-chance of occurring (i.e., the 100-year flood), and that new floodplain development will not aggravate existing flood problems or increase damage to other properties.

All jurisdictions in the planning area have adopted and enforce local floodplain management regulations in compliance with NFIP standards. It is the intent of all communities covered by this plan to maintain continued compliance and local enforcement of all NFIP Regulations per 44 CFR Part 60.3 as required. Some jurisdictions have also gone beyond FEMA's minimum requirements.

Table 5.122 and **Table 5.123** provide a brief description of the higher regulatory standards and other floodplain management activities currently implemented in each jurisdiction, and how they will continue to comply with NFIP requirements.

Table 5.122 Floodplain Management Table

Jurisdiction	Floodplain Manager	CAV[254] or CAC[255] Visit	Additional Notes Indicated by Jurisdiction Representatives
Bethany			Although not tasked as their primary mission, the Inland Wetlands Commission takes an active role in floodplain management. In addition, an abundance of the floodplain is under the umbrella of the Regional Water Authority and is subject to their management practices.
Branford	Town Engineer	March 2012	Ordinance Update December 2012
Hamden	Town Planner	2003?	Drainage system maintenance
Madison	Director of Public Works/ Town Engineer		Routine public education
North Branford	Town Engineer	September 2012	
North Haven	Town Engineer		
Orange	Director of Public Works/Town Engineer		
Wallingford	Environmental Planner		
West Haven	Assistant Planner		
Woodbridge	Department of Public Works, Operations Manager	2007	

[254] CAV: Community Assistance Visit

[255] CAC: Community Assistance Contact

Table 5.123 Floodplain Management Higher Regulatory Standards

Does the local floodplain ordinance exceed FEMA minimum requirements?	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge
Require freeboard (elevation requirements higher than the base flood)			✓		✓	✓			✓	
Require soil tests or engineered foundations					✓				✓	
Require compensatory storage for new developments		✓	✓						✓	
Prohibit or minimize new development in floodplain areas			✓						✓	
Prohibit or enforce higher standards for critical facilities subject to flood hazards					✓				✓	
Provision for cumulative substantial damage/improvement requirements		✓			✓	✓				
Provisions that protect natural and beneficial functions of floodplains									✓	

Another key service provided by the NFIP is the mapping of identified flood hazard areas. Once prepared, the Flood Insurance Rate Maps (FIRMs) are used to assess flood hazard risk, regulate construction practices and set flood insurance rates. FIRMs are an important source of information to educate residents, government officials and the private sector about the likelihood of flooding in their jurisdiction.

While the current FIRMs became effective on December 17, 2010, FEMA is currently in the process of remapping the coastal flood hazard areas in Branford, Madison, North Haven and West Haven. Preliminary FIRMs for these areas have been developed using the latest technologies, updated coastal engineering methods, and the most current data and are scheduled to become effective in 2013 following a jurisdiction review and public input process.

Safe Growth Analysis

The following Safe Growth Analysis was included in the Capability Assessment Data Gathering Worksheet distributed to each jurisdiction. This unique survey instrument was drawn from a technique proposed by David Godschalk, FAICP and Professor Emeritus of City and Regional Planning at the University of North Carolina at Chapel Hill, to help better evaluate the extent to which each local jurisdiction is positioned to grow safely relative to its natural hazards. Appropriate planning, zoning and/or community development staff for each jurisdiction completed the statements, and the results are summarized in **Table 5.124**.

In completing the survey each respondent was asked to indicate how strongly they agree or disagree with the "Safe Growth Statements" as they relate to their own jurisdiction's current plans, policies and programs for guiding future community growth and development, according to the following scale:

1 = Strongly Disagree 2 = Somewhat Disagree 3 = Neutral 4 = Somewhat Agree 5 = Strongly Agree

Averages were calculated for each question for the planning area as well as for each jurisdiction. Overall, the planning area scored an average of 3, which is a neutral response to each question. It is worth noting that Bethany and West Haven each scored an average of 4, which means Somewhat Agree to the questions. Woodbridge declined to participate in this portion of the capability assessment.

Table 5.124 Results of 2012 Safe Growth Survey

Safe Growth Statement	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge	Region Average
Land Use											
The comprehensive plan includes a future land use map that clearly identifies natural hazard areas.	1	2	1	1	5	1	2	3	5	n/a	2
Current land use policies discourage development and/or redevelopment within natural hazard areas.	5	1	4	2	5	5	2	4	5	n/a	4
The comprehensive plan provides adequate space for expected future growth in areas located outside of natural hazard areas.	5	4	3	3	5	5	3	1	5	n/a	4
Transportation											
The transportation element limits access to natural hazard areas.	5	1	2	2	3	1	3	3	5	n/a	3
Transportation policy is used to guide future growth and	3	1	2	2	3	1	4	3	5	n/a	3

Safe Growth Statement	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge	Region Average
development to safe locations.											
Transportation systems are designed to function under disaster conditions (e.g., evacuation, mobility for fire/rescue apparatus, etc.).	3	2	2	2	3	1	3	4	4	n/a	3
Environmental Management											
Environmental features that serve to protect development from hazards (e.g., wetlands, riparian buffers, etc.) are identified and mapped.	5	5	4	4	5	5	2	5	5	n/a	4
Environmental policies encourage the preservation and restoration of protective ecosystems.	5	4	4	4	5	5	4	5	4	n/a	4
Environmental policies provide incentives to development that is located outside of protective ecosystems.	4	1	2	2	4	3	4	5	1	n/a	3
Public Safety											
The goals and policies of the comprehensive plan are related to and consistent with those in the Multi-jurisdictional Hazard Mitigation Plan.	3	1	n/a	1	n/a	1	n/a	n/a	n/a	n/a	2
Public safety is explicitly included in the plan's growth and development policies.	3	4	2	2	n/a	3	3	4	5	n/a	3
The monitoring and implementation section of the plan covers safe growth objectives.	4	4	3	2	n/a	3	3	1	4	n/a	3
Zoning Ordinance											
The zoning ordinance conforms to the comprehensive plan in terms of discouraging development and/or redevelopment within natural hazard areas.	5	1	4	2	2	5	2	4	5	n/a	3

Safe Growth Statement	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge	Region Average
The ordinance contains natural hazard overlay zones that set conditions for land use within such zones.	4	1	4	2	2	1	1	4	5	n/a	3
Rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use.	5	1	2	4	4	1	3	4	5	n/a	3
The ordinance prohibits development within, or filling of, wetlands, floodways, and floodplains.	5	2	4	4	3	5	5	5	5	n/a	4
Subdivision Regulations											
The subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas.	5	1	4	2	2	5	4	4	5	n/a	4
The regulations provide for conservation subdivisions or cluster subdivisions in order to conserve environmental resources.	5	5	4	5	5	5	1	4	4	n/a	4
The regulations allow density transfers where hazard areas exist.	1	1	1	1	1	1	1	n/a	1	n/a	1
Capital Improvement Program and Infrastructure Policies											
The capital improvements program limits expenditures on projects that would encourage development and/or redevelopment in areas vulnerable to natural hazards.	2	1	2	n/a	3	4	2	3	5	n/a	3
Infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.	3	1	2	n/a	3	4	2	3	5	n/a	3
The capital improvements program provides funding for hazard mitigation projects identified in the South Central Connecticut Multi-jurisdictional	3	2	n/a	1	n/a	1	n/a	n/a	n/a	n/a	2

Safe Growth Statement	Bethany	Branford	Hamden	Madison	North Branford	North Haven	Orange	Wallingford	West Haven	Woodbridge	Region Average
Hazard Mitigation Plan.											
Other											
Small area or corridor plans recognize the need to avoid or mitigate natural hazards.	3	1	3	2	n/a	1	3	1	4	n/a	2
The building code contains provisions to strengthen or elevate new or substantially improved construction to withstand hazard forces.	5	n/a	4	4	5	5	4	1	5	n/a	4
Economic development and/or redevelopment strategies include provisions for mitigating natural hazards or otherwise enhancing social and economic resiliency to hazards.	5	1	3	2	4	3	1	1	5	n/a	3
Jurisdiction Average	4	3	3	3	3	3	3	3	4	n/a	
Overall Region Average	3										

While somewhat of a subjective exercise, the Safe Growth Analysis provides some quantitative measure of how adequately existing planning mechanisms and tools for each jurisdiction are being used to address the notion of safe growth as currently advocated by organizations such as FEMA and the American Planning Association (APA). In addition, the insertion of the survey instrument into the capability assessment was aimed at further integrating the subject of hazard risk management into the dialogue of local planners and to possibly consider and identify new mitigation actions as it relates to those local planning policies or programs already in place. It is anticipated that the survey will be used again during future plan updates to help measure progress over time and to continue identifying possible mitigation actions as they relate to future growth and community development practices, and how such actions may better be incorporated into local planning mechanisms.

Conclusion

Overall the SCRCOG region is well positioned to mitigate risks from natural hazards. The planning process has certainly bonded the jurisdictions closer together and positioned them to consider mitigation actions that would benefit multiple jurisdictions. In addition, SCRCOG continues to position itself as a resource and leader in terms of hazard mitigation.

Several Advisory Committee meetings included data gathering and discussion about regional and local capabilities. At the April 10, 2013 meeting an extensive conversation took place about the communication between first responders and town planners or engineers. The Advisory Committee agreed that overall it is a weakness in each town. There is a lack of collaboration with town officials who field calls from residents and business owners or implement land use planning regulations. Further discussion on the subject led to several mitigation actions included in this plan.

Each of the participating jurisdictions has the ability to mitigate risk. Except for having a wildfire protection plan, nearly all of the planning and regulatory capabilities are in place as shown in **Table 5.2**. In fact, as noted by the risk assessment, a wildfire plan is probably not necessary since wildfire impact is considered minimal. It is recommended that future comprehensive plans in all jurisdictions include natural hazard mitigation specifically.

All of the jurisdictions indicate sufficient administrative and technical resources. However, in the smaller communities, the same employee fills multiple positions. For instance, the Floodplain Manager may also be the Town Engineer or Director of Public Works.

All of the jurisdictions are in compliance with the NFIP. Each jurisdiction, especially those along the coast, is especially interested in FEMA's Risk MAP program and some are interested in CRS. In an effort to increase understanding of the program, Mike Goetz, FEMA R1 Branch Chief, spoke at the Advisory Committee meeting on February 13, 2013. Also, SCRCOG produced, with contractor support, a *Toolkit for Floodplain Mapping*, which was distributed to the Advisory Committee and made available on the SCRCOG website. A copy of the Toolkit is in Appendix H.

The financial resources are consistent with those in the rest of the state. Resources have been sought from the State and FEMA and used for mitigation in the past and will be sought in the future as well.

The majority of jurisdictions have not done a significant amount of public outreach or education regarding disasters. The Advisory Committee has become aware of how cost effective these measures can be and may implement them moving forward.

CHAPTER 6. MITIGATION STRATEGY

FEMA Requirement §201.6(c)(3)

A mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources and its ability to expand on and improve these existing tools.

The hazard mitigation strategy is the culmination of work presented in the regional profile, risk assessment and capability assessment. It is also the result of multiple meetings and public outreach. The work of the Advisory Committee was essential in creating the following mitigation goals and individual jurisdiction actions. The Advisory Committee worked to prioritize the goals and their mitigation actions.

Hazard Mitigation Goals and Objectives

FEMA Requirement §201.6(c)(3)(i)

The mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

2014 Multi-Jurisdiction Hazard Mitigation Plan Mission

Reduce or eliminate risk to people and property from natural hazards.

The Advisory Committee worked to identify five goal statements (**Table 6.125**). Early in the planning process flooding and downed trees were identified as the biggest concerns in each jurisdiction. As a result minimizing flood risk and limiting the impact of fallen trees became two of the goal statements. The collaboration and conversations that followed during Advisory Committee meetings helped to identify the other three goals of local community planning, regional collaboration and public awareness and preparedness. As goal statements these are "broad policy statements that explain what is to be achieved."[256]

In addition, these goal statements are consistent with the mission and goals of Connecticut's 2010 Natural Hazard Mitigation Plan Update.[257] These goals are:

- Promote implementation of sound floodplain management and other natural hazard mitigation principles on a state and local level.
- Encourage research to support management and planning activities for natural hazard mitigation and State investment policies.

[256] Local Mitigation Plan Review Guide, October 1, 2011, p.24.

[257] Connecticut's Natural Hazard Mitigation Plan Update, Years 2010-2013. p.250.

- Promote implementation of effective natural hazard mitigation objectives on a state and local level.

Table 6.125 Mitigation Plan Goals

Goal Categories	Mitigation Plan Goals
Community Planning	1. Reduce the impact of natural hazards by integrating natural hazard mitigation policies and practices into local community planning.
Flood Hazards	2. Minimize flood hazards in the region by maintaining continued compliance with the National Flood Insurance Program, adopting higher regulatory standards for new floodplain development, and implementing flood mitigation projects for existing flood prone structures.
Trees	3. Limit the impact of fallen trees due to natural hazards by collaborating with electric utility companies and property owners (private and public) to cut limbs and remove hazardous trees that pose threats to buildings, infrastructure and utility lifelines.
Regional Collaboration	4. Build capacity for natural hazard mitigation and climate adaptation at the local level through regional collaboration.
Public Awareness and Preparedness	5. Increase public awareness and preparedness for natural hazards by implementing community-based public education programs across the region.

Table 6.126 Mitigation Goals and Hazard Risk

Mitigation Goals	High Risk Hazards	Moderate Risk Hazards	Low Risk Hazards
	Severe Winter Storm/Nor'easter Hurricane/Tropical Storm Coastal Flood Riverine Flood	Tornado Coastal Erosion Sea Level Rise Extreme Temperatures Severe Thunderstorm Urban Flood	Wildfire Dam Failure Drought Earthquake
1. Community Planning	✓	✓	✓
2. Flood Hazards	✓	✓	✓
3. Trees	✓	✓	✓
4. Regional Collaboration	✓	✓	✓
5. Public Awareness and Preparedness	✓	✓	✓

SCRCOG Mitigation Objectives

SCRCOG intends to stay actively involved in hazard mitigation. They are fully committed to the mission of reducing risk to people and property in the region. Although this mitigation plan is for ten jurisdictions, it is their intent to include all fifteen jurisdictions in the region with their stated objectives. SCRCOG staff developed the following four objectives based on the above mitigation planning objectives and the identified needs of the region.

Table 6.127 SCRCOG Mitigation Plan Objectives

Objective Category	Mitigation Plan Objectives
Mitigation Planning	1. Stay actively involved in mitigation planning for the SCRCOG region.
Multi-Jurisdiction Collaboration	2. Facilitate multi-jurisdiction collaboration between the SCRCOG jurisdictions.
Education	3. Provide education regarding natural hazards, grant opportunities and mitigation and preparedness techniques.
Floodplain Management	4. Assist the SCRCOG jurisdictions with floodplain management and lessening the impact of flooding to the region.

Types of Mitigation Actions

FEMA Requirement §201.6(c)(3)(ii)

The mitigation strategy shall include a) section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Objectives are similar to goal statements in that they are fairly broad in scope. Mitigation actions on the other hand are more specific and identify an activity or process that is intended to reduce or eliminate risk to natural hazards. They can be categorized into the following four categories: Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection and Education and Awareness Programs. For this multi-jurisdiction plan, actions were identified for SCRCOG and each of the ten jurisdictions. The following table, taken from the Local Mitigation Planning Handbook, clearly defines each of these mitigation types and provides examples.[258]

[258] FEMA Local Mitigation Planning Handbook, March 2013. p.6-4.

Table 6.128 Mitigation Action Types[259]

Mitigation Type	Description	Examples
Local Plans and Regulations	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	• Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • NFIP Community Rating System • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance program. *Task 9 – Create a Safe and Resilient Community* provides more information on these programs.	• Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits. • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
Natural Systems Protection	These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation

[259] FEMA Local Mitigation Planning Handbook, March 2013. p.6-4.

Mitigation Type	Description	Examples
Education and Awareness Programs	These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.	• Radio or television spots • Websites with maps and information • Real estate disclosure • Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas. • StormReady • Firewise Communities

Regional Mitigation Priorities

To develop the mitigation actions in the following section, the planning team briefed the Advisory Committee on the types of mitigation actions. Each of the actions was thoroughly explained and examples were given. In addition, the Advisory Committee participated in an exercise at their meeting on April 10, 2013 to identify regional and local mitigation actions. The exercise is detailed in Chapter 3, The Planning Process. Following the meeting, Advisory Committee members consulted with other experts in their jurisdiction to develop a list of mitigation actions. Additional actions were identified in the Public Workshops.

The list of regional mitigation priorities in the table below is the result of the Advisory Committee exercise. The priorities are listed with their associated mitigation goal.

Table 6.129 Regional Mitigation Priorities

Mitigation Goals	Regional Mitigation Priorities
Community Planning	• Local zoning regulation changes (e.g. reducing allowable lot coverage and floor area) • Revise building codes
Flood Hazards	• Elevate roads • Floodgates on drainage systems • Erosion protection • Raise/elevate/floodproof buildings

Mitigation Goals	Regional Mitigation Priorities
	• Raise homes in floodplain
Trees	• Limit hazards to utility infrastructure • Clear trees off power lines
Regional Collaboration	• Regional coordination, planning and sharing of information, approaches and outcomes • Regional map of high-hazard places, in each town (parcel scale)
Public Awareness and Preparedness	• Equip all shelters with back-up power

Jurisdiction Actions

Jurisdiction Actions were developed by SCRCOG staff and by each of the participating jurisdictions. For the ten jurisdictions they had the ability to refer to the problem statements in the Risk Analysis section of this plan as a means to generate ideas. Each Advisory Committee member completed Mitigation Action Worksheets (found in Appendix J) as a way to prioritize and develop their mitigation actions. In addition, the problem statements provided continuity between the risk analysis and the mitigation strategy. Advisory Committee members had ample time to develop their actions and to review them with the Advisory Committee as a whole, the consulting team and their municipal leaders.

FEMA Requirement §201.6(c)(3)(iii)

The hazard mitigation plan shall include an action plan, describing how the action identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

FEMA Requirement §201.6(c)(3)iv)

For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

Evaluating and Prioritizing Mitigation Actions

SCRCOG staff and Advisory Committee considered a wide range of potential mitigation actions for the region as a whole and for individual jurisdictions to implement on their own. In order to further evaluate and narrow this range of potential actions down to a manageable number, SCRCOG staff and each of the ten jurisdictions first revisited and discussed the key findings and conclusions of the risk assessment and capability assessment. Then, in coordination with other local staff and municipal leaders, each jurisdiction relied on factors consistent with FEMA's recommended evaluation criteria listed in the table below as taken from the Local Mitigation Planning Handbook.[260] These criteria helped to not only provide further qualitative screening for the

[260] FEMA Local Mitigation Planning Handbook, March 2013. p.6-7.

proposed mitigation actions, but also aided in the specific ranking (prioritization) of specific mitigation actions included for SCRCOG and each jurisdiction.

Table 6.130 Evaluation and Prioritization Criteria

Criterion	Description / Questions to Consider
Benefit-Cost Review	Are the total estimated costs to implement the action (including any maintenance or operations costs) reasonable when compared to the probable long-term benefits (including future losses avoided and other anticipated benefits such as improved quality of life, environmental benefits, and achieving other community goals)?
Life Safety	How effective will the action be at protecting lives and preventing injuries?
Property Protection	How significant will the action be at eliminating or reducing damage to structures and infrastructure?
Technical	Is the mitigation action technically feasible? Is it a long-term solution? Actions that, from a technical standpoint, will not meet the goals should be eliminated.
Political	Is there overall public support for the mitigation action? Is there the political will to support it?
Legal	Does the community have the authority to implement the action?
Environmental	What are the potential environmental impacts of the action? Will it comply with environmental regulations?
Social	Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income and/or minority populations?
Administrative	Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?
Local Champion	Is there a strong advocate for the action or project among local departments and agencies that will support the action's implementation?
Other Community Objectives	Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of the comprehensive plan?

Using the above evaluation and prioritization criteria, combined with local community knowledge, SCRCOG staff and the ten jurisdictions ranked each mitigation action to be included in their action plan in priority order (according to each jurisdiction's unique action number). The completion of the ranked mitigation actions is contingent on the availability of funding. These priority rankings are specific to each jurisdiction and will be evaluated and updated as a matter of routine plan maintenance, and as local community conditions or planning objectives change over time.

SCRCOG Mitigation Actions

Table 6.131 SCRCOG Mitigation Actions

SCRCOG Mitigation Objectives	SCRCOG Mitigation Actions
Mitigation Planning	1. SCRCOG will maintain the current mitigation plan by seeking additional grant funding as needed. 2. SCRCOG will work to incorporate the five jurisdictions not part of this plan as their plans expire.
Multi-Jurisdiction Collaboration	3. SCRCOG will facilitate multi-jurisdiction collaboration by hosting mitigation meetings on at least a yearly basis.
Education	4. SCRCOG will work toward educating their members with the creation and distribution of tools such as the Toolkit for Floodplain Mapping and PowerPoint presentation. 5. SCRCOG will maintain their Regional Hazard Mitigation webpages. 6. SCRCOG will make their membership aware of grant opportunities. 7. SCRCOG will consider starting a newsletter as a method of educating their members about mitigation opportunities and strategies.
Floodplain Management	8. SCRCOG will educate their members about CRS and assist them with participation in the program if they are interested.

SCRCOG Mitigation Action #1	
Project Description	SCRCOG will maintain the current mitigation plan by seeking additional grant funding as needed.
Mitigation Goal	Community Planning
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	All Hazards
Estimated Cost	$200,000
Potential Funding Source	FEMA Mitigation Grant Programs
Lead Department	SCRCOG Staff
Implementation Schedule	October 2014 – October 2019

SCRCOG Mitigation Action #2	
Project Description	SCRCOG will work to incorporate the five jurisdictions not part of this plan as their plans expire.
Mitigation Goal	Community Planning
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	All Hazards
Estimated Cost	$100,000
Potential Funding Source	FEMA Mitigation Grant Programs
Lead Department	SCRCOG Staff
Implementation Schedule	January 2015 – October 2019

SCRCOG Mitigation Action #3	
Project Description	SCRCOG will educate their members about CRS and assist them with participation in the program if they are interested.
Mitigation Goal	Flood Hazards
Mitigation Category	Natural System Protection
Hazard(s) Addressed	All Hazards
Estimated Cost	$50,000
Potential Funding Source	FEMA Grant Programs; SCRCOG
Lead Department	SCRCOG Staff
Implementation Schedule	June 2015 – March 2018

SCRCOG Mitigation Action #4	
Project Description	SCRCOG will facilitate multi-jurisdiction collaboration by hosting mitigation meetings on at least a yearly basis.
Mitigation Goal	Regional Collaboration
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	All Hazards
Estimated Cost	$15,000
Potential Funding Source	SCRCOG
Lead Department	SCRCOG Staff
Implementation Schedule	May 2014 – October 2019

SCRCOG Mitigation Action #5	
Project Description	SCRCOG will work toward educating their members with the creation and distribution of tools such as the Toolkit for Floodplain Mapping and PowerPoint presentation.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Education and Awareness Programs
Hazard(s) Addressed	All Hazards
Estimated Cost	$20,000
Potential Funding Source	FEMA Grant Programs
Lead Department	SCRCOG Staff
Implementation Schedule	October 2014 – December 2018

SCRCOG Mitigation Action #6	
Project Description	SCRCOG will maintain their Regional Hazard Mitigation webpages.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Education and Awareness Programs
Hazard(s) Addressed	All Hazards
Estimated Cost	$10,000
Potential Funding Source	SCRCOG
Lead Department	SCRCOG Staff
Implementation Schedule	May 2014 – October 2019

SCRCOG Mitigation Action #7	
Project Description	SCRCOG will make their members aware of grant opportunities.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Education and Awareness Programs
Hazard(s) Addressed	All Hazards
Estimated Cost	$5,000
Potential Funding Source	SCRCOG (subscription service)
Lead Department	SCRCOG Staff
Implementation Schedule	October 2013 – December 2018

SCRCOG Mitigation Action #8	
Project Description	SCRCOG will consider starting a newsletter as a method of educating their members about mitigation opportunities and strategies.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Education and Awareness Programs
Hazard(s) Addressed	All Hazards
Estimated Cost	$20,000
Potential Funding Source	SCRCOG; HMGP
Lead Department	SCRCOG Staff
Implementation Schedule	May 2014 – December 2015

SCRCOG Mitigation Action #9	
Project Description	SCRCOG will collaborate with groups such as the Nature Conservancy to explore opportunities for green infrastructure and natural system restoration opportunities.
Mitigation Goal	Flood Hazards
Mitigation Category	Natural Resource Protection
Hazard(s) Addressed	Flooding
Estimated Cost	$100,000
Potential Funding Source	HMGP; Community Foundation Grant Opportunities
Lead Department	SCRCOG Staff
Implementation Schedule	August 2014 – December 2018

Bethany Mitigation Actions

Bethany Mitigation Action #1	Hazard Tree Management
Project Description	In coordination with private utility operators, develop and adopt an ordinance to require the routine inspection, maintenance and removal (if necessary) of hazardous trees along public rights of way which pose potential threats to power distribution lines.
Mitigation Goal	Trees
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	Hurricane/Tropical Storm (Wind); Severe Winter Storm/Nor'easter
Estimated Cost	$20,000
Potential Funding Source	Federal/State/Local
Lead Department	Planning and Zoning Commission, with support from Tree Warden
Implementation Schedule	July 2015 – July 2016

Bethany Mitigation Action #2	Miller Road Culvert Expansion
Project Description	Increase capacity of Miller Road Culvert to eliminate future and repetitive damages and loss of service to roadway and provide increased conveyance of stormwater during peak flows.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$40,000
Potential Funding Source	CT DOT (if eligible for pilot program funding); HMGP in combination with PA 406 (post-disaster)
Lead Department	Public Works
Implementation Schedule	January 2015 – October 2019

Bethany Mitigation Action #3	Town Hall Generator
Project Description	Install electric generator and quick-connect transfer switch to provide backup emergency power for Town Hall.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power outages due to all natural disasters
Estimated Cost	$50,000
Potential Funding Source	HMGP
Lead Department	Public Works
Implementation Schedule	July 2015 – July 2016

Bethany Mitigation Action #4	Homebound and Elderly Resident Directory
Project Description	Develop and maintain a Homebound and Elderly Resident Directory in order to quickly identify people with special needs during and following long-term power outages or other related emergency or disaster events.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Public Education and Awareness Programs
Hazard(s) Addressed	Power outages due to all natural disasters
Estimated Cost	$25,000
Potential Funding Source	Federal/State/Local
Lead Department	Human Services
Implementation Schedule	July 2015 – July 2016

Bethany Mitigation Action #5	Community Shelter
Project Description	Include in the plans currently underway to replace the existing hanger at the old airport on Amity Road, capabilities for the new structure to be used as a local community emergency shelter. This should include backup generator power and necessary facilities for overnight stays (kitchen and shower facilities).
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Primarily Hurricane/Tropical Storm (Wind); Severe Winter Storm/Nor'easter
Estimated Cost	$100,000
Potential Funding Source	CT Small Town Economic Assistance Program (STEAP); HMGP
Lead Department	Emergency Management Committee
Implementation Schedule	January 2015 – October 2019

Bethany Mitigation Action #6	Water Supply
Project Description	Coordinate with the CT Water Planning Council on drought preparedness and response planning activities to ensure the Town's unique vulnerabilities to water shortages (dependency on wells for potable water, coupled with large equine population) are adequately addressed through State and local action.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	Drought
Estimated Cost	$20,000
Potential Funding Source	Federal/State/Local
Lead Department	Environmental Services
Implementation Schedule	January 2015 – October 2019

Branford Mitigation Actions

Branford Mitigation Action #1	Linden Avenue Erosion Protection Project
Project Description	Identify and construct erosion protection measures along the coastal exposure of Linden Avenue.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Coastal Erosion due to wave action
Estimated Cost	$5 million
Potential Funding Source	Federal/State/Local
Lead Department	Engineering Department
Implementation Schedule	September 2014 – September 2019

Branford Mitigation Action #2	Generators for Town Buildings
Project Description	Install stand-by generators at two shelters and upgrade generators at the EOC/Police Station and Volunteer Services Center and Wastewater Treatment Plant.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outages due to all natural hazards
Estimated Cost	$900,000
Potential Funding Source	Federal/State/Local
Lead Department	GGB/BOE
Implementation Schedule	July 2014 – September 2019

Branford Mitigation Action #3	Meadow Street and Indian Neck Ave Flood Protection Project
Project Description	Flood protection of Meadow Street and Indian Neck Avenue. Will protect CL&P substation and possibly improve access during times of flood.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding – Coastal and Inland
Estimated Cost	$500,000
Potential Funding Source	State/Federal
Lead Department	Engineering Department
Implementation Schedule	July 2014 – September 2019

Branford Mitigation Action #4	Hotchkiss Structural Mitigation Project
Project Description	Raising electronics at Hotchkiss Sewage Pumping Station, 23 Seaview Avenue.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Rising sea water due to storm surge
Estimated Cost	$2,500 - $7,500
Potential Funding Source	Federal/State/Local
Lead Department	Waste Water Treatment Plan
Implementation Schedule	July 2013 – July 2015

Branford Mitigation Action #5	Hazards Planning and Public Health Preparedness Project
Project Description	To promote awareness/education on what businesses and property owners can do to prepare and prevent property damage and reduce injury and loss of life.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Public Education and Awareness Programs
Hazard(s) Addressed	Community resilience
Estimated Cost	$50,000
Potential Funding Source	Federal/State/Local
Lead Department	Local Health Department – East Shore District Health Department
Implementation Schedule	June 2014- July 2016

See Appendix J for more information regarding the Linden Shore projects.

Hamden Mitigation Actions

Hamden Mitigation Action #1	DPW Generator
Project Description	Replace generator at Public Works garage.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Loss Impacts DPW Critical Facilities
Estimated Cost	$50,000
Potential Funding Source	Local Capital Budget
Lead Department	DPW/Town of Hamden
Implementation Schedule	September 2014 – July 2019

Hamden Mitigation Action #2	Tree Pruning
Project Description	Tree pruning adjacent to power distribution wires.
Mitigation Goal	Trees
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outages
Estimated Cost	$50,000
Potential Funding Source	United Illuminating and its contractors
Lead Department	United Illuminating
Implementation Schedule	May 2014 – July 2019

Hamden Mitigation Action #3	FEMA Flood Study Update
Project Description	Update FEMA flood study for Hamden.
Mitigation Goal	Flood Hazards
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	Flooding
Estimated Cost	$55,000
Potential Funding Source	FEMA
Lead Department	FEMA
Implementation Schedule	May 2014 - June 2019

Hamden Mitigation Action #4	Pardee Brook Box Culvert Project
Project Description	Extend Pardee Brook Box culvert from south of School Street to Austen Road.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1.9 million
Potential Funding Source	Local Capital Budget
Lead Department	Town of Hamden
Implementation Schedule	April 2015 – May 2016

Hamden Mitigation Action #5	Snow Load Study
Project Description	Study town buildings to determine snow removal criteria.
Mitigation Goal	Community Planning
Mitigation Category	Local Plans and Regulations
Hazard(s) Addressed	Roof Collapse Due to Snow Load
Estimated Cost	$30,000
Potential Funding Source	Local Capital Budget
Lead Department	Town of Hamden
Implementation Schedule	July 2014 – June 2019

Hamden Mitigation Action #6	Raise Paradise Avenue South of Howard Drive
Project Description	Raise Paradise Avenue south of Howard Drive.
Mitigation Goal	Flood Hazards
Mitigation Category	Prevention
Hazard(s) Addressed	Flooding
Estimated Cost	$500,000 - $1,000,000
Potential Funding Source	Local Capital Budget
Lead Department	Town of Hamden
Implementation Schedule	January 2015 – July 2019

Madison Mitigation Actions

Madison Mitigation Action #1	Middle Beach Road Revetment
Project Description	Rehabilitation of an approximate 750 foot long stone revetment along Middle Beach Road.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$600,000
Potential Funding Source	FEMA Hazard Mitigation Grant Program
Lead Department	Public Works and Engineering
Implementation Schedule	September 2015 – September 2020

Madison Mitigation Action #2	Garvin Point Bulkhead
Project Description	Rehabilitation of an approximate 280 foot long steel sheet pile bulkhead at Garvin Point.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$400,000
Potential Funding Source	FEMA Hazard Mitigation Grant Program
Lead Department	Public Works and Engineering
Implementation Schedule	July 2015 – June 2020

Madison Mitigation Action #3	East River – Property Acquisition
Project Description	Property acquisition of five residential homes north of I-95
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1.6 million
Potential Funding Source	Emergency Watershed Program/USDA Natural Resources Conservation Service
Lead Department	DPW/EM
Implementation Schedule	January 2015 – December 2018

Madison Mitigation Action #4	East River – Elevation of Buildings and Roadway
Project Description	Elevation of buildings and roadway on south side
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$85,000 - $250,000
Potential Funding Source	Emergency Watershed Program/USDA Natural Resources Conservation Service
Lead Department	DPW/EM
Implementation Schedule	August 2014 – July 2019

Madison Mitigation Action #5	East River Roadway and Flood Control Structure
Project Description	Roadway reconstruction and flood control structure construction adjacent to the East River.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$500,000
Potential Funding Source	Emergency Watershed Program/USDA Natural Resources Conservation Service
Lead Department	Public Works and Engineering
Implementation Schedule	June 2015 – August 2020

Madison Mitigation Action #6	Radio Infrastructure Improvements
Project Description	New dispatch consoles; microwave connectivity between towers; simulcast to allow communication for both towers simultaneously; new tower
Mitigation Goal	Regional Collaboration
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	All hazards requiring emergency response
Estimated Cost	$1.5 million
Potential Funding Source	General jurisdiction funds
Lead Department	EM
Implementation Schedule	September 2014 – October 2019

Madison Mitigation Action #7	Generator at Senior Center
Project Description	Install generator at senior center to allow the center to serve some functions as an emergency shelter
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power outages due to storm events
Estimated Cost	$265,000
Potential Funding Source	General jurisdiction funds
Lead Department	EM
Implementation Schedule	June 2014 – March 2018

Madison Mitigation Action #8	Surf Club Dune Restoration
Project Description	Restoration of coastal dune at Surf Club Recreation Facility.
Mitigation Goal	Flood Hazards
Mitigation Category	Natural System Protection
Hazard(s) Addressed	Flooding
Estimated Cost	$200,000
Potential Funding Source	FEMA Hazard Mitigation Grant Program
Lead Department	Public Works and Engineering
Implementation Schedule	June 2015 – June 2020

See Appendix J for more information regarding mitigation actions in Madison.

North Branford Mitigation Actions

North Branford Mitigation Action #1	EOC (Town Hall) Stand-by Generator
Project Description	Installation of stand-by generator to service Town Hall/EOC (future) during times of potential power outages due to severe weather
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	All Major Storms
Estimated Cost	$100,000
Potential Funding Source	FEMA/DEEP
Lead Department	Emergency Operations
Implementation Schedule	July 2014 – June 2017

North Branford Mitigation Action #2	Installation of Generator at Police Station
Project Description	Installation of Stand-by Generator at North Branford Police Station
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	All Major Storms
Estimated Cost	$75,000
Potential Funding Source	FEMA/DEEP
Lead Department	Emergency Operations/Police Department
Implementation Schedule	July 2014 – June 2017

North Branford Mitigation Action #3	Installation of Generator at Firehouse #1
Project Description	Installation of Replacement Stand-by Generator at Company #1 Firehouse
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	All Major Storms
Estimated Cost	$50,000
Potential Funding Source	FEMA/DEEP
Lead Department	Emergency Operations/Fire Department
Implementation Schedule	June 2014 – August 2017

North Branford Mitigation Action #4	Tree Removal
Project Description	Removal of trees alongside roads and power lines.
Mitigation Goal	Trees
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Severe Weather
Estimated Cost	$50,000
Potential Funding Source	State of CT/Utilities/Local
Lead Department	DPW with State of CT/Utilities
Implementation Schedule	June 2014 – May 2018

North Branford Mitigation Action #5	Farm River Flood Control Project
Project Description	Construction of Farm River Flood Controls.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$2,000,000 - $4,000,000
Potential Funding Source	DEEP/NRCS/Town
Lead Department	NRCS/DEEP/FEMA
Implementation Schedule	January 2015 – October 2019

North Branford Mitigation Action #6	Public Education and Outreach
Project Description	Increase public awareness regarding the potential for flooding, the areas to be effected, the need for and availability of flood insurance.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Public Education and Awareness Programs
Hazard(s) Addressed	Flooding
Estimated Cost	$40,000
Potential Funding Source	Federal/State/Local
Lead Department	Engineering
Implementation Schedule	October 2014 – January 2016

North Branford Mitigation Action #7	Open Space Acquisition
Project Description	Open space acquisition.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$50,000 – $500,000
Potential Funding Source	DEEP/Local
Lead Department	Town Manager
Implementation Schedule	January 2015 – October 2019

North Branford Mitigation Action #8	Removal or Elevation of Structures
Project Description	Remove or elevate existing structures in flood prone areas.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$50,000 – $500,000
Potential Funding Source	FEMA/DEEP
Lead Department	Engineering Department
Implementation Schedule	May 2015 – June 2019

North Haven Mitigation Actions

North Haven Mitigation Action #1	Emergency Generators
Project Description	Emergency Generators.
Mitigation Goal	Community Planning
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outage
Estimated Cost	$180,000
Potential Funding Source	FEMA Hazard Mitigation Grant Program
Lead Department	Fire Department
Implementation Schedule	November 2014 – October 2019

North Haven Mitigation Action #2	Pine River Road Project
Project Description	Pine River Road homes flood due to the Muddy River overflowing.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1,700,000
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	August 2014 – September 2018

North Haven Mitigation Action #3	Spring Road Project
Project Description	Remedy the flooding of Spring Road due to Muddy River overflow.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1,000,000 - $5,000,000
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	January 2015 – October 2019

North Haven Mitigation Action #4	Pattern Road Project
Project Description	Remedy flooding of Pattern Road due to the Muddy River.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1,000,000 - $5,000,000
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	January 2015 – October 2019

North Haven Mitigation Action #5	Todd Drive Area Project
Project Description	Remedy Todd Drive area flooding.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$2,200,000
Potential Funding Source	CT DEEP and Town
Lead Department	DPW
Implementation Schedule	September 2014 – October 2016

Orange Mitigation Actions

Orange Mitigation Action #1	Old Grassy Hill Road Flooding
Project Description	Reduce storm water flooding: Old Grassy Hill Road, water flows across road in heavy rain. Have had to close highly traveled road before.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$25,000 to $250,000 – depends on method of correction and funds available
Potential Funding Source	Grant funding (Federal/State/Local)
Lead Department	Town of Orange, Town Engineer
Implementation Schedule	August 2014 – September 2019

Orange Mitigation Action #2	Generator for Indian River Road Sewer
Project Description	Install a permanent generator for sewer pump station at 220 Indian River Road to prevent sewer from backing up during power outages.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding and Sewage backup which causes a major health emergency.
Estimated Cost	$80,000 including design.
Potential Funding Source	Grant funding (Federal/State/Local)
Lead Department	Town of Orange, Sewer Commission
Implementation Schedule	August 2014 – September 2019

Orange Mitigation Action #3	Generator for Boston Post Road Sewer
Project Description	Permanent generator for sewer pumps station at 538 Boston Post Road. Prevent sewers from backing up during power outages.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Sewage backup causes a major health emergency.
Estimated Cost	$50,000 for construction, $7,500 for design
Potential Funding Source	Grant funding (Federal/State/Local)
Lead Department	Town of Orange, Sewer Commission
Implementation Schedule	August 2014 – September 2019

Orange Mitigation Action #4	Generator for Smith Farm Road Pump Station
Project Description	Permanent generator for sewer pumps station at 352 Smith Farm Road. Prevent sewers from backing up during power outages.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Sewage backup causes a major health emergency.
Estimated Cost	$50,000 for construction, $7,500 for design
Potential Funding Source	Grant funding (Federal/State/Local)
Lead Department	Town of Orange, Sewer Commission
Implementation Schedule	August 2014 – September 2019

Orange Mitigation Action #5	Tree Removal
Project Description	Tree removal along roadsides. Town roads have trees hanging over roadways. Hurricane winds could cause massive road closures and power outages.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Winter storms and high winds
Estimated Cost	$20,000 to $4,000,000
Potential Funding Source	Grant funding (Federal/State/Local)
Lead Department	Town of Orange, Highway Department
Implementation Schedule	August 2014 – September 2019

Wallingford Mitigation Actions

Wallingford Mitigation Action #1	**Generator at High School**
Project Description	Install emergency generator at the High School to support primary shelter.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outage
Estimated Cost	$500,000
Potential Funding Source	Post Disaster Mitigation Funds
Lead Department	Civil Preparedness/EM
Implementation Schedule	November 2013 – November 2016

Wallingford Mitigation Action #2	**New Generator at Fire Headquarters**
Project Description	Replace the emergency generator at central Fire Headquarters.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Loss of power in community; critical services at risk
Estimated Cost	$75,000
Potential Funding Source	Post Disaster Mitigation Funds/Town
Lead Department	Civil Preparedness/EM
Implementation Schedule	September 2013 – October 2016

Wallingford Mitigation Action #3	**Upgrades to Cook Hill Shelter**
Project Description	Replace kitchen and install refrigerator at Cook Hill Emergency Management building to feed small shelter population and critical workers from town and private contractors.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Loss of power in community; critical services at risk
Estimated Cost	$10,000
Potential Funding Source	EMPG Grant Funds from in-kind services
Lead Department	Civil Preparedness/EM
Implementation Schedule	September 2013 – December 2016

Wallingford Mitigation Action #4	Emergency Preparedness Webpage Project
Project Description	Create webpage for emergency preparedness on Town Website. Include information on preparation, and keeping debris from small streams to prevent street flooding.
Mitigation Goal	Public Awareness and Preparedness
Mitigation Category	Education and Awareness Programs
Hazard(s) Addressed	Natural Hazards
Estimated Cost	$2,000
Potential Funding Source	EMPG Grant Funds from in-kind services
Lead Department	Civil Preparedness/EM
Implementation Schedule	September 2013 – November 2016

Wallingford Mitigation Action #5	Generator at Well No. 1 Production Well
Project Description	Install emergency generator at the Well No. 1 production well to maintain water supply to the Town's system during power outages.
Mitigation Goal	Public Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outage
Estimated Cost	$60,000
Potential Funding Source	Post Disaster Mitigation Funds
Lead Department	Water Division
Implementation Schedule	September 2015 – September 2017

Wallingford Mitigation Action #6	New Generator at Pond Hill Pumping Station
Project Description	Replace the emergency generator at the Pond Hill pumping station in order to maintain sanitary sewer pump station operation during power outages.
Mitigation Goal	Public Preparedness
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Power Outage
Estimated Cost	$40,000
Potential Funding Source	Post Disaster Mitigation Funds
Lead Department	Sewer Division
Implementation Schedule	September 2014 – September 2016

West Haven Mitigation Actions

West Haven Mitigation Action #1	Property Buyout 3rd Avenue Extension
Project Description	Buy properties on 3rd Avenue Extension, Blohm Street in the Old Field Creek Floodplain and demolish houses.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood
Estimated Cost	$2 million
Potential Funding Source	Federal
Lead Department	DPW/Planning
Implementation Schedule	March 2014 – June 2016

West Haven Mitigation Action #2	Beach Sand Nourishment and Dune Restoration
Project Description	Beach sand nourishment and dune restoration.
Mitigation Goal	Flood Hazards
Mitigation Category	Natural Systems Protection
Hazard(s) Addressed	Flood
Estimated Cost	$3 million
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	September 2014 – September 2015

West Haven Mitigation Action #3	Bridge and Channel Improvement
Project Description	Improve bridge and channel on Cove River at Painter Drive and West Main Street.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood
Estimated Cost	$1.5 million
Potential Funding Source	Federal/State/Local
Lead Department	DPW/State DOT
Implementation Schedule	June 2015 – December 2016

West Haven Mitigation Action #4	Cove River Channel Study
Project Description	Study, design and construct Cove River Channel and retention basins to reduce flooding at Greta Street & West Spring Street.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood
Estimated Cost	$2 million
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	January 2016 – December 2018

West Haven Mitigation Action #5	Mechanized Tide Gate
Project Description	Install mechanized tide gates at Captain Thomas Blvd. on Cove River
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood
Estimated Cost	$1.5 million
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	January 2016 – March 2018

West Haven Mitigation Action #6	Raise Beach Street
Project Description	Raise roadway from Monahan Place to Second Avenue to provide access to Water Pollution Control Plant
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flood
Estimated Cost	$1 million
Potential Funding Source	Federal/State/Local
Lead Department	DPW
Implementation Schedule	January 2016 – March 2018

See Appendix J for more information regarding the West Haven Watershed Restoration Committee.

Woodbridge Mitigation Actions

Woodbridge Mitigation Action #1	Merritt Avenue Bridge Replacement
Project Description	Involves structure replacement to eliminate risk of deck closure due to scour potential during high water flow. It also eliminates a center peer that creates water flow restriction and debris collection.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$1.4 million
Potential Funding Source	Federal Funding 80% under the Federal Local Bridge Program and 20% Town of Woodbridge Capital Funding
Lead Department	Public Works under Board of Selectman and Board of Finance
Implementation Schedule	August 2007 – November 2014

Woodbridge Mitigation Action #2	Dam Removal at Lily Pond
Project Description	Elimination of the Lily Pond Dam will reduce low storm year flood potential upstream in Woodbridge on West River.
Mitigation Goal	Flood Hazards
Mitigation Category	Structure and Infrastructure Projects
Hazard(s) Addressed	Flooding
Estimated Cost	$500,000
Potential Funding Source	An initial grant was obtained in the amount of $60,000 for initial planning. Milone & MacBroom was retained for design of dam removal, which provides up to 60% of the plan. Fund seeking must continue for additional planning and permits.
Lead Department	Board of Selectman and Finance
Implementation Schedule	September 2012 – October 20 16

FEMA Grant Funding Sources

The Federal Emergency Management Agency (FEMA) makes grant funding for mitigation available via several programs. Jurisdictions such as the ten jurisdictions represented in this plan are eligible to apply for funding through the State of Connecticut as subgrantees. Assistance with application development and project eligibility criteria are available online and through the State. The brief descriptions provide an overview of the many grant opportunities available through FEMA.

Hazard Mitigation Assistance (HMA)[261]
FEMA's Hazard Mitigation Assistance (HMA) grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. Currently, FEMA administers the following HMA grant programs: Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM), and Flood Mitigation Assistance (FMA).

Hazard Mitigation Grant Program (HMGP) [262]
The Hazard Mitigation Grant Program (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. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

Pre-Disaster Mitigation (PDM) Grant Program[263]
The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.

Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

Flood Mitigation Assistance (FMA) Program[264]
The Flood Mitigation Assistance (FMA) program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).

FEMA provides FMA funds to assist States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the NFIP.

[261] http://www.fema.gov/pre-disaster-mitigation-grant-program

[262] http://www.fema.gov/hazard-mitigation-grant-program

[263] http://www.fema.gov/pre-disaster-mitigation-grant-program

[264] http://www.fema.gov/flood-mitigation-assistance-program

FY 2014 Emergency Management Performance Grants (EMPG) Program[265]

As appropriated by the Department of Homeland Security Appropriations Act, 2014 (Public Law 13-76); the Fiscal Year (FY) 2014 Emergency Management Performance Grants (EMPG) Program provides resources to assist state, local, tribal, and territorial governments in preparing for all hazards, as authorized by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.). The FY 2014 EMPG program plays an important role in the implementation of the National Preparedness System (NPS) by supporting the building, sustainment, and delivery of core capabilities essential to achieving the National Preparedness Goal (NPG) of a secure and resilient Nation. Delivering core capabilities requires the combined effort of the whole community, rather than the exclusive effort of any single organization or level of government. The FY 2014 EMPG's allowable costs support efforts to build and sustain core capabilities across the prevention, protection, mitigation, response, and recovery mission areas.

Title VI of the Stafford Act authorizes FEMA to make grants for the purpose of providing a system of emergency preparedness for the protection of life and property in the United States from hazards, and to vest responsibility for emergency preparedness jointly in the Federal government and the states and their political subdivisions. The Federal government, through the EMPG Program, provides the necessary direction, coordination, and guidance, and provides the necessary assistance, as authorized in this title so that a comprehensive emergency preparedness system exists for all hazards.

[265] DHS, FY 2014 Emergency Management Performance Grants (EMPG) Program Fact Sheet

CHAPTER 7. PLAN IMPLEMENTATION AND MAINTENANCE

SCRCOG staff and the Advisory Committee will implement the strategies outlined in this mitigation Plan and update and maintain the Plan according to the guidelines below. SCRCOG staff and each of the participating jurisdictions will use the Plan's goals, as well as continued analysis of hazard risks and capabilities, to weigh the available resources against the costs and benefits for each mitigation action. The participating jurisdictions understand the value of this Plan and its positive mitigation impact and intend to continue updating this Plan and implementing the Plan's strategies.

Plan Implementation

Each of the ten jurisdictions represented in this Plan, as well as SCRCOG staff, will implement portions of the Plan. They will collaborate on the completion of regional mitigation actions in addition to plan monitoring, evaluating and updating. They will independently implement their own jurisdiction-specific mitigation actions. Each mitigation action in this Plan is prioritized and assigned to a specific department or person for implementation. Timelines are given for each mitigation action where appropriate.

Method for Continued Regional Public Participation

FEMA Requirement §201.6(c)(4)(i)
Is there discussion of how the community(ies) will continue public participation in the plan maintenance process?

Public participation was an integral part of this Plan's development. The Advisory Committee with SCRCOG's leadership is committed to continuing public outreach and public involvement. To this end, the public will remain involved in mitigation, in the region and specifically in this Plan, via several vehicles. Public involvement will be fostered through the strategies listed below.

- The SCRCOG Mitigation Webpages (www.scrcog.org/regional-hazard-mitigation.html) will contain a copy of the plan and all updates.
- A SCRCOG Mitigation Newsletter (if implementation is feasible).
- Public meetings advertised in local newspapers and local websites.
- Advisory Committee members will update their local constituency of implementation and update progress.
- Copies of this plan will be available in each jurisdiction's Town Hall or other venue for public view.

Mitigation Action Progress Report				
Progress Report Period	From Date		To Date	
Action/Project Title				
Responsible Agency				
Contact Name				
Contact Phone/Email				
Project Description				
Project Goal				
Project Objective				
Project Cost				
Project Status				
Date of Project Approval	Date of Project Start	Anticipated Date of Completion	Project Canceled	Project Delayed
Explanation of Delay or Cost Overruns				
Project Report Summary				
What was accomplished for this project during this reporting period?				
What obstacles, problems, or delays did the project encounter?				
Plans for next reporting period.				

Method and Schedule for Monitoring, Evaluating and Updating the Mitigation Plan

The Advisory Committee has agreed to meet annually at a minimum to review the Plan. SCRCOG staff will host these meetings. All of the SCRCOG jurisdictions will be invited to participate in these meetings.

FEMA Requirement §201.6(c)(4)(i)
Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)?

Three key methods to keeping this Plan current are monitoring, evaluating and updating the Plan. FEMA defines these the following way[266]:

- Monitoring: Tracking the implementation of the plan over time.
- Evaluating: Assessing the effectiveness of the plan at achieving its stated purpose and goals.
- Updating: Reviewing and revising the plan at least once every five years.

Monitoring

The form below, *Mitigation Action Progress Report Form*, will be distributed to the Advisory Committee and available on the SCRCOG Mitigation Planning webpage. This form will be used by representatives from departments assigned with responsibility for action implementation to track and report on the progress of mitigation actions included in this Plan. Actions not included in this Plan will be added to the Plan via completion of the *Mitigation Action Progress Report Form*. Advisory Committee members are responsible for collecting additional mitigation actions from their jurisdiction and completing the form as needed.

Beyond five-year updates, SCRCOG staff will host Advisory Committee meetings on an annual basis, at a minimum, to look at the plan and discuss possible updates and mitigation actions.

Evaluating

SCRCOG's Regional Planner and the Advisory Committee will use the *Plan Update Evaluation Worksheet* to evaluate this Plan and make recommendations for future Plan updates and enhancements. The worksheet will be completed approximately three months after this Plan is adopted by all jurisdictions. It will then be completed annually with any updates to the plan.

[266] Local Mitigation Planning Handbook, FEMA March 2013. p. 7-1.

Table 7.132 Plan Update Evaluation Worksheet

Plan Section	Considerations	Explanation
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?	
	Have any internal or external agencies been invaluable to the mitigation strategy?	
	Can any procedures (e.g., meeting announcements, plan updates) be done differently or more efficiently?	
	Has the Advisory Committee undertaken any public outreach activities?	
	How can public participation be improved?	
	Have there been any changes in public support and/or decision-maker priorities related to hazard mitigation?	
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?	
	Are there different or additional administrative, human, technical, and financial resources available for mitigation planning?	
	Are there different or new education and outreach programs and resources available for mitigation activities?	
	Has NFIP participation changed in the participating jurisdictions?	
Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?	
	Should the list of hazards addressed in the Plan be modified?	
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?	
	Do any new critical facilities or infrastructure need to be added to	

Plan Section	Considerations	Explanation
	the asset lists?	
	Have any changes in development trends occurred that could create or reduce risks?	
	Are there repetitive losses and/or severe repetitive losses to document?	
Mitigation Strategy	Is the mitigation strategy being implemented as anticipated? Were the cost and timeline estimates accurate?	
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or removed from the plan?	
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?	
	Are there new funding sources to consider?	
	Have elements of the plan been incorporated into other planning mechanisms?	
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?	
	What are needed improvements to the procedures?	

Updating

SCRCOG has committed to maintaining this Plan by applying for funding toward plan updates. SCRCOG's Regional Planner will take the lead in this effort. SCRCOG staff will invite the five jurisdictions in the region that already have plans or are working on plans, to participate in future multi-jurisdiction plan updates.

In the event of a large-scale disaster, SCRCOG staff will review the Plan with the impacted jurisdictions to verify the Plan's accuracy. A meeting will be convened and the Plan will be updated as necessary.

Table 7.133 Method and Schedule for Maintaining and Updating Mitigation Plan

Months 1-12	Months 13-24	Months 25-36	Months 37-48	Months 49-60
SCRCOG hosts annual Advisory Committee Meeting.	SCRCOG hosts annual Advisory Committee Meeting.	SCRCOG hosts annual Advisory Committee Meeting.	SCRCOG hosts annual Advisory Committee Meeting.	SCRCOG leads Plan update process similar to process used for this Plan.
Advisory Committee proceeds with mitigation action implementation.	Advisory Committee proceeds with mitigation action implementation.	Advisory Committee proceeds with mitigation action implementation.	Advisory Committee proceeds with mitigation action implementation and considers additional mitigation projects.	SCRCOG hosts a minimum of 8 Advisory Committee Planning Meetings.
Advisory Committee members incorporate this Plan into other municipality plans.	Advisory Committee members incorporate this Plan into other municipality plans.	Advisory Committee members incorporate this Plan into other municipality plans.	Advisory Committee members incorporate this Plan into other municipality plans.	SCRCOG incorporates outreach strategy, which includes municipality meetings, public workshops and public surveys.
SCRCOG seeks funding for regional mitigation projects.	SCRCOG seeks funding for regional mitigation projects.	SCRCOG seeks funding for regional mitigation projects.	SCRCOG seeks funding for Plan update.	SCRCOG seeks funding for regional mitigation projects.
SCRCOG initiates mitigation planning review process for lessons learned.	SCRCOG maintains communication with all 15 municipalities to incorporate their mitigation plans into one regional plan.	SCRCOG maintains communication with all 15 municipalities to incorporate their mitigation plans into one regional plan.	SCRCOG invites all 15 municipalities to participate in next regional plan. SCRCOG secures Resolutions of commitment.	SCRCOG hosts meetings for additional stakeholders such as CL&P, The Nature Conservancy, and the Regional Planning Commission.
SCRCOG hosts Advisory Committee Meeting following any large scale disasters to discuss potential additional mitigation actions	SCRCOG hosts Advisory Committee Meeting following any large scale disasters to discuss potential additional mitigation actions	SCRCOG hosts Advisory Committee Meeting following any large scale disasters to discuss potential additional mitigation actions	SCRCOG hosts Advisory Committee Meeting following any large scale disasters to discuss potential additional mitigation actions	SCRCOG hosts Advisory Committee Meeting following any large scale disasters to discuss potential additional mitigation actions

Plan Incorporation into Existing Planning Mechanisms

FEMA Requirement §201.6(c)(4)(ii)
Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?

Integrating components of this Plan with other plans is the responsibility of each participating jurisdiction. Whenever appropriate, the jurisdictions will integrate elements of this Plan into local planning mechanisms, including Plans of Conservation and Development, Emergency Operations Plans, Floodplain Management and Zoning Regulations, and Capital Improvement Plans. Additionally, SCRCOG will integrate elements of this Plan into regional planning documents, such as the Regional Plan of Conservation and Development and Long-Range Transportation Plan, as appropriate. The integration process and schedule of incorporating elements of this Plan will vary based on the particular plan's update cycle. The yearly mitigation meetings will provide an opportunity to track the progress on the integration of this Plan into local planning mechanisms.

Per Section 8-23 of the Connecticut General Statutes, the jurisdictions will update their plans of conservation and development (POCD) at least once every ten years. Jurisdictions were exempt from this requirement between July 1, 2010 and June 30, 2013 due to the development of the *State of Connecticut Conservation and* Development Policies Plan, 2013-2018. Table 7.134 below outlines when each jurisdiction's POCD was last updated. The Town of Madison integrated the hazard mitigation planning process during the update of their POCD in the fall of 2013. The Town identified specific policies related to hazard mitigation and developed the following task to be completed: "As part of the regional hazard mitigation planning process, identify potentially vulnerable areas and prepare response plans." a task of identification of vulnerable areas and appropriate response plans. The Town has also incorporated a policy of the continual review and improvement of the hazard mitigation plan through regular updates. Table 7.135 shows opportunities that each municipality has to integrate the mitigation Plan into other local planning mechanisms based on data collected during the Capability Assessment.

Table 7.134 Dates of POCD Plans

Jurisdiction	POCD Last Updated
SCRCOG	2008
Bethany	2010
Branford	2008
Hamden	2004
Madison	2013
North Branford	2009
North Haven	2005
Orange	2000
Wallingford	2004
West Haven	2004
Woodbridge	2005

Table 7.135 Opportunities to Integrate Mitigation Plan

Jurisdiction	Integration Opportunity as Cited in Capability Assessment	Process of Integration into Plan of Conservation and Development
Bethany	Desire an increase in comprehensive planning and regulatory enforcement.	Integrate stormwater management actions.
Branford	Sea level rise preparation, stormwater management and flooding emphasized.	Integrate named flooding mitigation actions into plan.
Hamden	Flood control is named but stormwater management focus is water quality not flood control.	Integrate named flooding mitigation actions into plan.
Madison	Coastal land management emphasized.	Updated early Fall 2013 with mitigation plan content.
North Branford	Interested in increasing funding sources for mitigation actions.	Include mitigation actions relevant to the new Regional Shelter.
North Haven	Specific areas of stormwater flooding named.	Integrate named flooding mitigation actions into plan.
Orange	Municipality meeting feedback included an interest in additional	Integrate public outreach and education actions.

Jurisdiction	Integration Opportunity as Cited in Capability Assessment	Process of Integration into Plan of Conservation and Development
	public outreach and education.	
Wallingford	Comprehensive infrastructure improvements that coincide with mitigation actions.	Integrate mitigation actions specific to flooding and infrastructure improvements.
West Haven	Land use emphasis is on conservation to be balanced with preservation and development.	Integrate named flooding mitigation actions into plan.
Woodbridge	Tree canopy growth is emphasized in terms of public safety.	Integrate mitigation actions specific to tree maintenance.

Following Plan adoption, the Advisory Committee will be encouraged to identify locally-specific opportunities to integrate the relevant components of this Plan into other local plans and planning processes. To assist in this effort, SCRCOG staff will continue to encourage Advisory Committee members to consult FEMA's recently released publication, titled *Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials*. The recommended process in FEMA's publication includes the following five steps:

1. Assess your community's planning framework with a lens for resilience.
2. Inform and engage local leadership, staff, and stakeholders.
3. Establish an integration agenda of resilient community principles and actions.
4. Be opportunistic.
5. Monitor, measure, report, and repeat.

At the moment, it is deemed appropriate for SCRCOG staff to lead the effort to maintain this Multi-Jurisdiction Plan and future regional plans. However, individual jurisdictions have the authority to choose their level of participation in this Plan.

Plan Adoption

FEMA Requirement §201.6(c)(5)
For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption?

Each participating jurisdiction completed local plan adoption procedures following the issuance of final Plan approval by FEMA. The dates each jurisdiction and the SCRCOG Board adopted the plan are in Appendix L. Also included in Appendix L are copies of the Adoption Resolutions