Predisaster Mitigation Strategy Document
Connecticut's South Western Region

2011

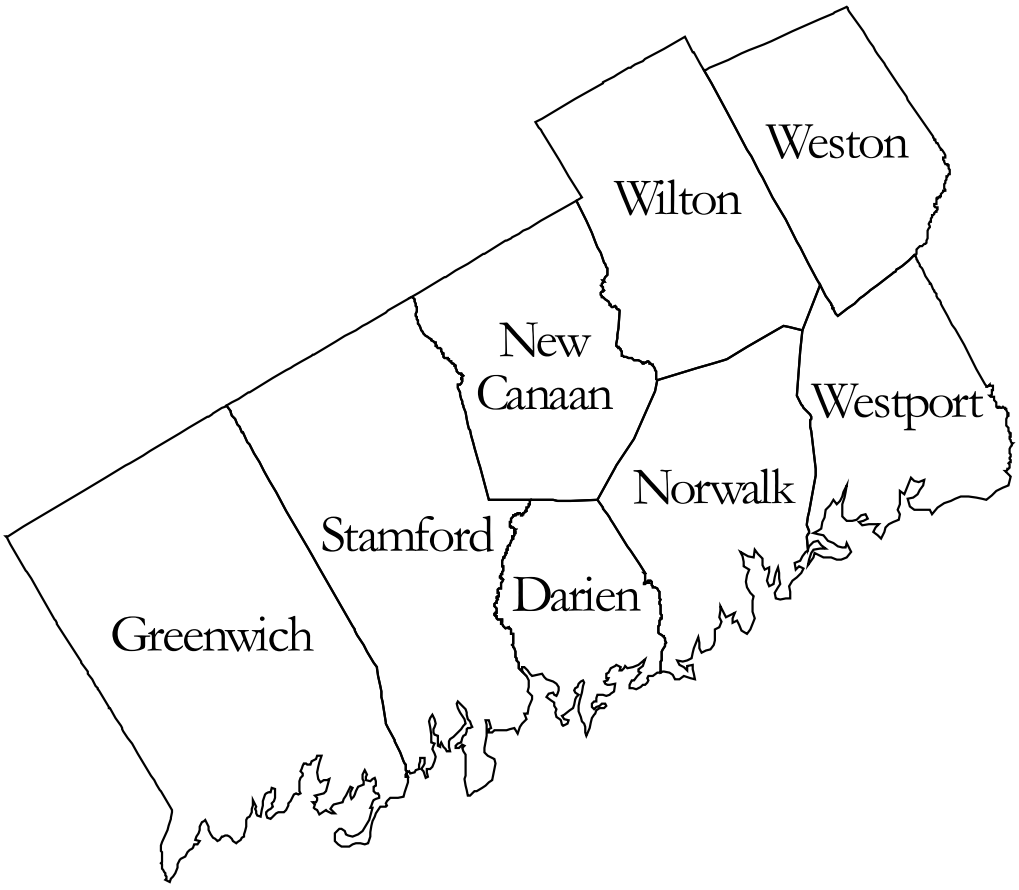

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Table of Contents

Appendices

Tables

Figures

Acknowledgements

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Advisory Committee

Darien	Mr. Marc McEwan
Greenwich	Mr. Daniel Warzoha
New Canaan	Mr. Tiger Mann and Mr. Steve Bury
Norwalk	Chief Denis McCarthy and Michele DeLuca
Stamford	Ms. Erin McKenna and Captain Thomas Lombardo
Weston	Sgt. Mike Ferullo
Westport	Chief Christopher Ackley, Ms. Alicia Mozian and Ms. Michelle Perillie
Wilton	Chief Paul Milositz

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Acronyms

CIS	Community Information System
CGS	Connecticut General Statutes
CRS	Community Rating System
CSBC	Connecticut State Building Code
CTDEP	Connecticut Department of Environmental Protection
DEMHS	Department of Emergency Management and Homeland Security
DMA2000	Disaster Mitigation Act of 2000
EF-Scale	Enhanced Fujita Scale
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ESF	Emergency Support Functions
F-Scale	Fujita Scale
ISTEA	Intermodal Surface Transportation Efficiency Act (U.S. Law – 1991) (Replaced by TEA-21 in 1998)
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HAZUS-MH	Hazards U.S. Multi-Hazards
HMGP	Hazard Mitigation Grant Program
ICS	Incident Command System
IPCC	Intergovernmental Panel on Climate Change
IWWA	Inland Wetlands and Watercourses Agency
LIS	Long Island Sound
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NOAA	National Oceanic & Atmospheric Administration
NRWI	Norwalk River Watershed Initiative
NWS	National Weather Service
P&Z	Planning and Zoning
PDM	Pre-Disaster Mitigation
RL	Repetitive Loss
SBA	Connecticut Small Business Administration
SRL	Severe Repetitive Loss
SNEW	South Norwalk Electric Works
SWRPA	South Western Regional Planning Agency
TEA-21	Transportation Equity Act for the 21st Century
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
ZEO	Zoning Enforcement Officer

I. Introduction

Purpose

The purpose of the South Western Region Pre-Disaster Mitigation Strategy Document is to propose mitigation strategies that reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters. In 2005 the eight municipalities of South Western Connecticut put together the Region's first multi-jurisdictional Predisaster Mitigation Plan. The *Pre-Disaster Mitigation Strategy Document, Connecticut's South Western Region* (2005 PDM) was approved by FEMA on July 17, 2005 and covered the municipalities of Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton. The *2010 Predisaster Mitigation Strategy Document* (referred to as "the Plan") is an update to the original plan adopted by the region's municipalities in 2005.

Natural disasters often cause repeated damage and require reconstruction that is often more expensive as the years go by. Hazard mitigation breaks this expensive cycle of recurrent damage and increasing reconstruction costs by taking a long-term view of rebuilding and recovery following natural disasters. Mitigation is distinct from other phases of emergency management – such as preparedness, response and recovery – because it *reduces* or *eliminates* long-term risk to human life and property resulting from hazards. These long-term strategies include planning, policy-making, programs, projects and other activities.

The Plan takes into consideration the following natural disasters:

- Floods
- Hurricanes & Tropical Storms
- Severe Storms
    - Coastal Storms
    - Wind Storms
    - Severe Winter Storms, Nor'easters, Blizzards & Ice Storms
- Severe Thunderstorms
- Tornadoes
- Dam failure
- Drought
- Earthquakes
- Sea level rise

Municipalities have a variety of formal and informal hazard mitigation strategies in place. For example, zoning, subdivision and other land-use regulations often require structures to be raised in flood zones. The Plan identifies these existing strategies and assesses their ability to mitigate the damage caused by various types of natural disasters. The Plan evaluates the risks associated with each of the above natural hazards, reviews mitigation strategies recommended as part of the 2005 PDM, assesses implemented strategies, and also proposes new mitigation strategies that address identified risks. The Plan also prioritizes the mitigation recommendation and proposes an overall implementation strategy that utilizes limited resources to maximize benefits on identified hazard areas.

The South Western Regional Planning Agency (SWRPA) has received funding under the Hazard Mitigation Grant Program to update the 2005 PDM Plan for the eight municipalities comprising the South Western Region. This initiative is being funded primarily by the Federal Emergency Management

Agency (FEMA), with the Connecticut Department of Environmental Protection (CTDEP) administering the grant.

Authority

The Federal Disaster Mitigation Act of 2000 (DMA 200) amended "Section 322 – Mitigation Planning," and Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1997 (Stafford Act) requires all local governments to have an approved PDM Plan in place to be eligible to receive Public Assistance Grants and Hazard Mitigation Grant Program project funding.[1] The eight municipalities of South Western Connecticut (Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport and Wilton) decided to work together to develop a multi-jurisdictional pre-disaster mitigation plan for natural hazards that pose a risk to the Region.

Region Overview

The South Western Region ("the Region") consists of the eight municipalities in the southwest "panhandle" of Fairfield County and the State of Connecticut. These municipalities are the cities of Norwalk and Stamford and the towns of Darien, Greenwich, New Canaan, Weston, Westport and Wilton. All of the communities lie in the coastal slope region of Connecticut and five of them have direct coastal frontage on Long Island Sound (Figure 1-1).

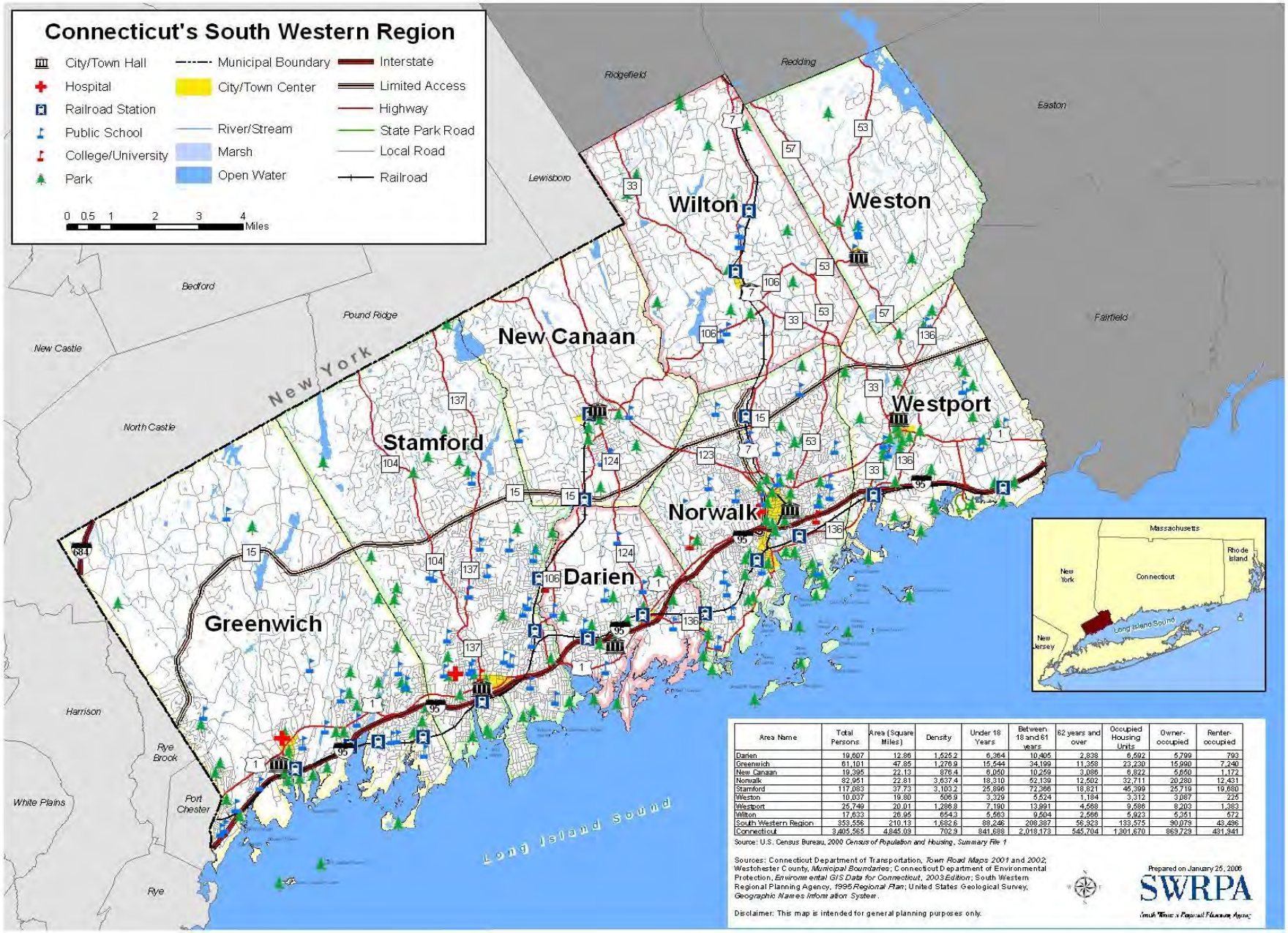
Generally, the Region is heavily developed and is one of the most densely populated areas in the state. The total regional population as indicated in the 2000 Census is 353,556 persons and the total land area is 210.1 square miles, for a regional population density of 1,683 persons per square mile. The coastal City of Norwalk has the highest population density in the Region at 3,637 persons per square mile, while the inland Town of Weston has the lowest at 507 persons per square mile (Table 1-1).

Table 1-1. Population Density by Municipality, Region and State, 2000

Area Name	Total Population	Area (Sq. Miles)	Pop. Density
Darien	19,607	12.9	1,525.2
Greenwich	61,101	47.8	1,277.6
New Canaan	19,395	22.1	876.5
Norwalk	82,951	22.8	3,637.3
Stamford	117,083	37.7	3,102.0
Weston	10,037	19.8	507.0
Westport	25,749	20.0	1,286.7
Wilton	17,633	26.9	654.3
Region	**353,556**	**210.1**	**1,682.7**
Connecticut	3,405,565	4,845.1	702.9

Source: United States Census Bureau. 2000 Census of Population and Housing, Summary File 1.

The Region is part of the New York Metropolitan Area with very strong ties to New York City and neighboring Westchester County. The Region's proximity to the employment and cultural opportunities of New York City and Westchester is one of its greatest assets. According to the 2000 census, 19,128 residents of the Region worked in Manhattan, 2,285 residents worked in the other four boroughs and 9,587 worked in Westchester County. The relatively reasonable commute to Manhattan facilitated by MTA Metro-North Railroad and, to a lesser extent, Interstate 95 and the Merritt/Hutchinson River



Area Name	Total Persons	Area (Square Miles)	Density	Under 18 Years	Between 18 and 61 years	62 years and over	Occupied Housing Units	Owner-occupied	Renter-occupied
Darien	19,607	12.86	1,525.2	6,364	10,405	2,838	6,592	5,799	793
Greenwich	61,101	47.85	1,276.9	15,544	34,199	11,358	23,230	15,990	7,240
New Canaan	19,395	22.13	876.4	6,050	10,259	3,086	6,822	5,650	1,172
Norwalk	82,951	22.81	3,637.4	18,310	52,139	12,502	32,711	20,280	12,431
Stamford	117,083	37.73	3,103.2	25,896	72,366	18,821	46,399	25,719	19,680
Weston	10,037	19.80	506.9	3,329	5,524	1,184	3,312	3,087	225
Westport	25,749	20.01	1,286.8	7,190	13,991	4,568	9,586	8,203	1,383
Wilton	17,633	26.95	654.3	5,563	9,504	2,566	5,923	5,351	572
South Western Region	353,556	210.13	1,682.6	88,246	208,387	56,923	133,575	90,079	43,496
Connecticut	3,405,565	4,845.09	702.9	841,688	2,018,173	545,704	1,301,670	869,729	431,941

Source: U.S. Census Bureau, *2000 Census of Population and Housing, Summary File 1*

Sources: Connecticut Department of Transportation, *Town Road Maps 2001* and *2002*; Westchester County, *Municipal Boundaries*; Connecticut Department of Environmental Protection, *Environmental GIS Data for Connecticut, 2003 Edition*; South Western Regional Planning Agency, *1995 Regional Plan*; United States Geological Survey, *Geographic Names Information System*.

Figure 1-1. Connecticut's South Western Region.

Parkway makes the Region a highly desirable and very expensive place to live. In fact, real estate values in the Region are among the highest in the nation.

According to the 2000 Census, the median value of owner-occupied housing in the Region was $469,500, which is 2.8 times greater than the statewide median of $166,900.[2] Only the cities of Norwalk and Stamford had median values below $500,000. Among the Region's six towns, Norwalk had the lowest at $270,100 while New Canaan had the highest, at $831,000 (Table 1-2).[3] Therefore, monetary losses from natural hazards occurring in the Region are likely to be significantly higher than those experienced in other parts of the state. Furthermore, damage to the I-95 and Northeast Rail corridors – which are critical to the economies of the Mid-Atlantic and New England regions – could result in severe economic consequences for the Region and the State of Connecticut.

Table 1-2. Housing Values by Municipality, Region and State (1999 dollars)

Area Name	Occupied Housing Units	Specified Owner-Occupied Units	Median value
Darien	6,592	5,503	$711,000
Greenwich	23,230	13,148	$781,500
New Canaan	6,822	5,002	$831,000
Norwalk	32,711	15,736	$270,100
Stamford	45,399	18,034	$362,300
Weston	3,312	2,885	$633,900
Westport	9,586	7,483	$625,800
Wilton	5,923	4,904	$561,100
Region	**133,575**	**72,695**	**$469,500**
Connecticut	1,301,670	728,244	$166,900

Source: United States Census Bureau, *2000 Census of Population and Housing, Demographic Profile, DP-4. Profile of Selected Housing Characteristics.*

The South Western Region is expected to experience continued population growth, although at a slower pace than in the previous decade. Potential growth is limited because much of the Region is either built out, or undeveloped parcels are designated as open space. The scarcity of developable land combined with the tremendously high real estate values has pushed developers to look toward land with steep slopes, wetlands and other unfavorable conditions that make them more vulnerable to natural hazards. Commercial developers are also turning their attention to brownfields and abandoned sites.

Transportation will remain one of the biggest issues in the Region and contributes to developmental pressure. Traffic volumes on I-95, the Merritt Parkway, Route 1, Route 7 and the other principal arterial routes continue to grow. Ridership on Metro-North Railroad also continues to grow despite its reliance on old, unreliable equipment. There is a burgeoning movement to expand freight traffic on the railroad as congestion continues to increase on major highways. Proposed highway and transit projects in Stamford, South Norwalk and along the Route 7 corridor are also expected to generate additional commercial and residential development in those areas.

Climate and Weather

The South Western Region is classified as a "hot summer continental climate" in the Koppen-Trewartha system. This climate is marked by four well-defined seasons, an average temperature above 50° F in their warmest months, and a coldest month average below 26.6° F. Between 1931 and 2010, Connecticut's average temperature was 48.6°F for all months. January had the coldest average temperature of 25.9°F and July had the warmest average temperature of 71.2° F. However, the weather in the South Western

Region is moderated by its proximity to Long Island Sound. Darien, Greenwich, New Canaan, Norwalk, Stamford and Westport are in the Coastal Connecticut climate division, which had an average temperature of 50.6°F for all months, 28.8°F for January, and 72.6°F for July. On the other hand, Wilton and Weston are part of the cooler Central Connecticut climate division, which had an average temperature of 48.8°F for all months, 26.1°F in January, and 71.4°F in July.[4]

Between 1931 and 2010, Connecticut's annual precipitation averaged 50.4 inches, and the average monthly precipitation ranged from a low of 3.13 inches in February to a high of 4.36 inches in November. Despite the fairly consistent average monthly precipitation, the annual standard deviation was 7.25 inches. This statistic suggests that Connecticut experienced between 40.12 and 54.62 inches of precipitation in 68 percent of all years, and between 32.87 inches and 61.87 inches in 95 percent of all years. The inconsistent annual precipitation makes Connecticut prone to both drought and flood.[2]
In addition to temperature, Long Island Sound affects precipitation in the South Western Region. More specifically, the Coastal Connecticut climate division averaged 46.51 inches with a standard deviation of 6.99 inches. The monthly precipitation averaged between 3.21 inches (February) and 4.22 inches (November). Conversely, the Central Connecticut climate division averaged 47.66 inches with a standard deviation of 7.40 inches. The monthly precipitation averaged between 3.16 inches (February) and 4.47 inches (November). Thus, the Coastal Connecticut climate division tends to have more consistent precipitation than does the Central Connecticut climate division.

Precipitation is typically in the form of rain from April through October. From November through March, precipitation can be in the form of rain, freezing rain, ice, sleet or snow. In fact, precipitation often changes during the same storm event.

Freezing rain can be particularly disruptive when the heavy weight of the ice causes power lines and tree limbs to fall, and when it coats roads and highways. Although rare, hail is experienced in the Region and can be quite destructive.

The Region experiences a wide variety of wind speeds from diverse weather patterns. Major hurricanes and tornados occur infrequently in the Region. The most recent hurricane to hit Connecticut was Hurricane Gloria in 1985. Tropical storms and thunderstorms occur regularly and can bring damaging winds and heavy rainfall. Additionally, areas near the coast can experience fierce winds, sometimes independent of any local storms.

In summary, the Region has four well defined seasons, with hot summers and cold winters. Although the Region experiences regular precipitation throughout any given year, the irregular annual precipitation cycle makes the Region prone to flooding and drought. Each natural hazard is further discussed in the section III. Hazard Evaluation and Risk Assessment.

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[1] FEMA 44 CFR Parts 201 & 206
[2] United States Census Bureau. *2000 Census of Population and Housing, Summary File 1*
[3] United States Census Bureau, *2000 Census of Population and Housing, Demographic Profile, DP-4. Profile of Selected Housing Characteristics*
[4] National Climatic Data Center http://www.ncdc.noaa.gov/oa/ncdc.html

II. Planning Process

Overview

The 2010 Pre-Disaster Mitigation Strategy Document was developed in collaboration with the Region's eight municipalities, CTDEP and FEMA. SWRPA coordinated its planning efforts through an Advisory Committee, who would serve as the liaison and coordinate the planning process with the other municipal entities involved in disaster mitigation, preparedness and response. At the onset of the planning process a request was made to the chief elected official in each municipality to appoint a representative(s) to the Advisory Committee. SWRPA and the Advisory Committee reviewed the 2005 PDM, reassessed the goals and objectives of the plan, updated the hazard risk assessment based on currently available data, developed new mitigation strategies for each municipality and revised the plan maintenance procedures. Current planning documents local studies and other technical documents were also reviewed as part of the update to the 2005 PDM. A list of the primary resources reviewed as part of the planning process is included in Appendix E. A number of opportunities were provided for the community and interested stakeholders to participate in the plan update and to comment on the document.

Advisory Committee

The members of the Advisory Committee were appointed by the chief elected official of each participating municipality. The Advisory Committee consisted of a mix of emergency personnel, engineers, land-use planners and environmental planners (Table 2-1); as needed additional town departments were consulted and asked to review documents. Each Advisory Committee member made their own unique positive contribution to the development of the Plan and worked to coordinate the planning process in their respective municipality.

Table 2-1. 2010 Advisory Committee Members

	Department	2010 Member
Darien	Fire Marshal	Mr. Marc McEwan
Greenwich	Emergency Management	Mr. Daniel Warzoha
New Canaan	Engineering	Mr. Tiger Mann and Mr. Steve Bury
	Emergency Preparedness	Norman Cole
Norwalk	Emergency Management	Chief Denis McCarthy and Michele DeLuca
Stamford	Planning	Ms. Erin McKenna
	Emergency Management	Captain Thomas Lombardo
Weston	Emergency Management	Sgt. Mike Ferullo
Westport	Emergency Management	Chief Christopher Ackley,
	Planning	Mr. Larry Bradley and Ms. Michelle Perillie
	Conservation	Ms. Alicia Mozian
Wilton	Emergency Management	Chief Paul Milositz

Several Advisory Committee meetings were held during the Plan's development. These meetings allowed Agency staff to coordinate the planning efforts in each municipality. Equally important, they provided an avenue for municipalities to share ideas about developing mitigation strategies. To accommodate the diverse schedules of the Advisory Committee, electronic communication and circulation of materials was heavily relied upon during the plan update. This provided an opportunity for all members of the advisory committee to review and comment on materials and share information to the entire committee even if they were unable to attend a meeting. Appendix D includes a summary of how each municipality participated in the planning process.

2005 Predisaster Mitigation Plan Review

On April 12, 2010 the Advisory Committee met and was charged with the task of collecting existing mitigation strategies, reviewing the 2005 PDM, and evaluating the goals and objectives identified in the 2005 PDM. The Advisory Committee was asked to identify the status of recommended mitigation strategies in the 2005 PDM and to identify any strategies that were not successful after implementations. The 2005 PDM did not include any Regional or Multi-Jurisdictional strategies, which the Advisory Committee identified as something they would like to include in the update plan. The Advisory Committee was also asked:

- What would you like to see included, enhanced, or removed from the 2005 PDM?
- Any recommendations or problem area that should be included in the update?
- Specific problem areas in your municipality that need mitigation or should be identified in the update?
- Specific mitigation strategies that would like to be included in the update?
- Please identify additional mitigation activities that have taken place since 2005.

Once responses had been received from a majority of the municipalities a summary of the 2005 PDM was prepared and circulated to the Advisory Committee for comment.

The 2005 PDM included 208 tasks supporting hazard mitigation in the Region. Since the adoption of the 2005 PDM 142 projects were successfully implemented, 95 of which have been incorporated into the communities' ongoing mitigation activities. As of August 2010, 38 of the supporting tasks were in the process of being implemented and eight had been removed from the list by the municipalities. Of the 208 recommended supporting tasks, 20 had not yet been implemented and were incorporated in the recommended strategies identified in the update. An additional 19 mitigation projects were also conducted by the Region's municipalities that were not identified in the 2005 PDM. No strategies implemented were identified as unsuccessful. A summary of the status of each of the tasks is included in Appendix B.

Since the adoption of the 2005 PDM the Region and its municipalities also received four grants from FEMA's Hazard Mitigation Program to complete three property elevations, upgrade to a portion of Keeler Brook in Norwalk, and update the 2005 PDM. At least two properties have also been elevated independently without federal or local funding. In addition, the first HMGP acquisition/open space project to be completed in Connecticut was also completed by the Town of Darien in 2007.

Hazards Evaluation and Risk Assessment

The review and update of the hazard vulnerability and risk assessment was initiated following the review of the 2005 PDM. The natural hazards addressed in the 2005 PDM were selected based upon the frequency and potential impacts of each natural hazard, with the understanding that the selected hazards would be further evaluated during the development of the plan. During the update process current climatic

data and the history of storm events in the Region were reviewed, resulting in no changes to the Natural Hazards included in the plan.

During the development of the 2005 PDM SWRPA staff met with CTDEP to propose a list of natural hazards for consideration by the Advisory Committee. The list of possible natural hazards was derived from a planning worksheet found in FEMA publication No. 386-2, page 1-2. The following hazards were easily agreed upon for inclusion of the plan due to their likelihood or potential impacts on the Region:

- Floods
- Hurricanes/Tropical Storms
- Severe Storms
- Severe Thunderstorms
- Tornadoes
- Dam Failure
- Drought
- Earthquakes

Wildfires were discussed under drought because their occurrence is most likely during times of extremely dry conditions, and coastal storms, wind storms, winter storms, nor'easters, blizzards and ice storms were all included with severe storms. Coastal erosion is also a legitimate environmental concern in the coastal municipalities, but coastal erosion has a relatively low potential impact on the assets and infrastructure in these communities. Instead, sea level rise was included given the mounting evidence supporting the threat; and due to its high potential to impact both the coastal communities directly and on the inland portions of the Region through potential changes in weather patterns and tidal cycles.

Using all currently available data, including the updated Flood Insurance Rate Maps issued for Fairfield County in June 2010, current storm event data, local land use and zoning data and contemporary information on sea level rise, the hazard risk assessment for each municipality in the Region was updated. The HAZUS-MH loss estimation software developed by FEMA was used to evaluate natural disasters in terms of frequency, magnitude, areas of impact and economic loss. The HAZUS-MH earthquake and hurricane models were used to assess the risks and losses associated with these hazards. Information from the National Flood Insurance Program (NFIP) yielded more detailed results than the HAZUS-MH flood model, and was used in conjunction with local data to assess risks and losses using a GIS. Recent climate change models developed by the CTDEP based on data collected by FEMA, for the Connecticut Coastal Hazards Portal & Draft Visualization Tool Data were overlain with the scenarios developed for mean high water plus 6 inches.[5] The NOAA storm database and climatic data were also used to provide information on the frequency and severity of natural hazards and to fill in data gaps where needed.

Goals and Objectives

As part of the update process SWRPA reviewed each of the goals and objectives identified in the 2005 PDM to ensure they were consistent with the Region's vision for land use planning and hazard mitigation. The goals in the State of Connecticut's *Natural Hazards Mitigation Plan for 2007 – 2010* were also considered as part of the initial evaluation of the goals in the 2005 PDM. During the first Advisory Committee meeting, each municipality was then asked to review the goals identified in the 2005 PDM and to verify that they were still consistent with the goals and priorities outlined in other municipal planning documents. Once risk assessments had been completed and reviewed each municipality was then asked to re-evaluate the goals to be included in the 2010 plan. After careful review of the risk assessments and community vulnerability all eight municipalities reaffirmed the original goal(s) identified in the 2005 PDM.

As part of the risk assessment review each municipality also reviewed the objectives included in the 2005 PDM to help focus and organize mitigation strategies. Where appropriate, objectives were modified, removed, or new objectives were developed to help enhance achievement of each goal. However, many municipalities found that the objectives identified in the 2005 PDM were still consistent with the community priorities.

Mitigation Strategies

A list of potential mitigation strategies was developed for each municipality based on the goals and objectives identified, their vulnerability to specific hazards, and projects and recommendations included in other local planning documents. The list of potential mitigation strategies was circulated to the respective Advisory Committee member(s) for each municipality, who coordinated the review with other town departments involved with natural hazard mitigation and disaster response. During July and August and October 2010 a meeting with each municipality and the appropriate town departments was then scheduled to review the proposed mitigation strategies and to select mitigation strategies to be incorporated into the plan. Municipal departments participating in the selection and prioritization generally included: planning and zoning, department of public works, emergency management, fire, police, conservation and public health. Specific participants and the planning process for each municipality are included in Appendix D.

Initially, mitigation strategies were selected based on municipal priorities, whether or not local and political support existed, and the municipality's ability to implement the recommendations. The list of mitigation strategies was further refined for each municipality and prioritized using a simple evaluation matrix. Although individual evaluation criteria were developed by each municipality, the evaluation and prioritization generally asked:

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- The anticipated time frame for implementation.

A numeric score was assigned to each criteria: a score of one (1) indicated the criteria was satisfied, a zero (0) indicated the mitigation strategy did not satisfy the criteria, and 0.5 was used when a specific mitigation strategy could possibly satisfy the criteria, dependant on other factors, not known or predictable during the development of the plan. Scores were then totaled and assigned a priority ranking of high, medium, or low. Specific rating criteria and ranking information are included in Appendix C.
After the evaluation and prioritization were complete the draft list of mitigation strategies was again circulated through each municipality for review and comment. The draft mitigation strategies were also presented during the public information session held as part of the Advisory Committee meeting on September 23, 2010.

A number of regional recommendations were also developed during the planning process. Regional recommendations focused on methods to assist the municipalities in enhancing the existing mitigation program and in facilitating inter-municipal cooperation. Recommendations were prioritized as high medium and low based on importance to the region's municipalities, the impact to the region and the expected time frame for implementation.

Plan Maintenance Procedures

The effectiveness of the Plan Maintenance Procedures section of the 2005 PDM was reviewed by SWRPA staff. One main deficiency was identified regarding the 5 year update of the plan. To address this, additional details on the time frame for initiating the plan update, and the roles and responsibility of SWRPA and the Advisory Committee were added. During the update process the Advisory Committee also recommended the plan be reviewed annually and a status report of implemented strategies be

compiled to facilitate the five-year update and inter-municipal collaboration on mitigation activities underway in the Region.

The Advisory Committee met again on October 13, 2010 to review the preliminary draft of the Plan, discuss the next steps towards town approval, and to establish the formal public review process.

Public Involvement and Plan Review

Throughout the Plan's development, SWRPA used its website as the primary method to encourage public involvement. Meeting information and relevant documents were posted on the website. All Advisory Committee meetings were open to the public and media releases were issued to all local news outlets prior to each meeting. A formal public information session was held as part of the September 23, 2010 Advisory Committee meeting, to discuss proposed mitigation strategies and review the hazard vulnerability and risk assessment.

Copies of the preliminary draft Plan were sent to state and local officials, and local utilities for their review to ensure compliance with existing regulations, policies, and procedures. Local department heads, all identified stakeholders and the adjacent Regional Planning Organizations were also offered the opportunity to comment on the Plan. After this initial review, the Plan was updated as appropriate in preparation for the formal public review process. On October 19, 2010 the draft Plan was made available for a 30-day public review and comment period. Draft documents were made available on the each municipality's and SWRPA's website, at local libraries, at the SWRPA offices and by the Advisory Committee member in each municipality, with information on how to provide comment on the document. A media release was also issued announcing the availability of the plan for review and comment. As a result a news story on the plan appeared in the Stamford Advocate on October 27, 2010 and a Radio interview was conducted which aired on local AM radio station WGCH October 25, 2010.

During the public review period a number of public presentations were made across the Region, additional presentations were also made to local officials in Stamford, Darien, and Norwalk following the end of the public review period. Presentations were made:

- October 28, 2010 – South Western Region Metropolitan Planning Organizations (SWRMPO) – Norwalk Transit District – 8:15 am*
- November 1, 2010 – SWRPA Board – Norwalk Police Station – 7:30 pm*
- November 4, 2010 – Greenwich Board of Selectmen – Greenwich Town Hall – 10:00 am*
- November 15 – Wilton Board of Selectmen – Wilton Town Hall – 7:00 pm*
- November 17, 2010 – Westport Board of Selectmen – Westport Town Hall – 4:00 pm*
- November 17, 2010 – New Canaan Town Council – New Canaan Town Hall – 7:30 pm*
- November 18, 2010 – Weston Board of Selectmen – Weston Town Hall – 7:30 pm*
- November 18, 2010 – Norwalk Health, Safety and Welfare Committee – Norwalk Town Hall – 7:00 pm*
- December 2, 2010 – Stamford Board of Representatives – Stamford Government Center 7:00 pm
- December 13, 2010 – Darien Board of Selectmen – Darien Town Hall – 7:45 pm

*indicate formal public involvement opportunities and meeting recorded for broad cast over local cable stations or through municipal websites.

At the end of the 30-day public review period no comments were received.

Plan Adoption

During the public review period public presentations were made in each municipality to the governing board, who was asked to grant the chief elected official the power to approve the final Plan following conditional approval from FEMA (see list above). The final Plan was submitted to CTDEP and FEMA for "conditional approval on November 22, 2010. "Approval pending adoption" was received from FEMA May 24, 2011. Resolution to adopt the plan were signed by the eight Chief Elected Officials on May 26, 2011 and by the SWRPA Board on June 6, 2011. The adopting resolutions and final FEMA approval are provided in Appendix A.

[5] Connecticut Coastal Hazards Portal and Visualization Tool http://depweb.dms.uconn.edu/index.html

III. Hazard Evaluation and Risk Assessment

Overview

The purpose of the hazard evaluation and risk assessment is to evaluate the Region's risk of natural disasters in terms of frequency, magnitude, vulnerable locations and economic loss. The frequency refers to the likelihood that a natural disaster would occur in any given year. The magnitude is the degree to which a natural disaster could cause the loss of property and life. Vulnerable locations are those particularly prone to the effects of a natural disaster, and economic loss refers to the direct and indirect costs attributable to a natural event. Together, these components identify the most likely natural hazards to strike the Region, the potential impact of each hazard, and areas most susceptible to each hazard. In this way, the hazard evaluation and risk assessment can help evaluate existing mitigation strategies and prioritize proposed mitigation strategies.

The Region covers a relatively small are of land, 225 square miles, on the north western shore of Long Island Sound and is home to approximately 345,000 people[2]. Each of the Region's cities and towns blends elements of town or city center development with traditional suburban-style development. Like much of New England, early development centered on the Region's navigable rivers and coastline, with the town green and churches serving as the social and cultural centers of the community. Rivers served as both ports and commercial hubs, aiding the movement of goods and serving as a source for powering manufacturing facilities. With rivers, railroads, and later highways serving as major the economic drivers, development patterns in the Region are primarily centered on and around this infrastructure (Figure 3-1).

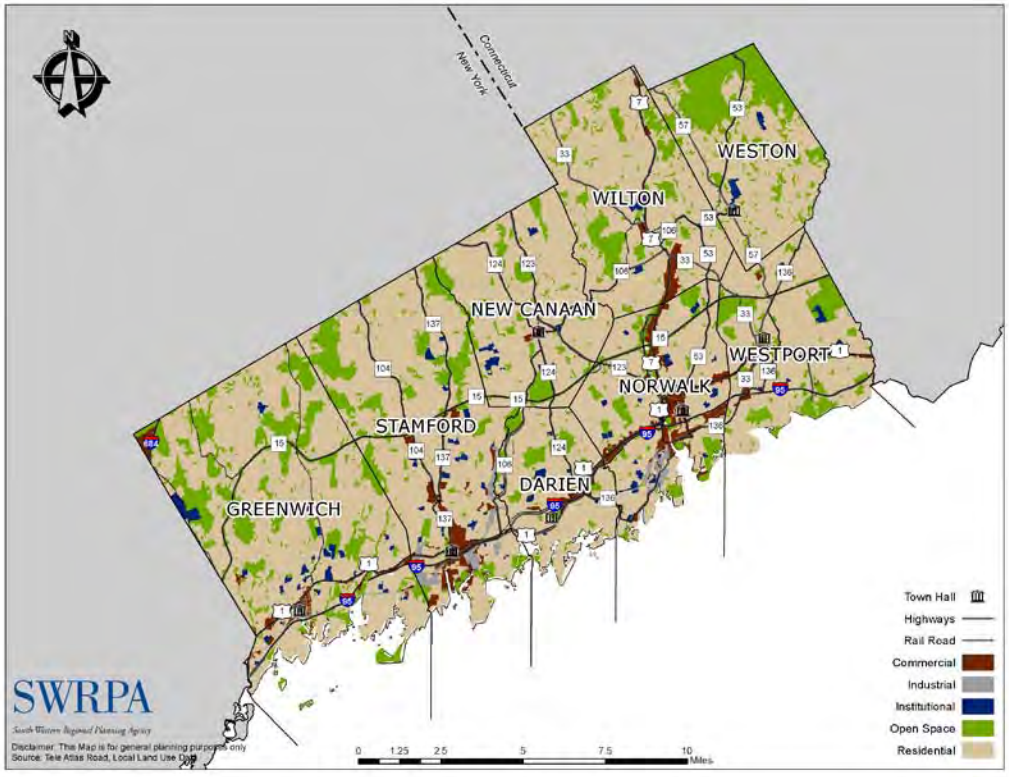

Figure 3-1. Land Use in South Western Connecticut

Areas with High Potential Loss of Life and Property

If a natural disaster were to strike the entire Region with the same magnitude, the loss of life and property would largely depend upon the number of people and structures in an area. Therefore, areas with high concentration of population and property have the greatest potential for loss. The concentration of population is measured by population density, which is calculated by dividing the number of persons by the corresponding amount of land area. Figure 3-2 shows the Region's population density expressed as the number of persons per square mile. Development patterns in the Region are primarily centered on and around the Region's infrastructure south of the Merritt Parkway (Route 15). The highest concentrations of people are in Norwalk and Stamford is south of the Merritt Parkway (Route 15) along state and federal highways. In Darien and Greenwich, the highest concentration is along the I-95/Route 1 corridor. The population density in New Canaan is greatest in and south of the town center. In Wilton, the population is concentrated in pockets found mostly along Route 7. In Westport, the population density is greatest along the east side of the Saugatuck River and along portions of the coast and Route 1. The Weston population is spread out, with pockets of modest density.

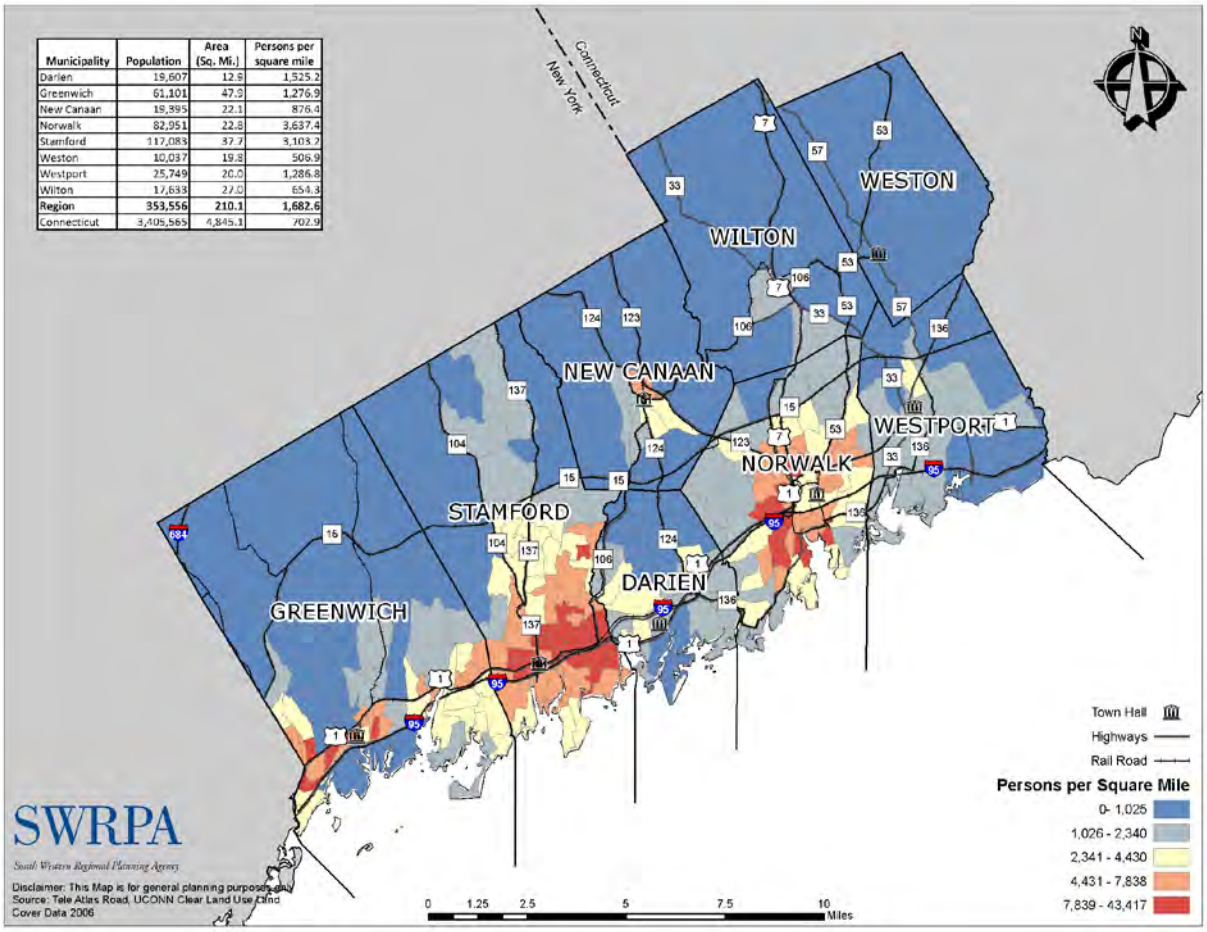

Figure 3-2. Population Density by Block Group (persons per square mile)

Similarly, the concentration of property values can be expressed as the building replacement value. The default database supplied with HAZUS-MH software provides estimated building replacement value information for buildings by Census tract, which is illustrated in Figure 3-3. This figure shows a pattern similar to population density.

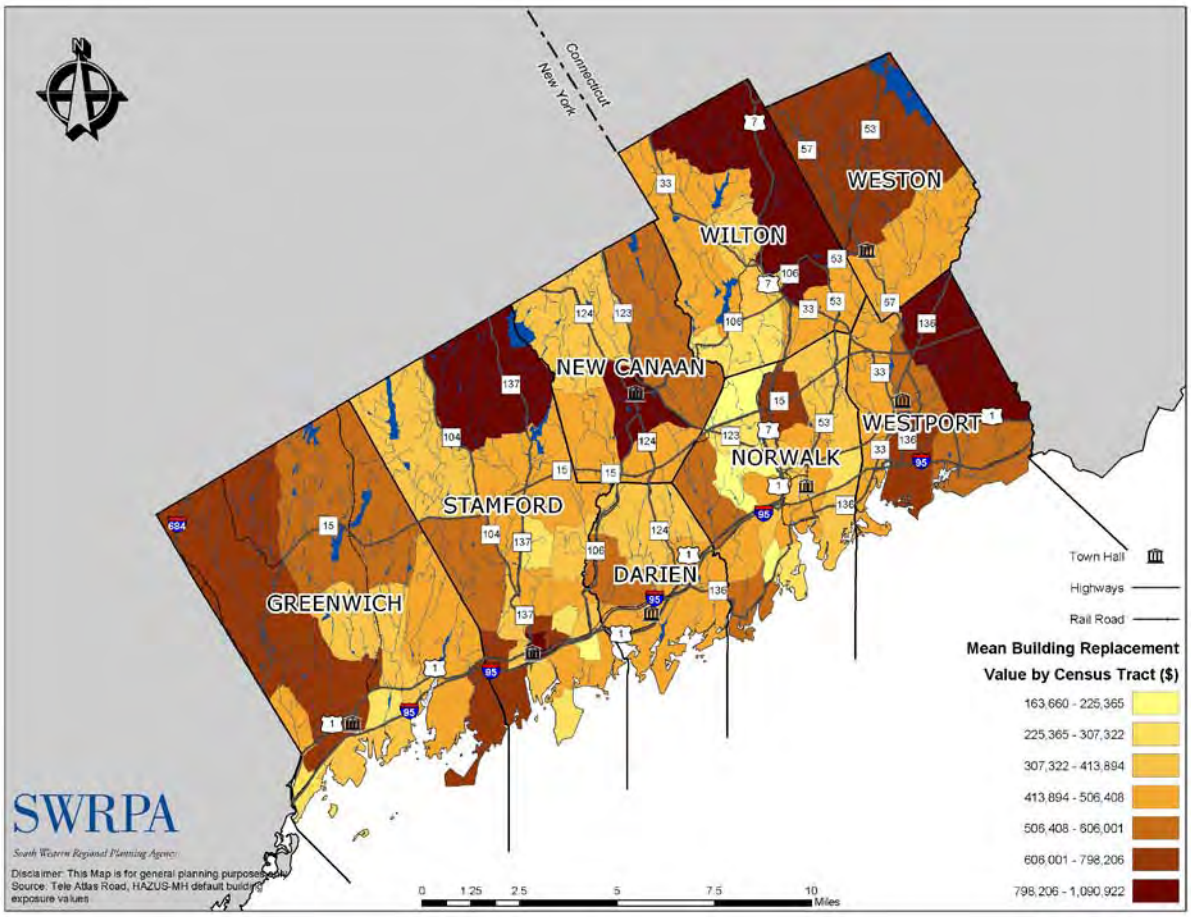

Figure 3-3. Mean Replacement Value for all Building Types by Census Tract

Although the distribution and population densities vary across the Region, variations should be taken in context. The Region itself is relatively compact, covering 225 square miles. The communities located furthest from the Long Island sound are only 11 miles away at the most inland point (northern Weston and Wilton). In a small geography with relatively consistent land use patterns, the overall vulnerability and risks to the communities as a result of natural hazards are similar. In general, the areas with high concentrations of population and property will most likely experience the greatest benefit from mitigation strategies, especially if these strategies address direct damage from flooding and wind, and/or reduce indirect economic loss due to power outages and road closures. Specific mitigation strategies may need to consider some limitations of these maps. First, the population density is based upon the location of residences and ignores shifts in population density throughout the day, week and year. Second, areas with high building replacement values may consist of a high concentration of low value buildings, a low concentration of high value buildings, or other combinations of building density and value.

Initial results of the HAZUS-MH models showed the risk and vulnerability associated with natural hazards varied little between municipalities. Therefore, the following section discusses risk and vulnerability for the entire Region for each of the identified natural hazards. For each hazard specific sections of a community are identified if there was a great risk or vulnerability than the Region as a whole.

Critical Facilities

Besides direct loss of life and property, natural hazards may disrupt the proper functioning of critical facilities (referred to as essential facilities by HAZUS-MH) following a natural disaster. Critical facilities have important functions that are vital to the health and welfare of the whole population and include schools, colleges and universities, emergency operating centers (Emergency Operations Center (EOC)), police stations, fire stations, town halls and hospitals. For the purposes of this Plan, critical facilities are divided into the same five categories used in HAZUS-MH. The five categories are medical care facilities (hospitals), fire stations, police stations, emergency response centers and schools. The transportation system is important for response and recovery in the event of a natural disaster and, as previously discussed in the Introduction, is vital to the economic well-being of the Region. The vulnerability of utility systems (electric, communication, gas, water, and sewer) and high potential loss facilities (Class C dams) were evaluated as part of the risk assessment.

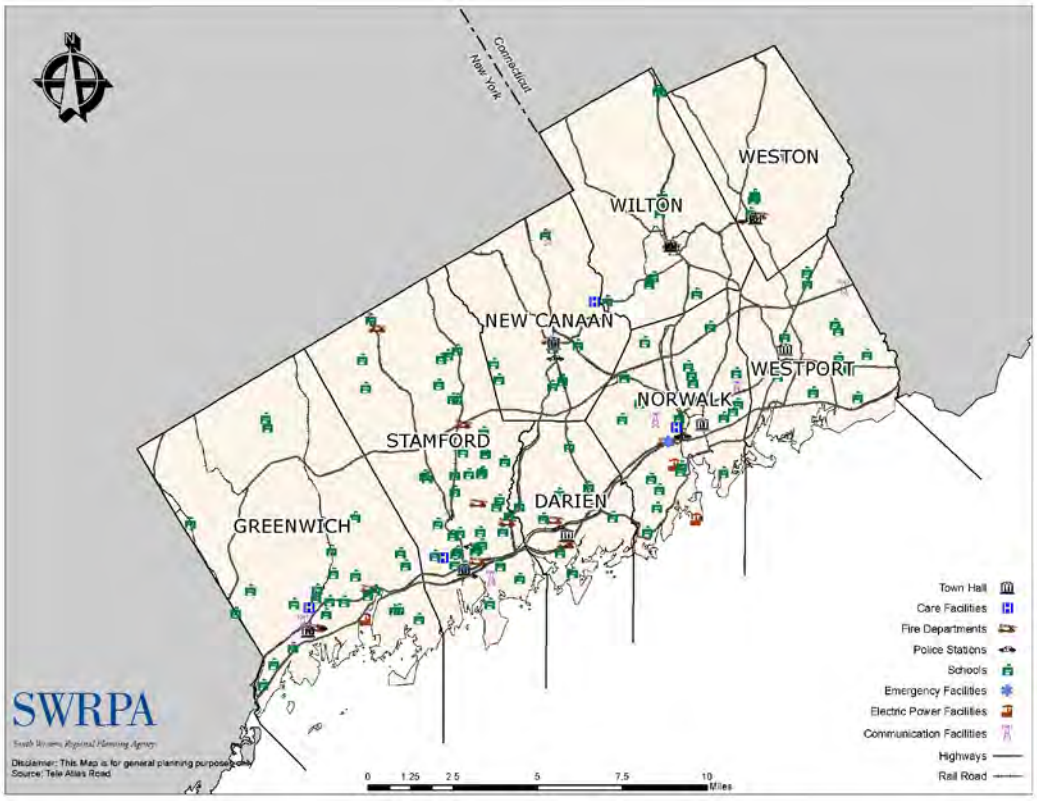

Figure 3-4. Essential Facilities in South Western Connecticut

The list of critical facilities began with the data supplied with HAZUS-MH. Local input greatly enhanced the list of rail facilities, police stations, fire stations, water treatment facilities and schools. Unfortunately, a comprehensive list of hazardous material sites was not available during the development of this Plan. Figure 3-4 shows the locations of the Region's essential facilities and transportation system. In South Western Connecticut there are 135 Schools (elementary, middle and high schools), nine police stations, 15 fire stations, four emergency operations centers, 19 rail stations, seven waste water treatment facilities, four hospitals and numerous public and private medical facilities. The Region also hosts an extensive network of highways including I-95, and the northeast rail corridor, both of which run extensively along the coast. A number of utilities also serve the Region, with three electric power facilities and a number of communication towers.

Floods

Flooding has been a reoccurring problem in the Region and poses a serious threat to residents, infrastructure and property. With over 85 miles of coastline fronting the Long Island Sound (LIS) and more than 600 miles of rivers and stream, flooding has been identified as one the biggest challenges for all eight of the Region's municipalities.

A flood occurs when rivers and streams overflow their banks and inundate low lying areas. Nationwide, floods are the most common hazard, killing an average of 150 people a year and causing an estimated $4 billion in property losses. Similarly, floods represent the most common and costly natural hazard in Connecticut. The state typically experiences floods in the early spring due to snow melt and severe storms, and in the late summer/early autumn due to hurricanes and tropical storms. Historically, severe flooding occurs approximately once every five years. However, Fairfield County has experienced an increase in seasonal flooding over the past decade.

Photo from the Floods of 1955, City of Stamford.
Washington Boulevard looking north at intersection of West Main Street in Stamford.
Source: Stamford Historical Society

The Region has substantial amounts of impervious surface that cause water to flow rapidly over the landscape; it is prone to flash flooding, which is typically triggered by heavy rains. The Region is also vulnerable to storm surges as all drainage basins ultimately drain into Long Island Sound. A storm surge is a temporary rise in sea level that prevents sea-bound waterways from draining normally into the sea, which can trigger inland flooding.

The floods of 1938, 1954 and 1955 exemplify the devastation that floods can wreak in the Region. Injuring 1,700 others and causing major property loss. In August of 1954, Hurricane Carol struck the Connecticut coast. Carol's storm surge added five to eight feet of water on top of the normal high tide, resulting in the greatest flood damage ever recorded in the Region. In August of the following year (1955), the Region experienced torrential rains and flooding as a result of back-to-back hurricanes, named Connie and Diane. In October of that same year, additional flooding occurred as a result of heavy rains. These severe flood events in such short succession permanently transformed the landscape of the Region, and many of the devastated areas never fully recovered.

In 2007 the Region experienced three major storm events which caused severe flooding in the Region. A storm in early March dropped more that three inches of rain in a short period of time, followed by three weeks of steady rain, which left the ground saturated and rivers full. Then early in April two nor'easters hit the Region within a three-day period. Damage was seen across the Region with homes and businesses along the Byram, Five Mile, and Saugatuck Rivers experiencing significant losses. In May of 2007, the President signed a declaration of a "major disaster" in Connecticut following the April 15 nor'easter. The signed declaration made federal funds available to local governments in Fairfield County to help cover the costs incurred from the storm and its aftermath.[6]

The National Weather Storm Events Database provides additional examples of the impacts of floods in the Region. The following list provides excerpts from selected storm events:[7]

June 13, 1996: As thunderstorms moved east at nearly 20 knots, they produced high winds and torrential rain. High winds knocked down power lines in Stamford. Rainfall rates of up to two inches in less than an hour caused significant flooding along the Merritt Parkway and on streets in Greenwich.

January 15, 1999: A combination of heavy rain falling on frozen ground, melting snow and ice, and partially clogged storm drains caused widespread flash flooding in low-lying and poorly-drained areas across the Region. In Fairfield County, widespread and significant street flooding occurred in Stamford and Norwalk.

September 2, 2002: Numerous streets in Westport were flooded and had to be closed. In Stamford, it was reported that portions of Elm, East Main and Dock Streets had to be closed due to flooding and that three feet of water covered portions of Cove Road. The water rose to a depth of about two-and-a-half feet at the intersection of Meadow and South Main Streets in Norwalk. The State Police reported that flash flooding forced them to close the Exit 14 ramp of I-95 northbound in Norwalk and the Route 7 connector's ramp to I-95 southbound were closed. Spotter and official National Weather Service observations showed that coastal sections of Fairfield County received between two and four-and-a-half inches of rain from this event.

Photo of the Five Mile River Flooding in New Canaan during the March 2007 Storm.
Source: aboutweston.com

August 27, 2006: Torrential rain caused widespread flash flooding throughout the Town of Darien and produced mudslides that closed I-95 in Norwalk between Exits 14 and 17. Hourly rainfall rates were estimated by radar from 3 to 4 inches per hour, mainly between Stamford and Norwalk. Storm total rainfall ranged from 2.5 to over 5 inches. Rainfall amounts of 3.72 inches were measured in Westport.

March 2, 2007: 3.9 inches of rain fell over South Western Connecticut. Numerous area roadways were flooded and had to be closed to traffic. Several area homes and businesses also experienced varying levels of flood damage. Frozen ground also exacerbated the problem with water unable to soak into the ground leading to increased runoff.

April 2007: A nor'easter on April 15 and a second storm on April 18 hit the Region. Both storms closed dozens of state and local roads, interrupted rail service on Metro-north and left many residents without power. In addition, numerous homes inland and along the coast experienced damage due to flooding, and the Cartbridge Bridge in Weston was washed out. This brought a burden to area homes and businesses that were still recovering from a major rain storm event on March 2, which flooded numerous area roadways and several area homes and businesses. Many of the same people suffered a loss again. A disaster declaration was made from this event.

October 11, **2007:** Localized flooding occurred in the Darien-Stamford area, when five inches of rain fell in a short period of time. Disaster assistance was requested from FEMA and the Connecticut Small Business Administration (SBA). Although the damage was extensive, only a small area was affected and did not meet the criteria for a FEMA declaration.

Photo of Heights Road in Darien, CT, October 11 2007
Source: Town of Darien

September 6, 2008: Two feet of water was reported on portions of Sound Beach Ave. and Arcadia Rd. in Greenwich. Tropical Storm Hanna impacted Southern Connecticut, making landfall near the Nassau/Suffolk County border in New York around 10:35 pm on the 6th. Storm total rainfall ranged from 2.76 inches at Groton Airport to 6.45 inches at New Canaan. Periods

of torrential rain from heavy showers and thunderstorms caused flash flooding in urban areas, small streams, and rivers. One person was killed due to flash flooding.

October 18, 2009: In Westport flooding was reported at Compo Beach Road and Soundview Drive during high tide. Water Street in Norwalk was closed for 5 hours due to coastal flooding, with at least one vehicle being stranded. Moderate tidal flooding was caused by a strong pressure gradient between high pressure to the north and a coastal storm passing south of Long Island October 17th and 18th. A prolonged period of strong northeast winds across coastal waters coupled with astronomically high tides caused water to build along the coast followed by tidal piling.

March 13, 2010: An unnamed nor'easter hit New England. Although the Region did not experience the same extent of flooding seen in the eastern part of the state, rain and strong gusts of wind caused localized flooding; and numerous trees were destroyed leaving many homes and businesses without power.

Photo of the Byram River in Greenwich during the March 2010 nor'easter.
Source: Greenwich Times

Figure 3-5 illustrates the Region's flood zones as represented on FEMA Flood Insurance Rate Maps (FIRMs). New Flood Insurance Rate Maps were issued for all of Fairfield County CT, June 18, 2010. The new maps were over-lain onto 2004 aerial photographs, which make identifying buildings, streets and other features easier than previous blueprint-style maps. More accurate topographic information and a revised vertical datum were also used. The FIRMs represent areas defined by the level of flood risk based on the probability of flooding during any given year. All eight of the Region's municipalities participate

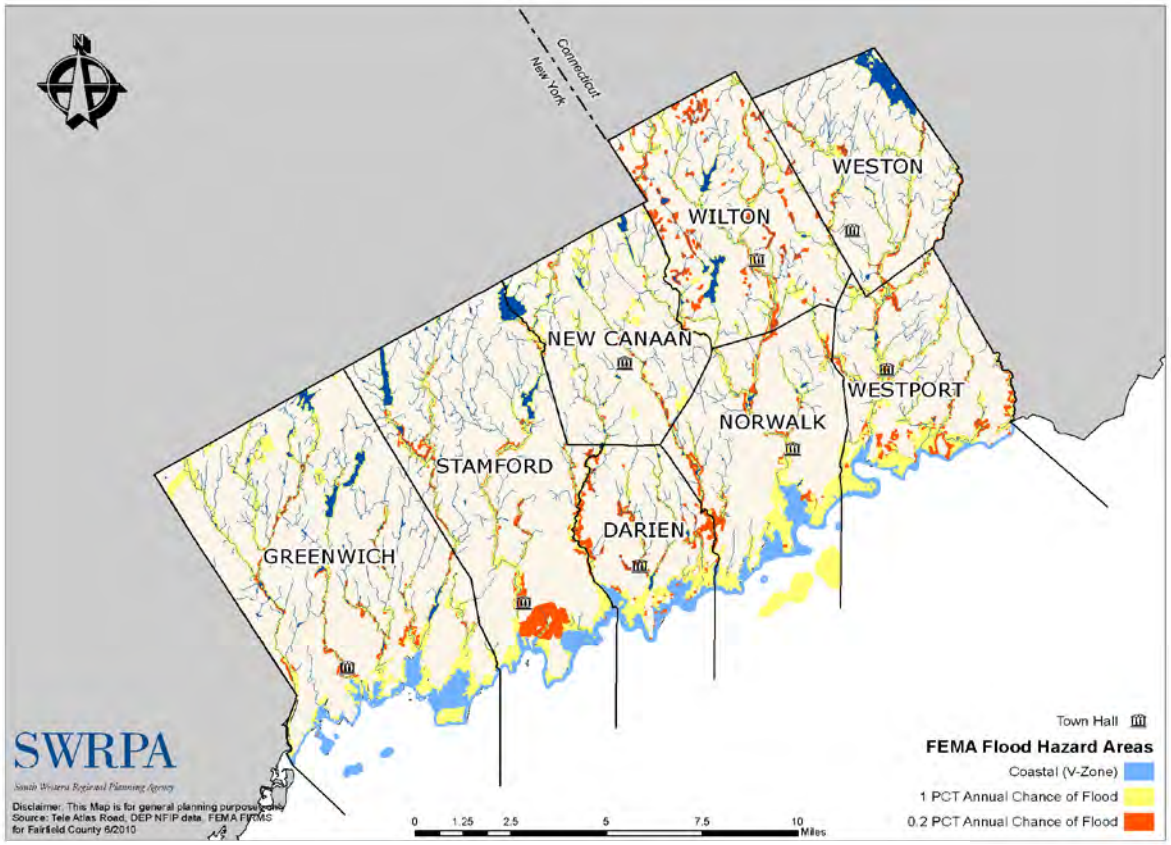

Figure 3-5. Flood Hazard Areas as Identified on the FEMA Flood Insurance Rate Maps

in the National Program (NFIP) and three of the municipalities participate in the Community Rating System (Table 3-1). A map of FIRM panels for the Region is included in Appendix F. Individual FIRM panels may be viewed at the town hall in each municipality or online at: http://www.msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeID=10001&catalogId=10001&langId=-1&userType=G.

Table 3-1. Municipal Participation in the National Flood Insurance Program (NFIP) and Community Rating System (CRS)

	# of Policies	Community CRS	CRS Rating	FIRM Date	Community Number	FIRM Panel #
Darien	548	No	n/a	06/18/2010	090005	0507, 0509, 0517, 0526, 0528, 0529, 0536, 0537
Greenwich	1,404	No	n/a	06/18/2010	090008	0343, 0344, 0363, 0476, 0477, 0478, 0479, 0481, 0482, 0483, 0484, 0487, 0491, 0492, 0493, 0494, 0501, 0503, 0504, 0511, 0512, 0513, 0514, 0516, 0518, 0606, 0607, 0626
New Canaan	145	No	n/a	06/18/2010	090010	0358, 0359, 0366, 0367, 0368, 0369, 0378, 0386, 0387, 0388, 0389, 0507, 0526, 0527
Norwalk	2,022	Yes	10	06/18/2010	090012	0389, 0391, 0392, 0393, 0394, 0526, 0527, 0529, 0531, 0532, 0533, 0534, 0537, 0541, 0542
Stamford	2,311	Yes	7	06/18/2010	090015	0344, 0363, 0364, 0365, 0366, 0368, 0369, 0501, 0502, 0503, 0504, 0506, 0507, 0508, 0509, 0512, 0516, 0517, 0518, 0519, 0536
Weston	135	No	n/a	06/18/2010	090018	0243, 0244, 0265, 0381, 0382, 0384, 0392, 0401, 0402, 0403, 0404, 0411
Westport	1,290	Yes	8	06/18/2010	090019	0392, 0394, 0403, 0404, 0411, 0412, 0413, 0414, 0416, 0418, 0532, 0534, 0551, 0552, 0553, 0556
Wilton	177	No	n/a	06/18/2010	090020	0238, 0239, 0243, 0357, 0376, 0377, 0378, 0379, 0381, 0382, 0383, 0384, 0386, 0387, 0389, 0391, 0392, 0393
Region	**8032**					

Source: FEMA CIS report 9/14/2010, provided by the CTDEP & FEMA FIRMS 6/18/2010.

Property owners in flood zone areas often have flood insurance policies and make claims when floodwaters damage a building or its contents. Based on National Flood Insurance claims, the coastal areas and areas along the Region's major rivers appear to have the most frequent loss, with other losses occurring in areas in or adjacent to wetlands (Table 3-2). In particular, Old Greenwich in Greenwich; Cove, Shippan and Waterside in Stamford; Noroton and Tokeneke in Darien; East Norwalk, Harborview and Rowayton in Norwalk; and Saugatuck Shores and Compo Beach in Westport experience frequent

flooding. Additionally, the Westport Town Center is vulnerable to flooding due to its proximity to the Saugatuck River and its fluctuations in response to tides in Long Island Sound.

Table 3-2. Properties Located within Flood Hazard Areas*

	V-Zone (Coastal Zone)	1% Annual Chance (100yr Flood)	0.2% Annual Chance (500 yr Flood
Darien*	221	1,297	1,098
Greenwich	266	3,056	715
New Canaan*	-	937	300
Norwalk	92	2,466	829
Stamford	50	2,162	
Weston	-	N/A	-
Westport	179	2,975	821
Wilton	-	N/A	-
Region	808	12,893	3,763

**Number of parcels within the flood zone. Individual build data not available.*
Source: FEMA Fairfield County FIRMs (6/2010) and currently available local parcel data.

Table 3-3 illustrates flood insurance claim information by municipality for four flood events. The time periods represent a coastal storm in October 1980, the "Great Nor'easter of 1992[8]", a heavy rain event in October 1996, and two Nor'easters in April 2007[4]. The insurance claim payments are represented in 2010 dollars to account for inflation. As the table demonstrates, the property owners in the land-locked communities—New Canaan, Weston and Wilton—received fewer insurance payments than the property owners in the Region's coastal communities (Darien, Greenwich, Norwalk, Stamford and Westport). Insurance claims in the region paid a total of $2.7 million in the 1980 event, $28.2 million in the 1992 event, $3.6 million in the 1996 event, and $7.8 million in the 2007 events.

Table 3-3. Flood Insurance Claims by Municipality (expressed in constant 2010 Dollars) for Selected Flood Events

	Oct. 25-26, 1980		Dec. 11-14, 1992		Oct. 19-21, 1996		Apr. 15-18, 2007	
	Claims	**Total Paid**	**Claims**	**Total Paid**	**Claims**	**Total Paid**	**Claims**	**Total Paid**
Darien	14	$144,902	90	$2,366,551	17	$277,282	25	$187,766
Greenwich	80	$563,566	220	$8,007,633	68	$915,635	116	$1,984,513
New Canaan	0	-	0	-	0	-	11	$131,064
Norwalk	94	$653,927	313	$6,183,685	74	$655,798	67	$606,767
Stamford	38	$614,568	114	$3,236,547	57	$1,079,409	145	$3,043,807
Weston	0	-	0	-	0	-	32	$659,166
Westport	91	$700,696	298	$8,396,282	57	$627,471	96	$1,187,859
Wilton	0	-	0	-	0	-	Data Not Available	
Region	**317**	**$2,677,659**	**1035**	**$28,190,698**	**273**	**$3,555,595**	**492**	**$7,800,942**

Note: The claim payments were adjusted to 2010 Dollars using the Consumer Price Index for the New York Metropolitan Area (Series No. CUURA101SA0). Source: Federal Emergency Management Agency, National Flood Insurance Program.

The Great Nor'easter of 1992 clearly represents the most costly incident in the insurance claim information. Although the recurrence intervals of these events are not readily available, the Great Nor'easter of 1992 event represents a rare occurrence that pales in comparison to the floods of 1938, 1954 and 1955. A reasonable conclusion is that the event represents a storm with a 10 to 25-year recurrence

interval. Therefore, the losses from a 100-year flood event would dwarf the $28.2 million figure, especially if it includes property damage to uninsured properties, clean-up costs and losses due to business interruption. More than $42 million was paid out across the Region in flood insurance claims as result of theses four storm events (Table 3-4). Although the magnitude of each storm event varied, the reduction in Flood insurance claims made during the 1996 and 2007 storm events may also be due, in part, to mitigation strategies implemented by the Region's municipalities.

Table 3-4. Total Flood Insurance Claims by Municipality (expressed in constant 2010 Dollars) for Four Selected Flood Events

	TOTAL PAID
Darien	$2,976,501
Greenwich	$11,471,347
New Canaan	$131,064
Norwalk	$8,100,177
Stamford	$7,974,331
Weston	$659,166
Westport	$10,912,309
Wilton	-
Region	**$42,224,896**

Floods may interfere with the ability of critical facilities to function properly. GIS software was used to identify critical and important facilities within 100-year floodplains (Figure 3-6). The results of the analysis were amended based upon feedback from the Advisory Committee. A total of fourteen critical facilities were found within a flood hazard area, of which two were in Greenwich, six in Norwalk, and six in Stamford. These structures included six schools, one fire station, one community health center, one water pollution control facility, one public water supply and four power supply stations.

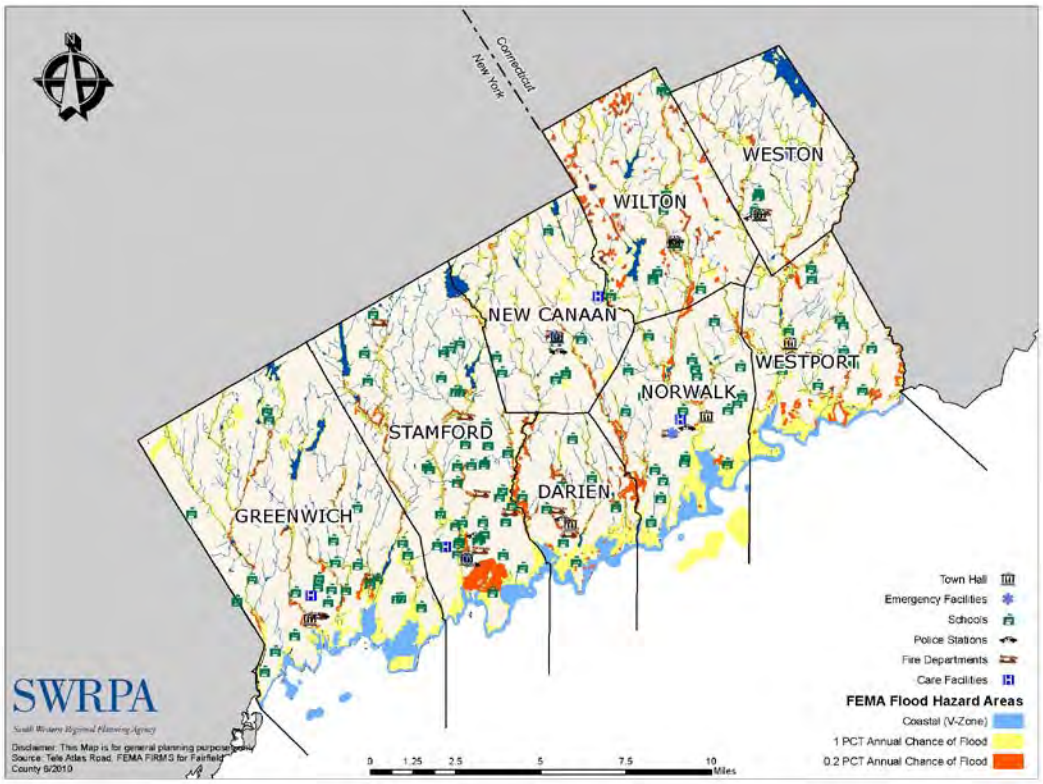

Figure 3-6. Critical Facilities in Relationship to Flood Hazard Areas

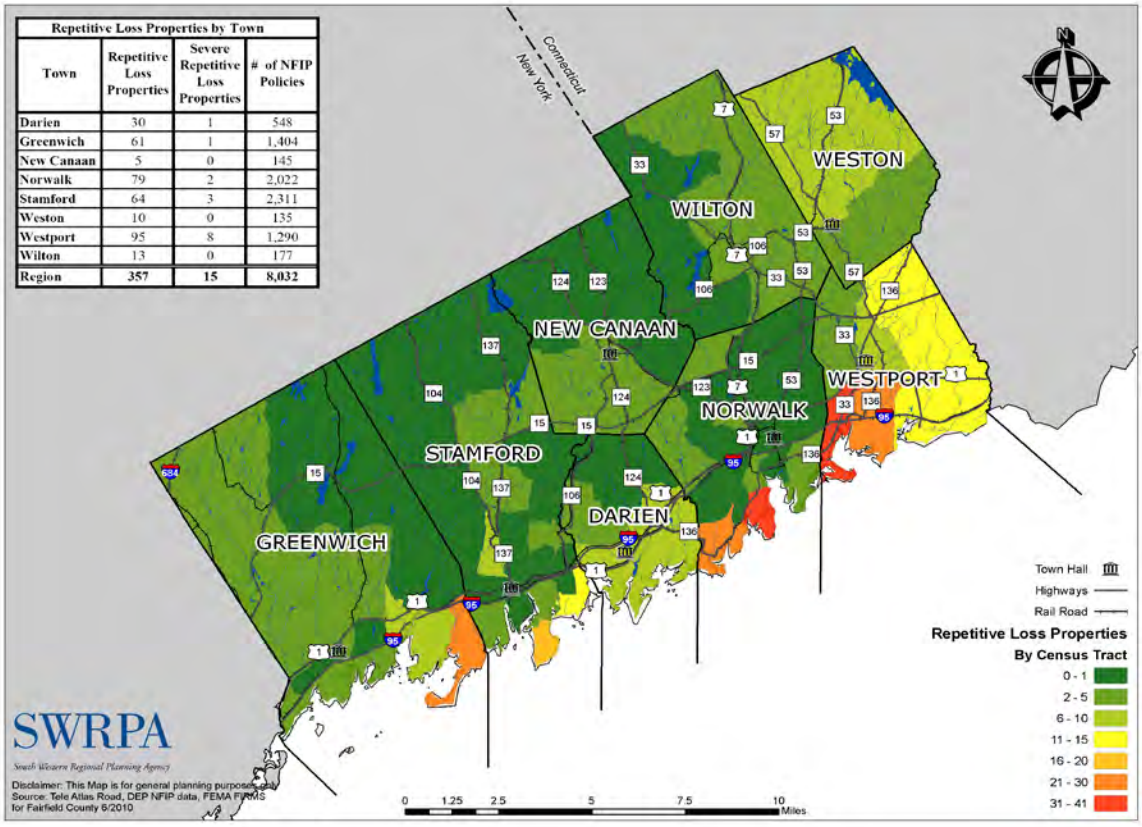

Figure 3-7. Repetitive Loss Properties Identified by the National Flood Insurance Program by Census Tract

Flooding is the only natural hazard affecting the Region where repetitive losses and severe repetitive losses are prevalent. A number of properties in the Region are prone to repetitive flooding and losses (Figure 3-7). The Community Information System (CIS), as of September 14, 2010, identified 372 repetitive loss properties and 15 severe repetitive loss properties in the Region (Table 3-5). Repetitive loss properties in the Region are more prevalent in coastal communities, with the highest number of repetitive loss properties in Westport; the Rowayton and South Norwalk Neighborhoods in Norwalk; Old Greenwich; and the Shippan neighborhood in Stamford and consist primarily of residential structures (Figure 3-7). Additional repetitive loss properties are located along watercourses and wetlands.

Table 3-5. Number of Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties by municipality

	# Of Variances	RL Properties	SRL Properties	Average Paid on SRL	# of NFIP Policies	CRS
Darien	7	30	1	$36,869	548	-
Greenwich	1	61	1	$18,960	1,404	-
New Canaan	0	5	0	$0	145	-
Norwalk	0	79	2	$16,869	2,022	YES
Stamford	1	64	3	$51,050	2,311	YES
Weston	0	10	0	$0	135	-
Westport	0	95	8	$9,142	1,290	YES
Wilton	0	13	0	$0	177	-
Region	**9**	**357**	**15**	**$20,991**	**8,032**	

Source: Connecticut NFIP data *September 14, 2010*

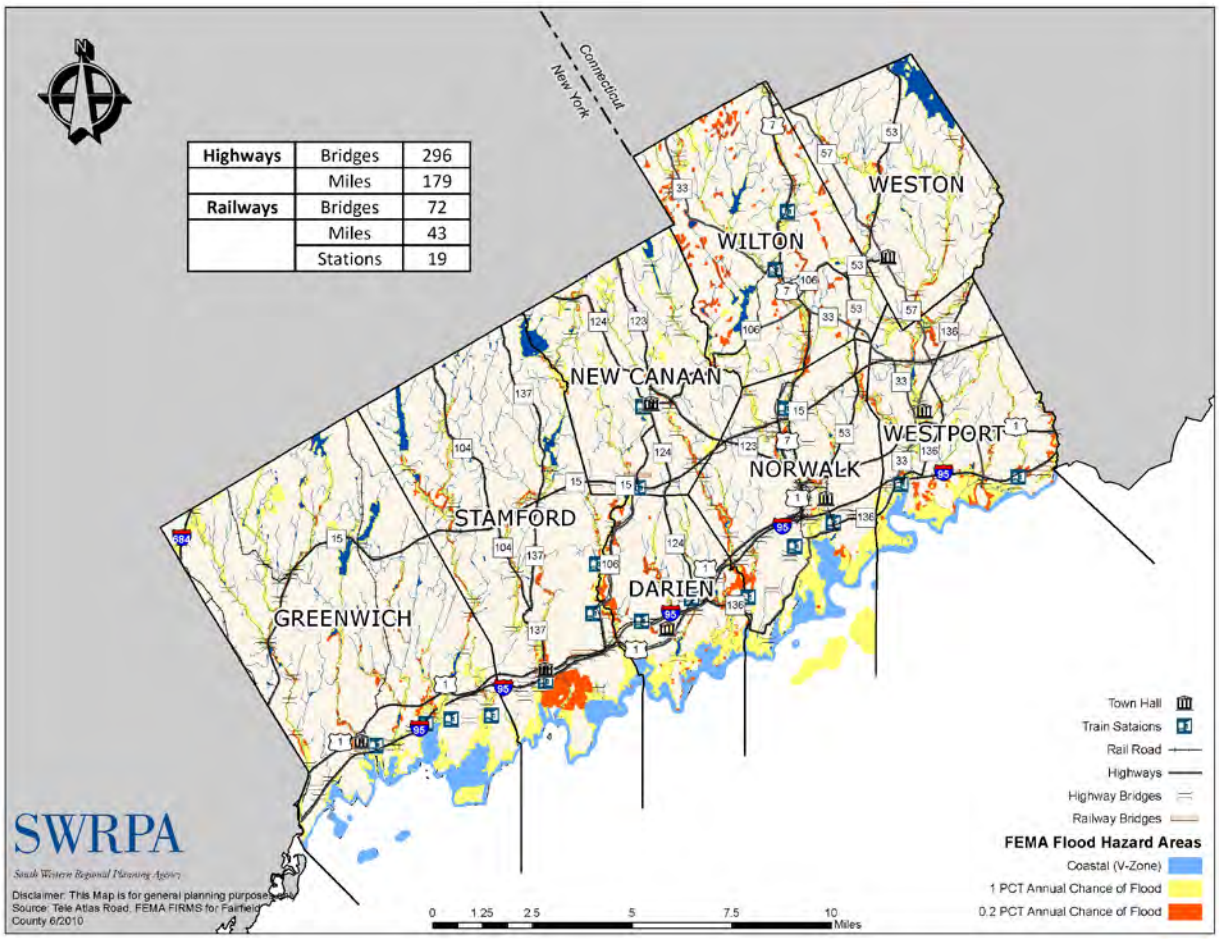

Figure 3-8. Transportation Infrastructure in Relationship to Flood Hazard Areas.

Transportation resources in the Region are also vulnerable to flooding. During the April 2007 storm event the Cartbridge in Weston was washed away, which cost FEMA and the Town $1.26 million to replace. Figure 3-8 shows the Region's transportation infrastructure within the identified flood zones. In addition to portions of the I-95 corridor, numerous local roads, and portions of the Metro North Rail line, there are more than 400 bridges, and numerous culverts that may wash away or become blocked during a flood or major rain event.

Although data is not readily available, it can be inferred that the economic losses associated with damage to the transportation network would be substantial, in addition to the cost of repairs. In an effort to reduce the potential for loss the Connecticut Department of Transportation inspects and maintains bridges and culverts, and works to ensure that new and replaced culverts are sufficiently-sized to handle at least a 10-year storm event.

Hurricanes and Tropical Storms

Hurricanes have the greatest destructive potential of all natural disasters occurring in the Region, with all eight municipalities likely to sustain significant damage. A hurricane typically forms over tropical waters, has an organized circulation and sustained wind speeds of at least 74 miles per hour. A moderate Category II hurricane can be expected to come through Region about once every ten years. At least one Category III or IV hurricane is likely to occur before 2040. Besides damaging winds, hurricanes are often accompanied by heavy rains and powerful storm surges (Figure 3-9).

As noted previously, the devastating floods in the Region were the result of the hurricane in 1938 and Hurricanes Carol, Connie and Diane in 1954 and 1955. Statewide, the hurricane in 1938 killed 600 people and injured 1,700. One retrospective article in the *Stamford Advocate* suggests that the lack of education and warning systems contributed to the loss of life and injuries. Hurricane Gloria (1985) was the most recent Category III hurricane to strike the Region (Table 3-6). Hurricane Gloria's damaging winds and torrential rains caused massive power outages throughout the state. The power outages affected 34,000 customers in Norwalk, 9,684 in Stamford, 5,431 in Darien, 4,239 in Weston, 4,076 in Greenwich, 1,128 in New Canaan, 1,050 in Westport and 161 in Wilton. The coastal and low lying areas experienced flooding, but the flooding was relatively modest when compared to the hurricanes in 1938,

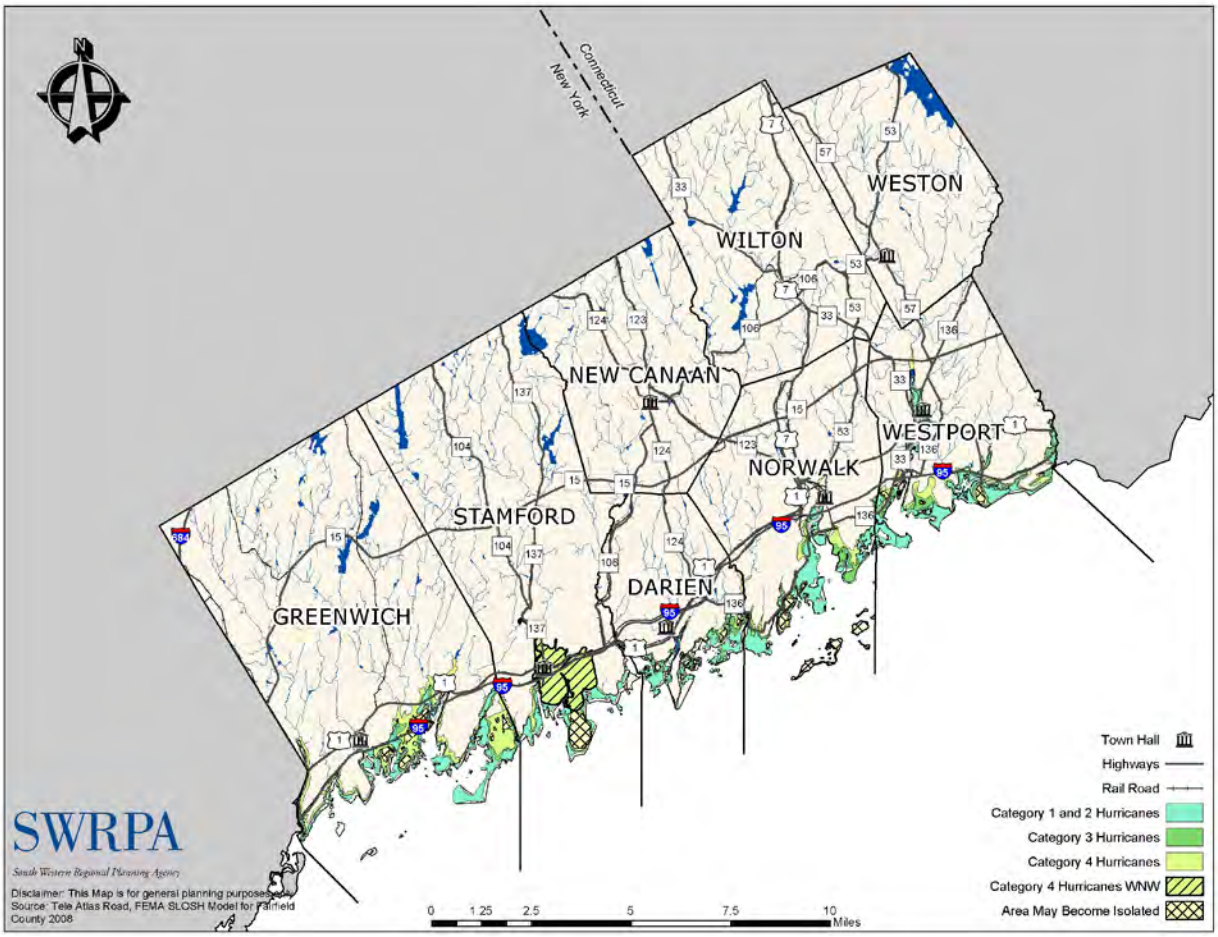

Figure 3-9. Hurricane Surge Areas based on the FEMA SLOSH (Sea, Lake and Overland Surges from Hurricanes) Model.

1954 and 1955. Hurricane Gloria drove many from their homes to emergency shelters. In addition, New Canaan, Westport, and other municipalities setup emergency water distribution centers to provide clean water to residents who did not have electricity to pump water from their wells.

Table 3-6. Connecticut Hurricanes

Date	Name	Category	Wind Speeds
September 21, 1938	(unnamed)	-	-
September 14-15, 1944	(unnamed)	-	-
August 31, 1954	Hurricane Carol	Category III	111-130 mph
August 12, 1955	Hurricane Connie	Category III	111-130 mph
August 19, 1955	Hurricane Diane	Category I	74-95 mph
September 12, 1960	Hurricane Donna	Category III	111-130 mph
August 10, 1976	Hurricane Belle	Category I	74-95 mph
September 27, 1985	Hurricane Gloria	Category III	111-130 mph
August 19, 1991	Hurricane Bob	Category II	96-110 mph
October 30, 1991	Hurricane Grace (Non-landfalling)	Category II	96-100 mph

Source: State of Connecticut. *Natural Hazards Mitigation Plan 2007-2010*, National Weather Service, *Storm Events Database*.

Based upon previous hurricanes, the HAZUS-MH software estimated that the Region would experience a hurricane with peak gusts ranging from 80.9 to 92.0 miles per hour during a 100-year period (Figure 3-10); from 80.9 to 87.4 in a 50-year period; and from 57.5 to 62.3 in a 20-year period. The peak gust speeds decreased moving from east (Westport) to west (Greenwich) and from south (Long Island Sound) to north (inland).

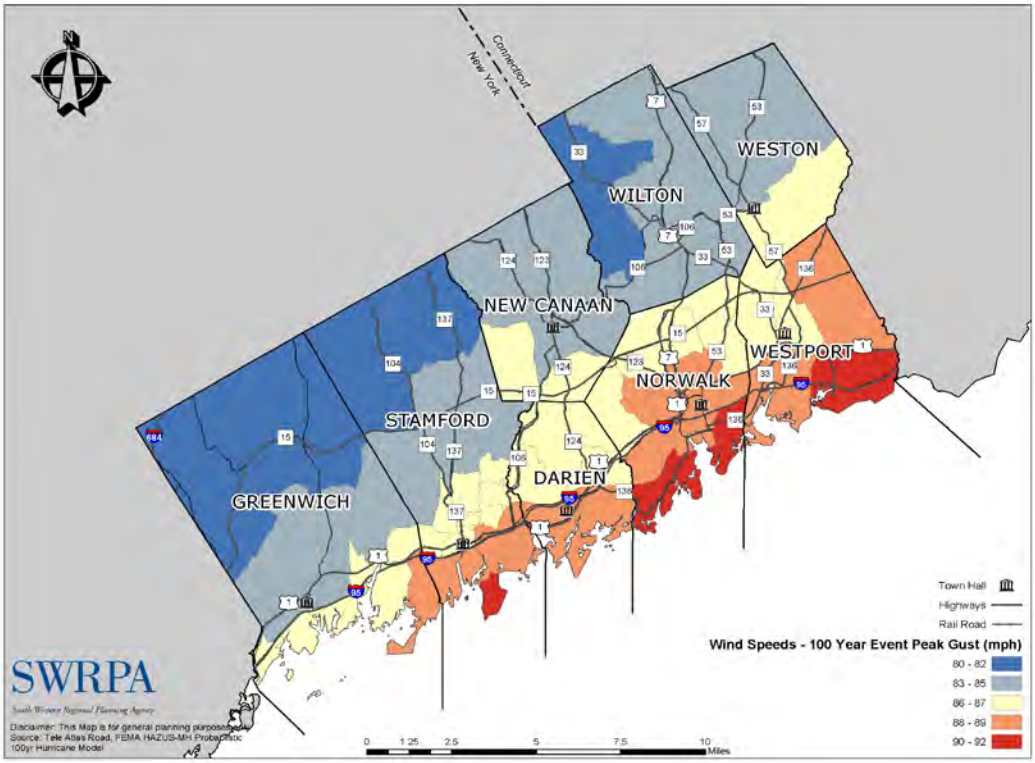

Figure 3-10. Predicted Peak Wind Gusts for a 100 year Probabilistic Hurricane

HAZUS-MH was used to evaluate the economic loss due to the *wind* from a probabilistic 100-year hurricane event. The hurricane model took into consideration historical events, critical facilities and broad building and population characteristics at the Census Tract levels. The software estimated that 5,480 buildings would be moderately damaged, 19 would be severely damaged, and four would be destroyed (Table 3-7). Residential properties accounted for over 87% of the buildings that would be at least moderately damaged, followed by commercial, industrial and other types (Table 3-8).

Table 3-7. Expected Building Damage by Municipality, 100-Year Probabilistic Hurricane

Municipality	Total	None		Minor		Moderate		Severe		Destruction	
		Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Darien	7703	7232	93.88%	407	5.29%	63	0.81%	1	< 0.1%	0	< 0.1%
Greenwich	22332	21470	96.14%	789	3.53%	71	0.32%	2	< 0.1%	0	< 0.1%
New Canaan	7458	7127	95.56%	278	3.73%	52	0.70%	0	< 0.1%	0	< 0.1%
Norwalk	27194	25460	93.62%	1613	5.93%	114	0.42%	6	< 0.1%	1	< 0.1%
Stamford	31488	30133	95.70%	1243	3.95%	103	0.33%	7	< 0.1%	2	< 0.1%
Weston	3920	3657	93.29%	213	5.42%	50	1.29%	0	< 0.1%	0	< 0.1%
Westport	11653	10880	93.37%	698	5.99%	71	0.61%	3	< 0.1%	1	< 0.1%
Wilton	6848	6559	95.79%	240	3.50%	49	0.71%	0	< 0.1%	0	< 0.1%
Region	**118,596**	**112,519**	**95%**	**5,480**	**5%**	**573**	**< 1%**	**19**	**< 1%**	**4**	**< 1%**

Source: Federal Emergency Management Agency, HAZUS-MH Hurricane Model.

On a percentage basis, wood and masonry buildings would be the most likely to be damaged. The hurricane model indicated that building-related economic loss would be $533.6 million, of which, $463 million would be property damage and $69.9 million would be business interruption loss. Again, residential properties would account for most of the economic loss, followed by commercial, industrial and other properties. Figure 3-11. Shows economic loss by block group for all building types and takes into account all occupancy types, building values, contents, inventory, relocation cost, lost income, rental costs and lost wages.

Table 3-8. Expected Building Damage by Occupancy in the Region, 100-Year Probabilistic Hurricane

Occupancy	Total	None		Minor		Moderate		Severe		Destruction	
		Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Residential	104,904	99,382	94.7%	4,998	4.8%	508	0.5%	12	< 0.1%	4	< 0.1%
Commercial	9,582	9,185	95.9%	348	3.6%	45	0.5%	4	< 0.1%	0	0%
Industrial	2,918	2801	96.0%	105	3.6%	10	0.3%	2	0.1%	0	0%
Other	1,192	1152	96.6%	29	2.4%	10	0.8%	1	0.1%	0	0%
Total	**118,596**	**112,520**	**95%**	**5,480**	**5%**	**573**	**< 1%**	**19**	**< 1%**	**4**	**< 1%**

Source: Federal Emergency Management Agency, HAZUS-MH Hurricane Model.

Figure 3-12 illustrates the location of residential properties with at least moderate damage by Census Tract. Similarly, Figure 3-13 illustrates the location of commercial and industrial properties with at least moderate damage by Census Tract. These two maps illustrate the quantity of properties in each Census Tract that may need further examination for vulnerable buildings.

Another way to examine the hurricane model results is to look at the spatial distribution of property damage by calculating the amount of property damage per square mile. Figure 3-14 illustrates the estimated economic loss by Census Tract. Unlike the previous maps, Figure 3-14 illustrates the estimated property damage by square mile per Census Tract, and takes into account all occupancy types, building values, and size of Census Tract. Clearly, the Region's most developed areas are the most vulnerable to hurricanes' damaging winds.

A tropical storm is similar to a hurricane except that sustained wind speed ranges from 39 to 73 miles per hour. Tropical storms can inflict substantial property damage, as exemplified by Tropical Storm Floyd. This storm struck Connecticut on September 16, 1999 and caused severe flooding in western and central

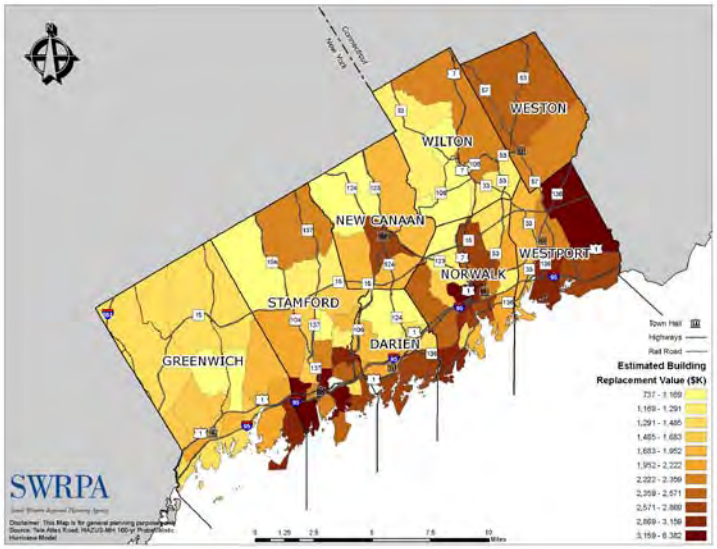

Figure 3-11. Monetary Damage caused by a 100 Year Probabilistic Hurricane by Census Tract

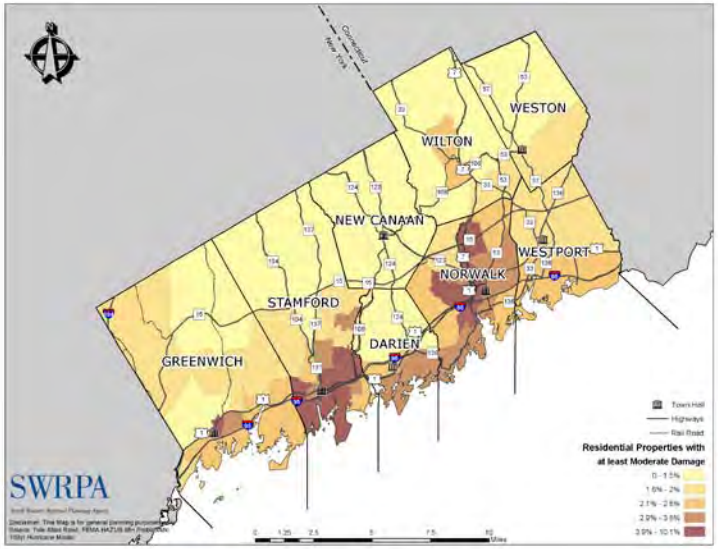

Figure 3-12. Residential Properties with Moderate Damage by Census Tract for a 100 Year Probabilistic Hurricane

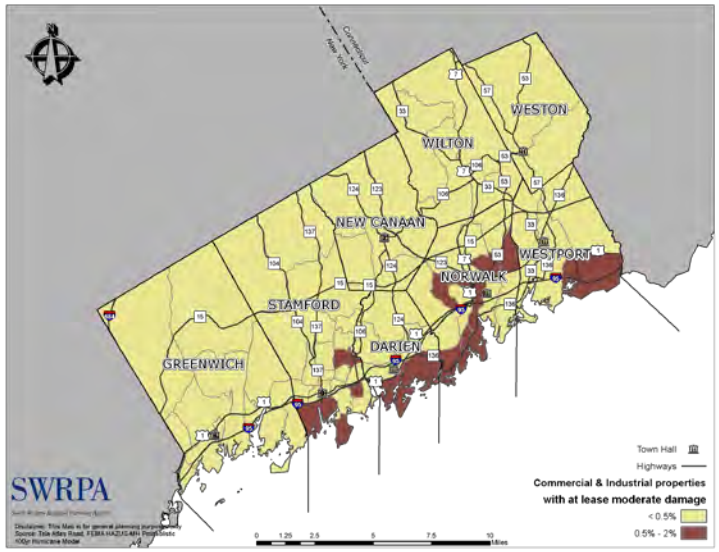

Figure 3-13. Commercial and Industrial Properties with Moderate Damage by Census Tract for a 100 Year Probabilistic Hurricane

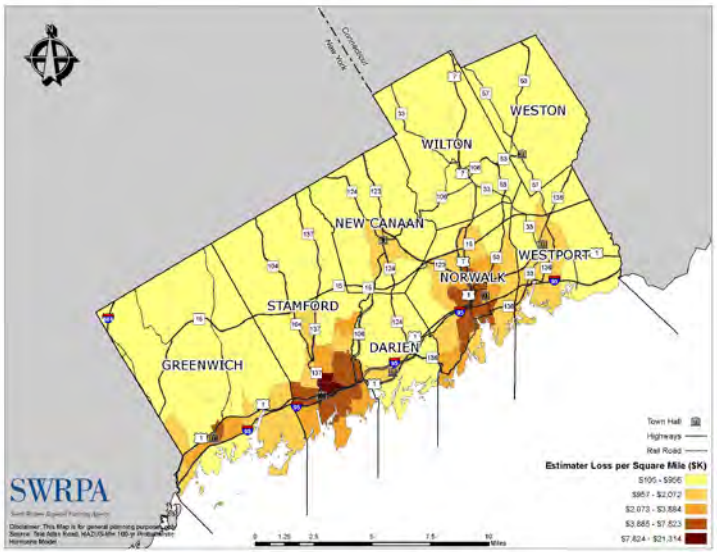

Figure 3-14. Estimated Damage per Square Mile by Census Tract for a 100 Year Probabilistic Hurricane

parts of the state. Connecticut received a Presidential Disaster Declaration as a result of this event. In the Region, the National Flood Insurance Claim Information data indicates that the storm resulted in 10 claims totaling $342,879. That figure most likely underestimates the actual damage because many property owners lack flood insurance. In 2008 Tropical Storm Hanna impacted the region. The storm made landfall on Long Island near the Nassau/Suffolk County border and continued north through Connecticut, causing flooding and tree damage.

Severe Storms

Severe storms occur annually in Connecticut, and include blizzards, severe winter storms/nor'easters, ice storms and wind storms. Connecticut experiences severe winter storms approximately once every five years. Severe storms can produce high tides, snow, ice, rain, flooding, downed power lines, traffic gridlock and damage to property and infrastructure.

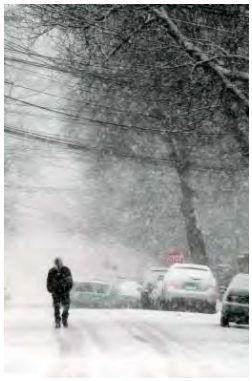

Photo of March 2010 snow storm, Stamford CT.
Source: Stamford Advocate

Blizzards: Blizzards have wind gusts of at least 35 mph and heavy snowfall that frequently reduces visibility to a quarter-mile or less for at least three hours.

Severe Winter Storms/ Nor'easters: Severe winter storms are regionally referred to as "Nor'easters." Nor'easters are characterized by an intense low-pressure system with strong northeasterly winds blowing ahead of the storm and over the coastal areas. Nor'easters typically occur between November 1st and April 1st. Like hurricanes, nor'easters have well-developed circulation and can inflict damaging winds, flooding and storm surges.

Ice Storms: Ice storms occur when warm air overrides colder air, generally below 32°, at the surface during a winter storm. The associated precipitation freezes on contact when it reaches the ground, due to the below-freezing temperatures. Ice storms consist of freezing precipitation that can coat roads, trees and power lines with slippery and heavy ice. This combination can result in hazardous road conditions, power outages and property damage. Ice storms occur every year in Connecticut; however, the warming affect of Long Island Sound helps to protect the South Western Region from major ice storms.

Wind Storms: Damaging winds are often associated with all winter storms, but can also be problematic in and of themselves. When occurring along with snow or ice, blinding conditions can ensue, making driving difficult or impossible. There have also been wind-related incidents independent of winter weather that have wreaked havoc on the Region.

Table 3-9. Federal Disaster Declarations in Connecticut: January 1, 1992 - March 31, 2010

Number	Declaration Date	Incident Period	Incident Type
FEMA-1904-DR	April 23, 2010	March 12-17, 2010	Nor'easter
FEMA-1700-DR	May 11, 2007	April 15-27, 2007	Nor'easter
FEMA-3266-EM	May 2, 2006	February 11-12, 2006	Winter Storm
FEMA-3200-EM	February 17, 2005	January 22-23, 2005	Winter Storm
FEMA-3192-EM	January 15, 2004	December 5-7, 2003	Winter Storm
FEMA-3176-EM	March 10, 2003	February 17-18, 2003	Winter Storm
FEMA-1302-DR	September 23, 1999	September 16-18, 1999	Tropical Storm Floyd
FEMA-1092-DR	January 24, 1996	January 7-8, 1996	Winter Storm
FEMA-3098-EM	March 16, 1993		Winter Storm
FEMA-972-DR	December 18, 1992		Coastal Storm

Sources: FEMA August 26, 2010. *Connecticut Disaster History* (http://www.fema.gov/news/disasters_state.fema?id=9)

During the past 25 years there have been major nor'easters in Connecticut in 1988, 1992, 1996, 2003, 2007 and 2010. The state also experienced major blizzards in that same time period, having occurred on March 13, 1993, January 7, 1996, January 22-23, 2005, and February 11-12, 2006. Winter storms have comprised seven out of ten federally declared natural disasters in the State of Connecticut since 1992 (Table 3-9).

Photo of March 2010 snow storm, Stamford CT.
Source: Stamford Advocate

The cost of snow removal is influenced by the number of storms, the characteristics of each winter storm event, and the amount of roads, parking lots and walkways that need plowing. Table 3-10 shows the snow removal costs by municipality in the Region for four consecutive state fiscal years. (Unlike the calendar year, the state fiscal year changes on the first of July and covers only one winter season.) Snow removal costs would increase along with future development expected in the Region.

Severe Storm events produce debris from damaged homes, trees, roads, businesses and infrastructure. In the fall of 2005 and the spring of 2006 the Northeast United States suffered an estimated $130 million in property damage from several intense storms. In Connecticut each municipality is required to make provisions for the safe and sanitary disposal of all solid wastes generated within its boundaries (Connecticut General Statutes (CGS) Section 22a-220). Local governments are responsible for the removal of debris from municipally owned lands and waters, and are generally the first to respond to a disaster situation.

Table 3-10. Total Snow Removal Costs, 2006-2010

	FY 2006-2007	FY 2007-2008	FY 2008-2009	FY 2009-2010	Total	Average Cost/Winter
Greenwich	$797,520	$820,212	$1,354,943	$872,356	**$3,845,031**	$961,258
Darien	-	-	-	-	-	-
New Canaan	$275,000	$358,000	$540,000	$343,000	**$1,516,000**	$379,000
Norwalk	$187,842	$468,917	$799,115	$579,632	**$2,035,506**	$508,877
Stamford	$1,073,553	$1,024,213	$1,717,198	$1,348,462	**$5,163,426**	$1,290,857
Weston	$139,620	$162,119	$256,706	$225,771	**$784,216**	$196,054
Westport	$360,704	$396,688	$746,404	$715,992	**$2,219,788**	$554,947
Wilton	-	-	-	-	-	-
Region	$2,834,239	$3,230,149	$5,414,366	$4,085,213	**$15,563,967**	$648,499

Source: Town of Greenwich, Town of New Canaan, City of Norwalk, City of Stamford, Town of Weston and Town of Westport.

The following list describes some of the impacts of severe storm events in the Region. These accounts were derived from the National Weather Service Storm Events Database:[7]

February 27, 1995: Freezing rain and drizzle during the night and early morning hours caused a significant disruption to transportation. Numerous traffic accidents were reported as roadways became extremely hazardous due to ice. The ice also coated trees and caused numerous branches to break off, which in turn downed some power lines.

January 7-8, 1996: A storm of historic proportions that became known as the "Blizzard of '96" moved northeast across the Region. Snowfall was extremely heavy, ranging from 14 to 26 inches in the Region. The heavy snow combined with strong winds to create blizzard conditions for several hours, crippling all

forms of transportation and keeping some airports closed for days. Several people were injured during the next several days as numerous roofs collapsed due to extremely heavy snow loads. Monetary losses from the blizzard – including lost sales at area businesses, snow removal costs, etc. – were enormous.

March 15, 1999: Heavy wet snow downed numerous tree limbs and power lines across the Region. Snowfall amounts ranged from seven inches in Stamford and New Canaan to nine inches in Danbury.

January 6-7, 2009: Across Fairfield County, reported amounts of ice were generally between 0.3 and 0.4 inches, but damage across the Region suggested higher amounts. Numerous power lines and large tree limbs were reported down across Fairfield County.

January 25, 2010: In Stamford, 1178 homes were without power due to downed trees and power lines. In Shippan, live wires were down on Harvard Avenue. A tight pressure gradient ahead of a cold front produced strong southerly winds and caused around $100,000 in damage.

March 13-14, 2010: A Nor'easter came through Connecticut causing severe damage across the state. Soaking rains combined with winds exceeding 65mph downed numerous trees, limbs and power lines and closed roads, schools, and businesses across the Region; one person was killed in Westport. Emergency shelters opened in Stamford and Norwalk. Connecticut Light & Power reported nearly 64,000 were without power, with 70 percent of the outages confined to Norwalk, Stamford and Greenwich. It took utility crews and tree workers more than a week to restore power and clear local roadways. Individual insurance claims in the South Western Region totaled over $343,000, and accounted for 56% if the claims made in Fairfield County (Table 3-11).

These accounts demonstrate that the Region is vulnerable to severe winter storms and their impacts, including bodily harm and damage to property and infrastructure.

Table 3-11. Individual Insurance Claims Filed in response to the March 13-14, 2010 Storm

	South Western Region		Fairfield County		Connecticut	
	Claims	Total Paid	Claims	Total Paid	Claims	Total Paid
Region	**607**	**$343,447**	**915**	**$613, 989**	**4182**	**$4,647,786**
Darien	32	$20,764				
Greenwich	48	$22,132				
New Canaan	38	$8,010				
Norwalk	252	$104,045				
Stamford	146	$143,521				
Weston	13	$17,415				
Westport	54	$20,173				
Wilton	24	$7,387				

Source: FEMA, Individual Assistance report of Regs and IHP approvals by City and County, COB 7-28-10

Severe Thunderstorms

Thunderstorms are the most common severe weather event in the Region. The National Weather Service estimates that more than 100,000 thunderstorms occur each year in the United States, of which approximately 10 percent are classified as severe. Thunderstorms can produce deadly and damaging tornadoes, hailstorms, intense downburst and microburst winds, lightning and flash floods. These storms have caused localized flooding and wind damage in the Region.

The following list describes some of the impacts of thunderstorms and wind events in the Region. These accounts were derived from the National Weather Service Storm Events Database:

June 22, 1997: Severe thunderstorms caused high winds that knocked down trees in Stamford. High winds also caused a 24-foot sailboat to capsize about two to three miles south of Darien in Long Island Sound. A 78-year old man died after he was thrown from a boat.

April 1, 1998: As showers and thunderstorms moved over the area, lightning struck a canine "invisible fence" wire, which was buried underground around the perimeter of 8 Bayberry Lane in Darien. The electrical surge traveled into the wiring of the house and caused extensive electrical damage.

May 20, 1998: A thunderstorm produced lightning that struck near the attic portion of the second floor at 24 Blue Spruce Circle in Weston. The fire was brought under control within 20 minutes and no injuries were reported.

August 14, 1999: As a severe thunderstorm moved east across Fairfield County, it produced high winds that downed power lines in New Canaan. It also produced torrential rain and frequent lightning.

June 2, 2000: Lines of severe thunderstorms swept southeast across the Region, causing one death and one injury. High winds downed many trees and power lines. In Norwalk, a tree fell on and injured a woman. High winds also downed trees in Greenwich. A wind gust to 60 mph was measured at Stamford.

August 27, 2001: Thunderstorms produced strong winds gusts which downed some tree limbs onto power lines, resulting in scattered power outages from Darien to Norwalk. As the thunderstorms interacted with a sea breeze boundary along the coast, they redeveloped and moved very slowly east. These thunderstorms produced torrential rainfall across the immediate coastal sections of southern Fairfield County, leading to localized flooding from Greenwich to Norwalk, particularly south of Interstate 95. This flooding led to some road closures during the heart of the evening commute.

October 15, 2003: Numerous tree limbs fell in Westport resulting in about a half dozen road closures, mainly on secondary roads. Approximately 2000 customers were left without power in the greater Norwalk area due to downed power lines. The estimated damage costs were at least $100 thousand dollars.

June 29, 2005: Slow moving thunderstorms developed over Connecticut, producing hourly rainfall in excess of 2 inches. In a matter of four hours parts of South Western Connecticut received up to five inches of rain.

August 12, 2005: Strong winds from a line of thunderstorms toppled over several trees and caused power outages. A microburst was embedded in the weaker thunderstorm winds on or near Bedford Street in Stamford, where winds were estimated between 70 and 80 mph. This small area experienced a large concentration of high end tree damage.

August 14, 2005: A macroburst leveled hundreds of trees in the Wilton, New Canaan, and Darien area. The thunderstorms produced very high winds and rainfall rates of over 2 inches per hour.

July 18, 2006: Severe thunderstorms produced damaging winds, hail, lightning, and heavy rain as they moved across the region. High winds downed many whole trees, large tree branches, and power lines. In Fairfield County, several trained spotters observed hail up to 1 inch in diameter in Darien and in Norwalk. A trained spotter's wind system measured a 60 mph wind gust near Stamford.

March 8, 2008: Multiple trees were knocked down across the Merritt Parkway between exits 42 and 44. One tree struck a car, injuring the occupants. A powerful low tracked across the Tri-State on the 8th, producing damaging winds across Fairfield County and a measured wind gust of 62 mph along the New London County Coast.

August 10, 2009: More than 40 trees and large branches were downed in Greenwich when an isolated severe thunderstorm developed, which produced gusts of 65mph.

June 24, 2010: A cold front and strong upper level trough moved across the Tri-State, triggering severe thunderstorms across Southwest Connecticut during the afternoon. This included both supercells and squall lines, producing severe winds and hail across the region and an F1 Tornado in Bridgeport.

These accounts demonstrate that the Region is vulnerable to damaging winds that can result in the loss of life, injury, power outages, road closures and damage to property and trees.

Tornadoes

A tornado is a violent rotating column of air that extends toward the Earth's surface. Tornadoes may be more violent than hurricanes, but are much shorter-lived. Tornadoes are rated using the Enhanced Fujita Scale (EF-Scale) and the Fujita-Pearson scale (F-scale) prior to 2007, based on the type and severity of damage caused by the tornado.[7] Historically Connecticut has experienced weak tornadoes, with no tornado greater than F2 touching down in Fairfield County. The state estimates that Connecticut experiences approximately three tornadoes every two years.[4] Statewide, tornadoes have caused $590 million in damage, claimed 7 lives and injured 700 people. The National Weather Service has recorded 88 tornadoes in Connecticut from 1950-2010 (Figure 3-15). Fairfield County has seen 14 tornadoes touch down, including a Category F2 tornado in Norwalk on July 19, 1971, a Category F1 tornado in Greenwich on September 18, 1973 and in North Greenwich July 12, 2006 (Table 3-12). Based on past storm events Fairfield County was identified to be an area of moderate to high risk for potential future tornadoes.[9]

Table 3-12. Tornadoes in Fairfield County 1970 – 2010

Date	Municipality	Fujita Tornado Scale	Wind Speed
July 19, 1971	Norwalk	F2	113-157 mph (98-136 kt)
September 18, 1973	Greenwich	F1	73-112 mph (63-97 kt)
June 29, 1990	Danbury	F0	40-72 mph (35-62 kt)
July 5, 1992	New Fairfield	F0	40-72 mph (35-62 kt)
August 4, 1992	Trumbull	F1	73-112 mph (63-97 kt)
July 9, 1996	Monroe	F1	73-112 mph (63-97 kt)
May 31, 2002	Brookfield	F1	73-112 mph (63-97 kt)
July 12, 2006	N. Greenwich	F1	73-112 mph (63-97 kt)
May 16, 2007	Newtown	EF1	73-112 mph (63-97 kt)
July 31, 2009	Shelton	EF1	73-112 mph (63-97 kt)
June 24, 2010	Bridgeport	EF1	73-112 mph (63-97 kt)

Source: National Weather Service, *Storm Events Database*.

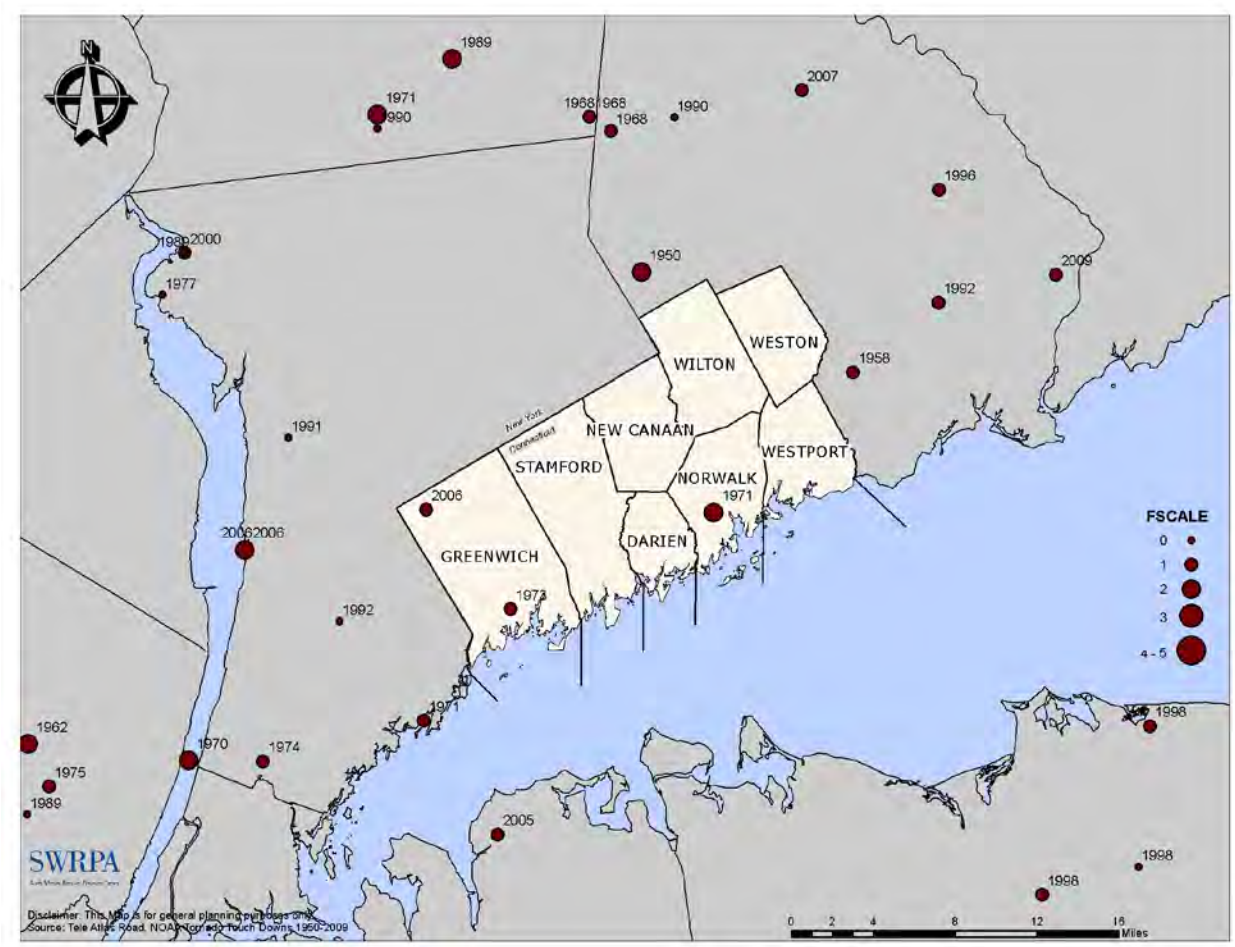

Figure 3-15. Tornado Touch Down Locations from 1950-2009 by Force.

Dam Failure

Dams are man-made or artificial barriers usually constructed across stream channels to impound water. Dams are used for manufacturing, water supply, power generation and fire protection and are categorized into three hazard categories. Class A dams are low hazard potential dams that upon failure would result in damage to agricultural land and unimproved roadways, with minimal economic loss. Class B dams are moderate hazard potential dams whose inundation zone includes normally unoccupied storage structures and low volume roadways. Class C dams are high potential hazard dams that upon failure would result in loss of life and major damage to habitable structures, residences, hospitals, convalescent homes, schools, and main highways. Dam failures can be triggered suddenly, with little or no warning or by other natural disasters such as floods and earthquakes.

The Dam Safety Section of the Inland Water Resources Division of CTDEP is responsible for the administration and enforcement of Connecticut's dam safety laws. Owners of Class C dams are required to maintain emergency operations plans. In addition, builders of new Class B dams are required to develop an emergency operations plan. Class A or B classifications can be misleading when it does not account for recent development in the inundation zones.

In Connecticut, numerous dam failures have occurred, of which the two most catastrophic events were in 1963 and 1982. In 1963 the Spaulding Pond Dam in Norwich failed and caused six deaths and $6-million in damage. In 1982, severe flooding caused 17 dams to fail and damaged 31 others, resulting in losses totaling approximately $70-million. The Town of Deep River suffered the greatest loss ($50-million) when the Bushy Hill Pond Dam failed.

Dam failures often occur in conjunction with flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail. During the Flood of 1955, several dams failed, including the dam at the Gilbert and Bennett factory in Georgetown and the dam at Buttery's Mill on the Silvermine River.

The Region has approximately 361 dams, of which 17 are categorized as Class C (Figure 3-16) and Table 3-13). In addition, several dams outside the Region impact waterways that are part of the Region's natural drainage system. The potential impacts of a dam failure can be dire due to the high population densities and development along many of its waterways. Three Class C dams are of particular concern to the Region, namely, the Samuel Senior Dam in Weston, the Browns Reservoir Dam in Lewisboro, NY, and the Grupes Reservoir Dam in New Canaan. The Samuel Senior Reservoir Dam is owned by the Aquarion Water Company of Connecticut. The failure of this dam could cause considerable loss of life and property in downtown Westport and other areas in the Saugatuck River Watershed. This dam is currently in good condition.

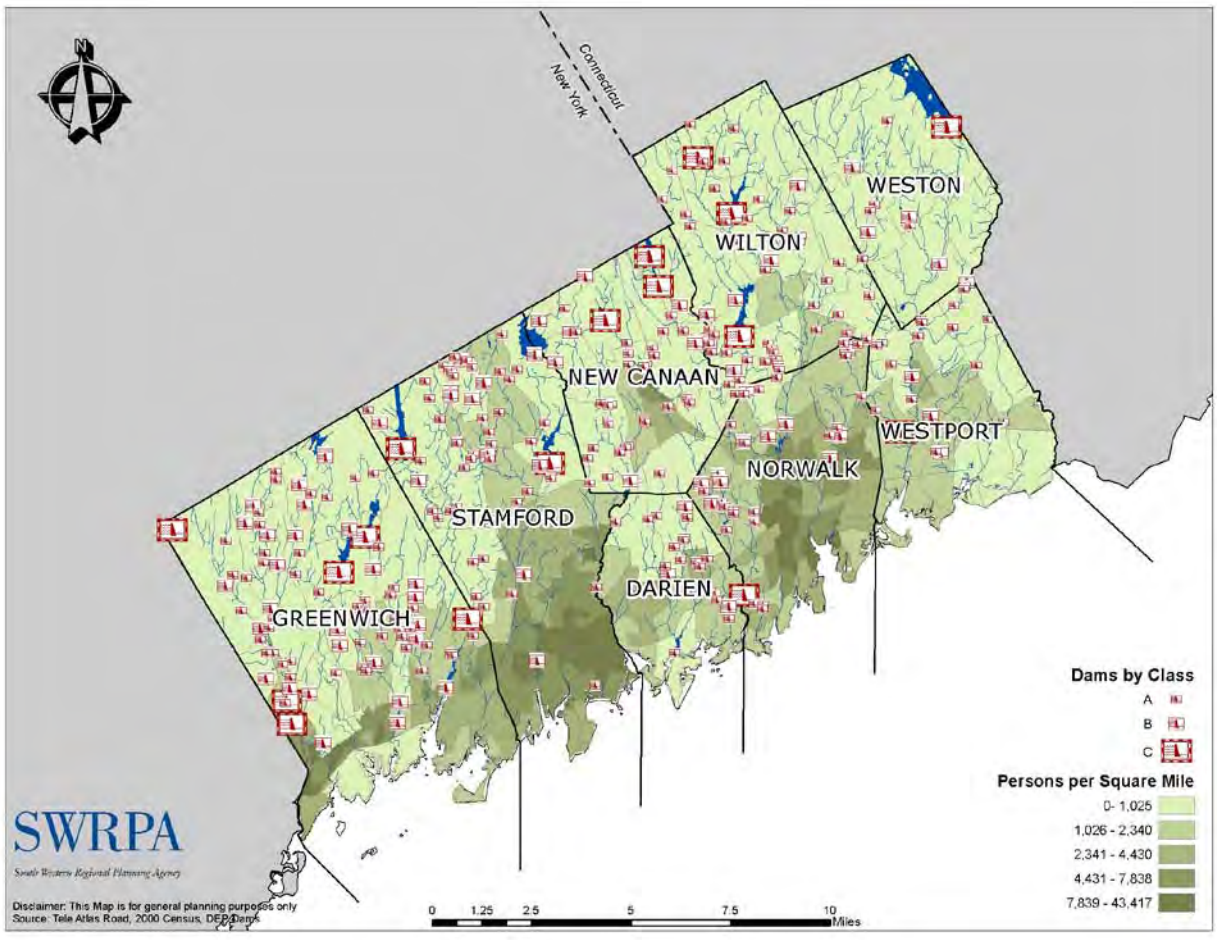

Figure 3-16. Dams in South Western Connecticut

The First District Water Department of the City of Norwalk owns the Browns Reservoir Dam in Lewisboro, NY and the downstream John D. Milne and Grupes Reservoir Dams in New Canaan. This reservoir system is vulnerable to a chain reaction where the failure of the Browns Dam would cause the Milne Dam to be overtopped and the Grupes Dam to fail. In the worst case scenario, catastrophic loss of life and property could occur in the Silvermine River watershed and downstream portions of the Norwalk River watershed in New Canaan, Wilton and Norwalk. In addition, First District Water Department customers could face short- and long-term water shortages. The New York State Department of Environmental Conservation regularly inspects the Browns Reservoir Dam, and the CTDEP regularly inspects the John D. Milne and Grupes Reservoir Dams. According to the inspection reports, these dams have sound structures, but the flood spillways of the Browns and Grupes Reservoir Dams do not meet State standards. Both the States of Connecticut and New York recommend dam improvements to address these deficiencies.

Besides the large Class C dams, some smaller dams have issues. According to the CTDEP Dam Safety Section, the Chasmars Pond Dam in Norwalk has a sound structure, but an out-of-date emergency operations plan. The dam owner resides outside the United States, which complicates matters if legal action is required. With regard to Class B dams, the Millard Dam in Norwalk will be removed pursuant to a court order due to its poor condition. In addition, the Buckley Pond Dam on the Westport-Fairfield town line partially failed.

Table 3-13. Class C Dams in the Region

Number	Name	Town	Owner	Condition
5704	American Felt Dam	Greenwich	1881 Liability Company	Good
5701	Mianus Filter Plant Dam	Greenwich	Aquarion Water Company of CT	Good
5728	American Can Company Dam	Greenwich	Bush & Greenwich Inc.	Good
5703	Pemberwick Dam	Greenwich	Riversedge Partners	Good
5702	Putnam Reservoir Dam	Greenwich	Aquarion Water Company of CT	Good
5726	Rockwood Lake Dam	Greenwich	Aquarion Water Company of CT	Good
9003	Grupes Reservoir Dam	New Canaan	First District Water Department	Fair
9002	John D Milne Lake Dam	New Canaan	First District Water Department	Good
9001	New Canaan Reservoir Dam	New Canaan	South Norwalk Electric and Water	Good
10312	Chasmars Pond Dam	Norwalk	Nathaniel Groby/France	Fair
13501	North Stamford Reservoir Dam	Stamford	Aquarion Water Company of CT	Good
13503	Samuel Bargh Reservoir Dam	Stamford	Aquarion Water Company of CT	Good
15701	Samuel Senior Dam	Weston	Aquarion Water Company of CT	Good
15801	Nash Pond Dam	Westport	Suzann B. Brainerd	Good
16104	Popes Pond Dam	Wilton	South Norwalk Electric and Water	Good
16101	South Norwalk Reservoir Dam	Wilton	South Norwalk Electric and Water	Good
16109	Spectacle Swamp Dam	Wilton	CTDEP	Good

Source: Connecticut Department of Environmental Protection. Dam Safety Section of the Inland Water Resources Division. June 17, 2010. *High Hazard Dams*.

Drought/Wildfire

A drought is a period of unusually dry weather that leads to severe water shortages. Unlike floods, hurricanes and earthquakes, droughts rarely pose an immediate threat to life and property. Instead, drought causes economic hardship through failed crops, loss of livestock and increased expenses and/or lost revenue for water-dependent businesses. In addition, drought can have health consequences, especially when ground water quality degrades or becomes unavailable to residences using wells. Droughts also increase the risk of wildfires. The Region is vulnerable to drought due to its water-dependent businesses and large number of residences using wells. Although agriculture comprises a small part of the Region's economy, agriculture tends to be the hardest-hit sector during a drought. In addition, drought increases the likelihood of fires, especially in low-density, forested areas common north of the Merritt Parkway in Greenwich, New Canaan, Stamford, Weston and Wilton. The ability to fight fires may also be compromised in these areas of the Region, as water levels in fire ponds drop. A further danger is the lack of municipal water in the town of Weston and the northwestern section of Wilton, making fire fighting more difficult. Despite all of this, the Connecticut's South Western Region has not been particularly susceptible to wildfire, and comprehensive historical data on this hazard is unavailable.
Droughts occurred in Connecticut in 1957, 1964-67, 1980-81, 2002, 2007 and 2010. The 2002 drought was unusual; peak water shortage occurred in the spring rather than the typical hot summer months. Drought conditions persisted from April through June, when the drought watch for the county was lifted.[4] In response to the 2002 drought, many of Connecticut's municipalities implemented education and outreach programs that encouraged residents and business owners to conserve water. In addition, many municipalities imposed water use restrictions enforced through fines. As a result of the 2002 drought the Connecticut Water Planning Council's Interagency Drought Work Group produced the CT Drought Preparedness and Response Plan.

During the summer of 2010, two water supply incidents occurred in the Region. In early July a water supply emergency was called by several of the local water companies, and voluntary water use restrictions were activated by local governments. A month later, The Governor issued a statewide drought advisory on August 18, 2010.[10] The summer months were characterized by high temperatures and spotty rainfall, resulting in abnormally dry conditions which persisted into October. Conditions caused an increased demand on the Region's water supply, and stream flows were at critical levels in a number of local rivers and streams.[4]

Research has indicated that climate change over the next 100 years will most likely impact temperatures and precipitation patterns across New England.[11] By the end of the 21st century it is anticipated that the effect of higher temperatures on evaporation during the summer months is expected to outweigh the increases seen in precipitation and may lead to an increases in the severity and frequency of droughts.[12]

Earthquakes

An earthquake is a sudden, transient motion or trembling of the Earth's crust. They typically occur along fault lines where two tectonic plates meet each other. The intensity of an earthquake is measured using the Richter Scale, where each whole number increase represents a tenfold increase in strength. A 4 magnitude earthquake is usually felt with little or no damage. However, a 6 magnitude earthquake would result in damage to poorly built structures near the earthquake's epicenter. A strong earthquake tremor can be felt many miles away from its origin.

Connecticut is located toward the middle of the North American Tectonic Plate and is subject to intra-tectonic – as opposed to inter-tectonic – disturbances. Between 1568 and 1989, Connecticut experienced 137 earthquakes, of which 61 were in the Moodus/East Haddam area. Connecticut experiences an earthquake of 4 magnitude or greater approximately once every 25 years, and a 6 magnitude earthquake every 300 years.

Besides frequency, earthquakes can be evaluated for their magnitude as measured by the peak ground acceleration with 10% probability of exceedance in 50 years. According to the United States Geological Survey (USGS), the Region has a 1 in 10 chance in 50 years of experiencing ground movement exceeding 5% of the acceleration of gravity, which is comparable to a 4 magnitude earthquake on the Richter Scale (Figure 3-17). In fact, the data suggests that the Region is likely to experience a more severe earthquake in the next 50 years than the remainder of Connecticut. While noteworthy, the increased vulnerability is relatively minor compared to areas prone to inter-tectonic disturbances, and is most likely due to the Region's proximity to fault lines in and around New York City.

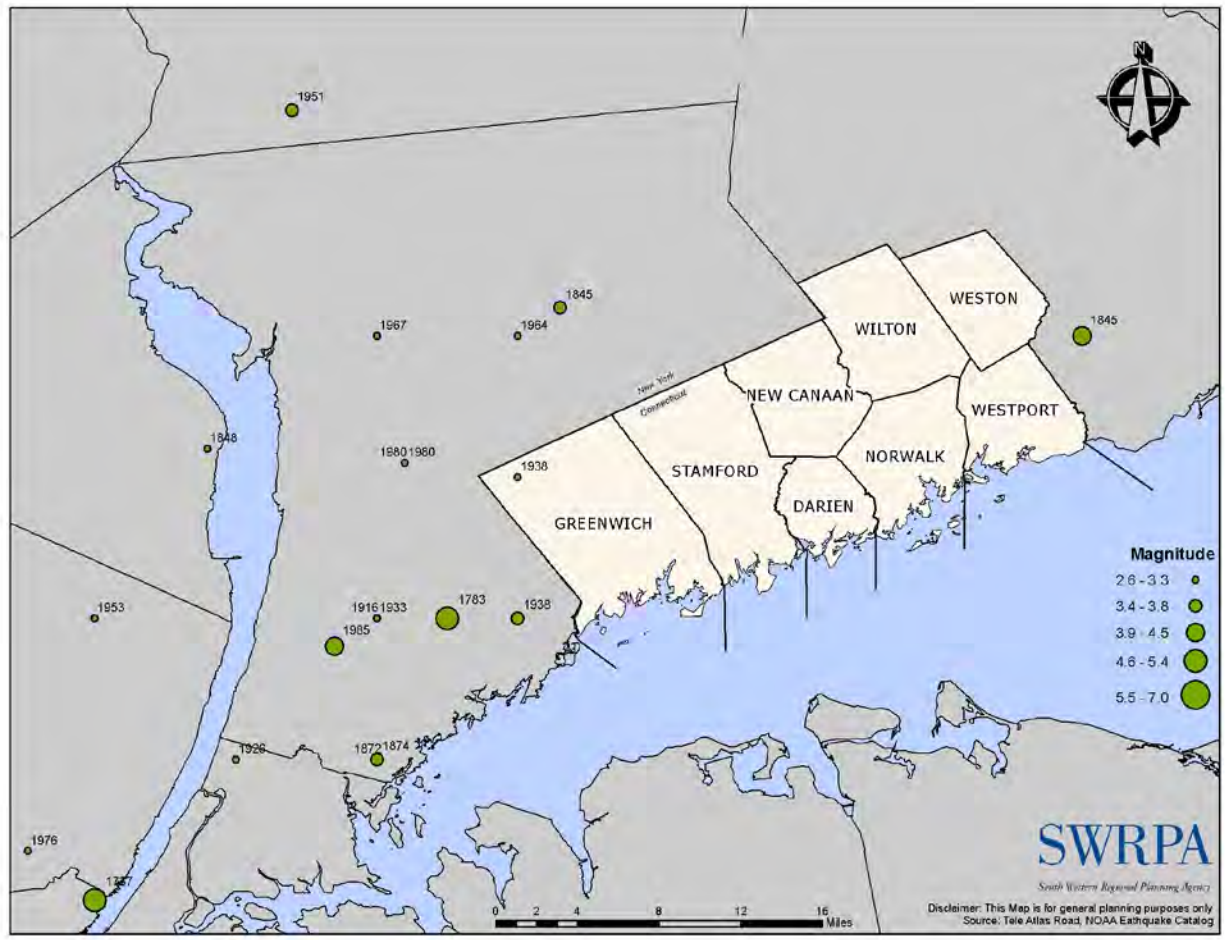

Figure 3-17. Earthquakes by Magnitude

Certain geological features are more susceptible to earthquake effects than others. Studies done on California earthquakes show that structural damage often results from soil liquefaction. This natural phenomenon occurs when the earthquake tremor weakens the ability of soil to support the foundation of buildings and bridges. Besides structure failure, soil liquefaction can cause retaining walls to tilt or slide and result in dam failure. Soil liquefaction tends to occur where artificial fill or sandy soils support

facilities. Figure 3-18 illustrates the locations of surficial materials comprised of artificial fill and sand. Artificial fill is often found in the coastal areas in Darien, Greenwich, Norwalk, Stamford and Westport. In addition, sandy soils are present along many waterways in all municipalities in the study Region. This map does not include small geographic areas where artificial fill supports individual bridge approaches or buildings. Although less likely, buildings could be damaged in other areas regardless of surficial material since most of the structures in the Region are not subject to seismic design standards as they would be in other parts of the country.

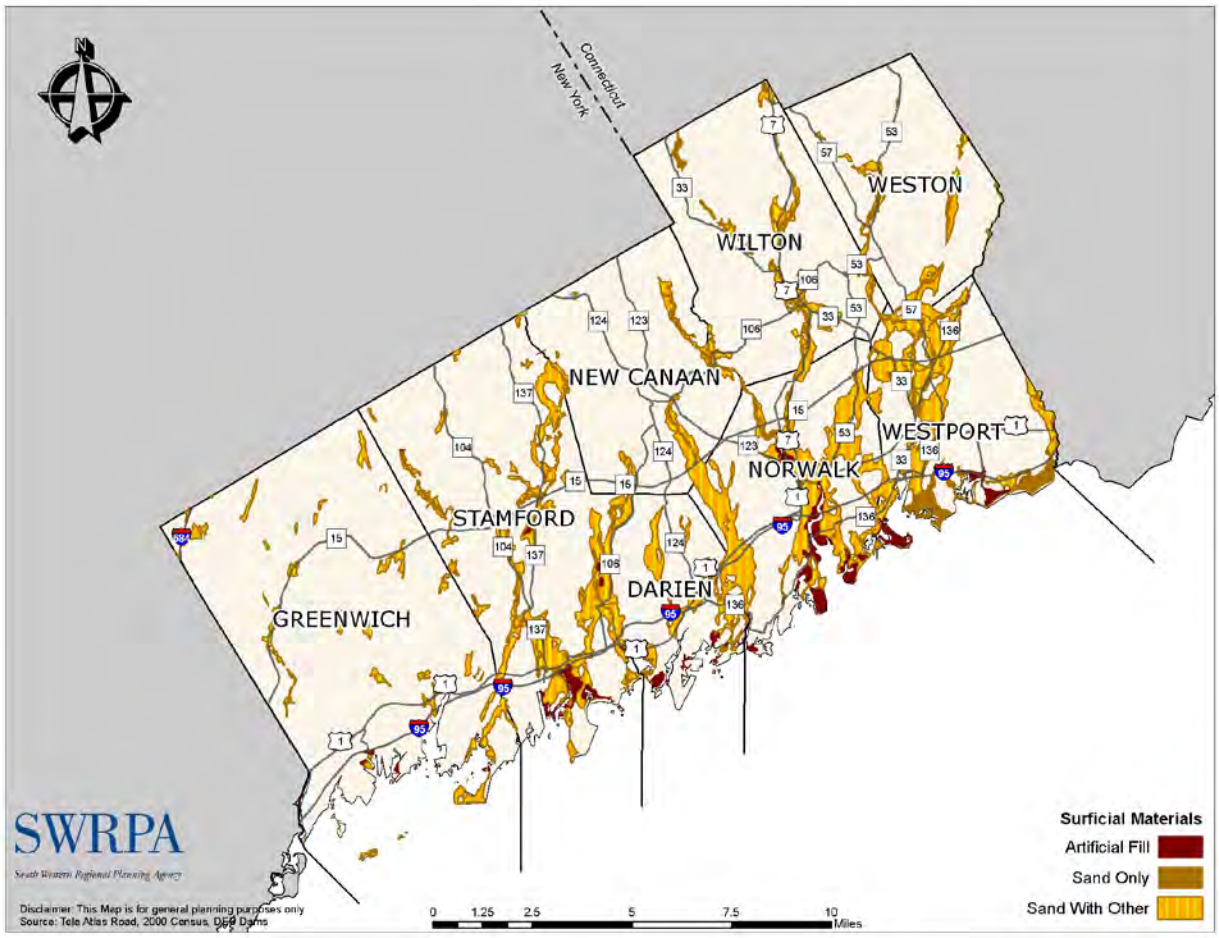

Figure 3-18. Locations of Surficial Materials

The following list describes some of earthquakes felt in the Region. These accounts were derived from the *Stamford Advocate*:

On **October 19, 1985**, a small earthquake awakened many in lower Fairfield County (6:08 a.m.). The earthquake measured 4.0 on the Richter Scale and its epicenter was located between Scarsdale, Ardsley, and Greenburgh in Westchester County, New York. The quake caused only minor damage such as cracks in windows.

On **October 28, 1991**, a small earthquake measuring 3.0 on the Richter Scale was felt in Stamford and Greenwich. The epicenter was located near where the Mianus River meets the Stamford-Greenwich town border. No damage was reported in the Region.

On **April 20, 2002**, the Region felt an earthquake whose epicenter was over 350 miles away near Plattsburgh, New York. No damage was reported in the Region.

These accounts demonstrate that the Region experiences small earthquakes that typically cause little or no damage. However, the State Hazard Mitigation Plan identifies South Western Connecticut as vulnerable to more intense earthquakes. Potential damage to the Region is anticipated to be low based on the character of development and the few structures over four-stories present. It should be noted that the City of Stamford was identified as being more susceptible to damage than other parts of the state due to the large commercial district with a number of multi-story buildings.[9]

The HAZUS-MH Earthquake Model confirms that the Region has a low vulnerability to earthquakes. Table 3-14 indicates that a five or six magnitude earthquake with a 100-year return period would cause a small amount of building damage, no injuries, and no economic loss. These scenarios are more severe than is expected for the Region. In the unlikely scenario of a 6 magnitude earthquake with a 250-year occurrence, the earthquake would cause at least moderate damage to 387 buildings, 55 injuries and $270,000 in building-related economic loss. The HAZUS-MH Earthquake Model is unable to predict damages for an Earthquake below a magnitude of 5. No earthquakes over magnitude 3.0 have been measured in Connecticut since 1996.

Table 3-14. HAZUS-MH Earthquake Model Scenario Results

Scenario		Results		
Frequency of Occurrence	**Magnitude**	**Buildings With At Least Moderate Damage**	**Injuries**	**Economic Loss (Dollars)**
100-year	5.0	0	0	0
100-year	6.0	4	0	0
250-year	6.0	387	55	270,000

Source: Federal Emergency Management Agency, HAZUS-MH Earthquake Model.

Sea Level Rise

Sea level rise is a growing concern as more scientific evidence supports the notion that increased carbon dioxide and other greenhouse gases are triggering an overall increase in average global temperature. The increase in temperatures causes ocean waters to expand and glaciers to melt, leading to sea level rise. The actual extent of risks associated with sea level rise are still unknown, but it is anticipated that increased frequency and severity of flood events, saltwater intrusion in groundwater and wastewater treatment systems, accelerated rates of erosion, and inundation of coastal lands and habitats will occur. [13]

Over the past two years the State of Connecticut has recognized the risk. In 2008 the Governor formed a Climate Change Steering Committee and created an Adaptation Subcommittee with work groups focusing on public health, natural resources, infrastructure and agriculture. Coastal communities have been identified as the most vulnerable. The coastal areas in Darien, Greenwich, Norwalk, Stamford and Westport are the most susceptible to sea level rise and subsequent loss of property in the Region (Figure 3-19). In addition, sea level rise may raise the base flood elevation, increase the likelihood of inland flooding, and increase salinity of rivers, bays, and ground water tables, which may also impact the inland communities[11] of New Canaan, Wilton and Weston, while the entire Region will be affected by an increase in the frequency and severity of storms.

The true extent of sea level rise is difficult to ascertain. The 2007 Intergovernmental Panel on Climate Change (IPCC) and Frumhoff et al. (2007) both estimate global mean sea level rise to be between 7 and 24 inches by 2100, (or 0.07 to 1.04 inches/yr), while several other studies estimate sea level rise to be an

order of magnitude higher.[12,13,14] Data available from the NOAA tide gauges in Bridgeport from 1964-1999, show an average increase of 0.1 inches/year of mean sea levels.[15] Based on these data, The CTDEP Coastal Sea Level Rise Digital Elevation Models for Mean High Water plus 6 inches were used to evaluate the probable extents of inundation from sea level rise[5] in the Region over the next 50 years.

After an evaluation of critical facilities and infrastructure potentially vulnerable to regular inundations at high tide, 61 buildings in Greenwich, 43 in Norwalk, 24 in Stamford (including a portion of the Water Pollution Control Facility), and 51 in Westport may potentially be impacted by a six inch increase in mean high water. At the time of the analysis individual building data was not available for the Town of Darien but an estimated 263 privately owned properties could also be impacted by a six inch increase in mean high water. In addition coastal frontage will be reduced and new areas may become vulnerable to diurnal flooding from tides. Sections of Route 1 in Greenwich, Norwalk and Westport may experience regular tidal flooding, and portions of the Metro North Rail line may also be impacted. In order to truly understand the potential impacts sea level rise may have on the Region's properties and infrastructure, additional data and analysis are needed.

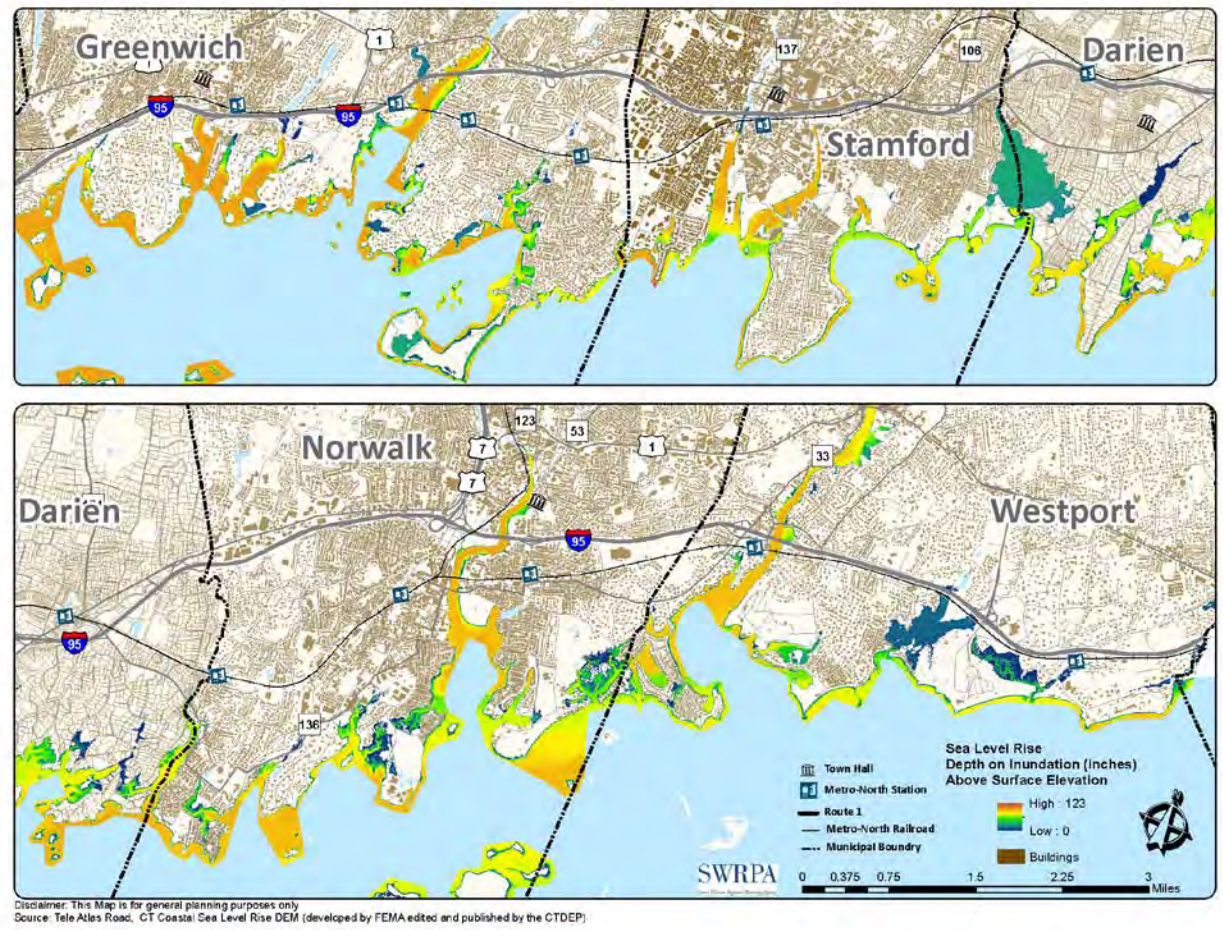

Figure 3-19. Areas Potentially Impacted by a Six Inch Sea Level Rise at Mean High Water

Future Development

As previously discussed in the introduction, the Region is expected to experience continued population growth, although at a slower pace than in the previous decade. Developable land in the Region is scarce. This combined with the tremendously high real estate values, have pushed developers to look at adaptive reuse, brownfield redevelopment and toward land with steep slopes, wetlands or other unfavorable conditions that make them more vulnerable to natural hazards. For instance, abandoned factories and small commercial areas are often found along waterways and harbors as a result of the Region's former reliance on water for power and transportation. Some of these areas include Cos Cob in Greenwich; Rowayton, Norwalk Harbor and Silvermine in Norwalk; Stamford Harbor in Stamford; Saugatuck in Westport; Cannondale in Wilton; and the former Gilbert & Bennett wire mill in the Georgetown section of Redding, on the Weston and Wilton town lines. Interestingly, some of these areas continue to be well served by the Region's transportation system and may become candidates for revitalization, as is the case at the Gilbert & Bennett site.

In addition, areas near Metro-North train stations in Darien, Greenwich, New Canaan, Norwalk, Stamford, Westport and Wilton are potential locations for residential and commercial development. In fact, considerable public and private investment has occurred and is expected to continue around the Stamford and South Norwalk train stations.

"Strip" development along U.S. Routes 1 and 7 will likely continue due to favorable zoning, scheduled improvements and the availability of sites along their lengths. This style of development is characterized by "big box" retail stores, strip malls, office buildings, and condominium developments. Route 1 runs parallel with the Long Island Sound shoreline, crossing numerous waterways and making it prone to flooding at those crossings. Based on flood insurance claim information, the most flood-prone crossings are where Route 1 intersects with the Saugatuck River in Westport, the Noroton River at the Darien-Stamford town line, and at the Metro-North overpass in downtown Darien. (Figure 3-20).

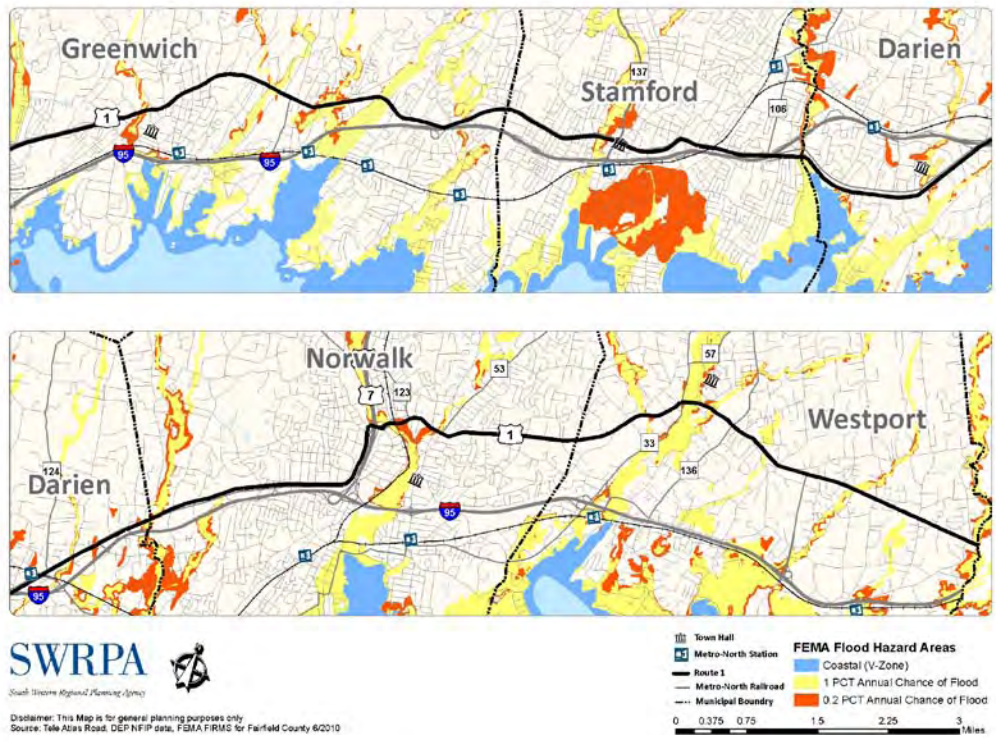

Figure 3-20. Route 1 Adjacent Flood Hazard Areas

Route 7 is a north-south route that parallels the Norwalk River. As a result, flood insurance claims tend to occur on the same side of Route 7 as the

Norwalk River. Even with regulations, future development could increase the likelihood and potential impacts of floods along the Route 7 corridor.

All of the municipalities in the Region utilize land-use regulations to control the development process. Among the goals of these regulations are to focus growth in town centers to preserve community character; promote the use of Metro-North Railroad and other forms of public transportation; prevent development within flood zones; conserve open space; and combat strip development along many of the state highways that could threaten the economic vitality of the traditional downtown areas. As more data becomes available municipalities are strengthening their regulations, particularly within special hazard flood zones to reduce vulnerability of new construction and aid in reducing the risks to existing structures. As new development in the Region becomes more dependant on reuse of existing structures efforts will be made to bring non conforming structures into compliance reducing the overall risk to the community.
In addition to municipal land-use regulations, there are numerous efforts underway by not-for-profit groups (often in partnership with government) to preserve open space in the Region. Open space preservation often prevents development from occurring in floodplains and other sensitive areas, which can help preserve natural drainage systems.

The transportation system and public policy will continue to influence development. Development can be expected in areas with a past history of water-dependent business, around many of the Metro-North train stations, along U.S. Routes 1 and 7, and in town centers. Through the use of land use regulations, municipal ordinances and comprehensive planning, municipalities are working to reduce the communities overall vulnerability and to ensure that future development does not increase the Region's vulnerability to natural hazards.

Summary

Table 3-15 summarizes the frequency, magnitude (potential impacts), vulnerable locations and economic loss for each hazard. The summary is based upon historical events, research, computer-based spatial analyses, and feedback from local and state officials, the Advisory Committee and the general public. Historical trends and current analysis have shown little variation in the vulnerability of the municipalities located in South Western Connecticut to the natural hazards discussed in the this plan

The most frequent natural disasters in the Region are floods, severe storms and severe thunderstorms. These events have a 20% or greater chance of occurrence in any given year. The following events have between a 4 and 14% chance of occurrence: drought, earthquakes, hurricanes and tornadoes. Dam failure is most likely to occur in conjunction with floods, hurricanes and earthquakes. Lastly, sea level rise is a gradual process that is expected to result in a seven to 24 inch rise in sea level by the end of the 21st century. [14]

In terms of potential impacts or magnitude, floods, dam failure, severe storms, hurricanes, tropical storms, tornadoes and severe thunderstorms have the greatest potential for loss of life and property in the Region. These events may result in road closures, power outages, business disruption, property and content damage, bodily harm and death. An earthquake with a four magnitude would do minimal damage in the Region, and an unlikely six magnitude earthquake could result in loss of life and property, especially in areas prone to soil liquefaction. Of the natural hazards, drought has the lowest potential for loss of life and property. Sea level rise is unique because it results in a gradual loss of property. Besides consequences for coastal areas, sea level rise may raise the base flood elevation, exacerbate the impacts of inland floods, and increase the frequency and severity of storms.

In the Region the coastal areas and flood zones may be slightly more prone to loss of life and property from floods, severe storms, hurricanes, dam failure and sea level rise. However, the furthest inland point of the Region is a mere 11 miles from the shore, leaving all eight communities vulnerable to impacts of coastal storms. With more than 360 dams across the Region the potential impact of dam failure is greatest, particularly in the dam inundation zones of the large capacity Class C dams.

Economic loss is closely tied to the potential impacts of a natural disaster. Again, floods, severe storms, hurricanes and dam failure would have the most costly direct and indirect economic consequences, including repair and replacement costs, business disruption and clean-up costs. The economic loss for earthquakes and drought is relatively low, and in the case of sea level rise, would be spread over the course of many years. With many of the municipalities in the Region at or close to being built-out, future vulnerability to natural hazards is not expected to increase as a result of new development.

Community Vulnerability

Darien is prone to floods, storm surges, severe storms, sea level rise, hurricanes, tornadoes and other high wind events. Darien may be impacted if a high magnitude earthquake occurred, while Noroton, Tokeneke and the Heights Road Business District experience routine flooding.

Greenwich is a community that is prone to floods, storm surges, severe storms, sea level rise, hurricanes, tornadoes and other high wind events. Greenwich may be impacted if a high magnitude earthquake occurred. Old Greenwich is particularly vulnerable to flooding. Drought can negatively impact its agricultural areas, cause health consequences for those on wells, and impact water levels in fire ponds.

New Canaan is a community challenged by floods, severe storms, hurricanes, tornadoes and other high wind events. A high magnitude earthquake could also impact the community. New Canaan could experience catastrophic loss of life and property as a result of dam failure of the Browns, Milne, and Grupes Reservoirs. Drought could cause health consequences for those on wells.

Norwalk is a community that is the most impacted by floods, storm surges, severe storms, sea level rise, hurricanes and other storms accompanied by high winds. A high magnitude earthquake may also impact the community. East Norwalk, Harborview, and Rowayton are areas prone to flooding. Like New Canaan, Norwalk could experience loss of life and property as a result of dam failure on the Browns, Milne, and Grupes Reservoirs. These dams are owned by Norwalk's First District Water Department.

Stamford is a community that is impacted by floods, storm surges, severe storms, sea level rise, and hurricanes and other high wind events. Cove, Shippan and Waterside are areas prone to flooding, while the downtown area may be impacted by an earthquake. Drought could cause health consequences for those on wells.

Weston is a community impacted by severe storms, hurricanes, flooding and other high wind events. A high magnitude earthquake could also impact the community. Weston could experience tragic loss in the event that Samuel Senior Dam fails. Drought could cause significant health consequences as wells are the primary source of drinking water in the town.

Westport is a community that is impacted by floods, storm surges, severe storms, sea level rise, hurricanes and other high wind events. A high magnitude earthquake could also impact the community. Westport could experience tragic loss in the event that Samuel Senior Dam in Weston fails. The Westport town center has known flooding issues related to its location in the floodplain of the Saugatuck River, which can be exacerbated by storm surges and high tides. In addition, Saugatuck Shores, Compo Cove and Compo Beach are flood-prone areas.

Wilton is a community impacted by severe storms, hurricanes, floods and other high wind events. A high magnitude earthquake could also impact the community. Wilton's steep hills present a challenge for

snow plowing, and its wooded streets make it vulnerable to road closures. Drought could cause health consequences for those on wells. In addition, Wilton has a small area that is in the inundation area for the failure of Browns, John D. Milne, and Grupes Dams.

In conclusion, the most likely and costliest natural disasters in the Region are floods, severe winter storms and hurricanes. All of the Region's municipalities would benefit the most from mitigation strategies that address those natural hazards. Due to the potential impacts, dam failure and sea level rise should also be addressed by mitigation strategies. The Region may also benefit from low-cost mitigation strategies that address earthquakes and drought.

Table 3-15. Summary of Natural Hazard Evaluation

Floods	
Probable Frequency & Magnitude	Once every five years or 20% chance of occurrence in any given year for special flood hazard areas to be impacted
Potential Impacts	Street closures, power outages, tree damage, utility damage, property and content damage, basement flooding, bodily harm and death.
Vulnerable Locations	Flood Plain, Special Flood Hazard Areas, Coastal and poorly drained areas, and areas adjacent to waterways and wetlands. Coastal areas are also prone to storm surges. See Table 3-6 and Figures 3-6, 3-7, 3-8 and 3-9 for details about vulnerable areas.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Repair and replacement costs, business disruption and debris removal and cleanup costs.
Severe Storms	
Probable Frequency & Magnitude	A severe storm (blizzard, nor'easter, ice storm, wind storm) is likely to occur once every five years or 20% chance of occurrence in any given year.
Potential Impacts	Street closures, power outages, schools closures, utility damage, property and content damage, car accidents, tree damage, bodily harm and death.
Vulnerable Locations	Entire region. Coastal areas in Darien, Greenwich, Norwalk, Stamford, and Westport are prone to storm surges from Nor'easters.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Repair and replacement costs, business disruption and snow removal and cleanup costs.

Hurricanes, Tropical Storms, Tornadoes, and Severe Thunderstorms	
Probable Frequency & Magnitude	A Category II hurricane is likely to occur approximately once every 10 years or 10% chance of occurrence in any given year. A Category III or IV hurricane is likely to occur about once every 50 years or 2% chance of occurrence in any given year. A tornado is likely to occur about once every twenty-five years or 4% in any given year. Severe thunderstorms occur each year or 100% chance of occurrence in any given year.
Potential Impacts	Street closures, power outages, utility damage, school closures, property and content damage, tree damage, storm surges, fire, bodily harm and death.
Vulnerable Locations	Entire region. Coastal areas in Darien, Greenwich, Stamford, Norwalk and Westport are the most prone to damaging storm surges from a hurricane, which may exacerbate riverine flooding in New Canaan, Weston and Wilton, and the inland sections of Darien, Greenwich, Stamford, Norwalk and Westport . Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton are all vulnerable to damage from high winds.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Repair and replacement costs, business disruption, and debris removal and cleanup costs.
Drought/Wildfire	
Probable Frequency & Magnitude	A drought occurs about once every seven years or has a 14% chance of occurrence in any given year. However, the frequency and severity of drought are expected to increase over the next century. The probability of wildfires occurring is currently un-reported but the risk increase when drought conditions are present
Potential Impacts	Water shortages, health issues, and increased risk of wildfires. In addition, drought increases the likelihood of wildfires, especially in low-density, forested areas common north of the Merritt Parkway in Greenwich, New Canaan, Stamford, Weston and Wilton.
Vulnerable Locations	Entire region. Agricultural areas and residences on wells would experience hardship first. Drought increases the likelihood of wildfires, especially in low-density, forested areas north of the Merritt Parkway in Greenwich, New Canaan, Stamford, Weston and Wilton.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Agricultural and water-dependent businesses may experience economic hardship.
Dam Failure	
Probable Frequency & Magnitude	The likelihood of dam failure is greatest in conjunction with flood, hurricanes and earthquakes. Severity is dependant on the type and size of dam.
Potential Impacts	Bodily harm and loss of life and property. A water shortage may occur in the event that a dam failure impacts an active reservoir.
Vulnerable Locations	Areas located downstream of or in a dam inundation zones, particularly for the large class C dams. Areas in Weston and Westport located in the dam inundation zone of the Samuel Senior Dam and areas in New Canaan, Norwalk, and Wilton located in the dam inundation zones of the Browns, John D. Milne and Grupes Reservoir dams.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Property and content damage, power outages, business disruption, and debris removal and cleanup costs.

Earthquakes	
Probable Frequency & Magnitude	A magnitude 4 or higher earthquake is likely to occur approximately once every twenty-five years or 4% chance of occurrence in any given year.
Potential Impacts	Little or no property and content damage.
Vulnerable Locations	Entire region (Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport and Wilton). The Town of Greenwich has the closest proximity to fault lines in and around New York City, while Stamford has an increased potential for loss due to multi-story structure in the downtown area. However the HAZUS-MH earthquake model shows ground acceleration to equal across the region.
Communities Affected	Darien, Greenwich, New Canaan, Norwalk, Stamford, Weston, Westport, and Wilton
Economic Loss	Repair and replacement costs.
Sea Level Rise	
Probable Frequency & Magnitude	A seven to 24 inch rise in sea level is expected to occur by the end of the 21st century or approximately 0.07 – 1.04 inches per year.
Potential Impacts	Gradual loss of property and increased salinity of rivers, bays and ground water tables. Changes in weather patterns and tidal cycles may lead to increase severity of storms and drought events, and changes in the tidal cycle may lead to increases in or the extent and duration of riverine flooding.
Vulnerable Locations	Coastal, low-lying, and flood prone areas and aquifers.
Communities Affected	Directly: Darien, Greenwich, Norwalk, Stamford, and Westport. Indirectly: New Canaan, Weston and Wilton
Economic Loss	Repair, replacement, demolition and relocation costs.

[6] Federal Disaster # 1700, Declared: May 11, 2007
[7] National Weather Service *Storm Event Data Base* http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
[8] Federal Disaster # 972, Declared: December 17, 1992
[9] CTDEP, 2007. Natural Hazard Mitigation Plan for 2007-2010, December 2007.
[10] CT Interagency Drought Advisory Group. Personal communication 2 September 2010.
[11] Horton, R., Gornitz, V., Bowman, M. and Blake, R. (2010)
[12] Frumhoff et al. (2007)
[13] Intergovernmental Panel on Climate Change (IPCC). (2007)
[14] Adaptation Subcommittee to the Governor's steering Committee on Climate Change. (2010)
[15] Gornitz et al. (2004)

IV. Mitigation Strategies

Overview

Mitigation strategies were developed to help guide future efforts to reduce the loss of life and property as a result of natural disasters and attempt to break the expensive cycle of repeated damage and reconstruction. Mitigation strategies were identified for each municipality based upon information in the Hazard Evaluation and Risk Assessment, internal resources, discussions and meetings with local officials and stakeholders (more detail on mitigation strategy development is included in Section II).

For each municipality, this section presents existing mitigation strategies, specific challenges, goals, objectives and proposed mitigation strategies. The proposed mitigation strategies are further prioritized to help establish the implementation schedule. Additionally, all eight of the Region's municipalities participate in the National Flood Insurance Program (Table 3-1). Mitigation strategies to assist with continued compliance with the National Flood Insurance Program (NFIP) were incorporated wherever possible.

Darien

Existing Mitigation Strategies

The Town of Darien uses regulations as a proactive means to protect the normal functioning of the natural drainage systems and to prevent inappropriate development in flood plains and coastal areas. For instance, the land-use regulations require development in flood hazard and coastal high hazard areas to be designed by a professional engineer to minimize flood damage. In addition, all new construction and substantial improvements of residential structures are required to have the lowest floor including basement elevated to at least one foot above base flood level. Structures used for the sole purpose of vehicle storage or other storage are required to be designed to automatically equalize hydrostatic flood forces on exterior walls and allow for entry and exit of flood waters. Furthermore, all new construction and substantial improvements are required to have the space below the lowest floor constructed with breakaway walls intended to collapse under stress without jeopardizing the structural supports of the structure. Such space can only be utilized for building access, parking of vehicles, and/or storage. In regards to floodways, regulations prohibit all development that would result in any increase in flood levels. The regulations also call for the conservation, preservation, and protection of wetlands, marshes, streams, rivers and ponds as natural resources to avoid flooding, erosion, and pollution. In addition, all filling and regrading of more than 20 cubic yards more than 25 feet from a residence needs review and action by the Planning and Zoning Commission. Activity cannot extend within 50 feet of inlands wetlands or watercourses, or within 100 feet of a named river unless specifically authorized by Environmental Protection Commission. As part of the subdivision review process, applicants are required to provide a soil erosion and sediment control plan that meets Connecticut guidelines.

In the Coastal High Hazard Zones, all new construction and substantial improvements to the bottom of the lowest structural member must be elevated to at least one foot above the base flood elevation and attached or anchored to the pile or column foundation to resist flotation or collapse and lateral movement due to the effects of wind and water loads acting simultaneously. In addition, the regulations for Coastal High Hazards Zones prohibit the use of fill for structural support of buildings. These land-use regulations are described in detail in the Zoning Regulations and Subdivision Regulations available through Darien Town Hall.

Early in 2010, Darien revised the existing flood damage prevention regulations in accordance with the most recent State DEP and FEMA requirements. Changes in regulations generally coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County in June 2010. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

Besides regulations, Darien takes a proactive approach towards addressing drainage issues. For instance, the Public Works Department, when possible, examines and clears public storm drains and grates of debris prior to and during periods of rainfall, snowfall, and storms. In addition, Public Works stocks sand bags for mitigating flooding conditions. Furthermore, Public Works coordinates studies to address intricate problems as exemplified by the recent studies that examined localized flooding of Heights Road and the Stony Brook and Goodwives River Watershed Evaluations.

Challenges

1. Due to mitigation, many Darien residents have not experienced a flood, hurricane or other natural disaster and may underestimate Darien’s vulnerability to natural hazards.

2. Darien has areas that experience repetitive losses due to flooding, in particular Noroton Bay and Tokeneke neighborhoods. Darien has limited options to address drainage issues in Noroton Bay and Tokeneke because these areas are served by privately held roads and drainage systems.
3. U.S. Route 1 near the railroad bridge experiences regular flooding as a result of minor rain events. Due to the geometry of the roadway and rail bridge and adjacent development, solutions to address this problem are cost prohibitive and cause major disruptions to rail service and the community.
4. A Darien-sponsored study found that localized flooding of a portion of Heights Road was attributable to an undersized drainage culvert under I-95. This culvert cannot handle peak storm flows from upstream. The study also looked into existing conditions downstream to evaluate the potential for downstream flooding once the culvert under I-95 was corrected.

Proposed Mitigation Strategies

Darien personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign each supporting recommendations a priority rating of "High," "Medium" or "Low".

- Does the supporting task mitigate multiple natural hazards?
- Is the supporting task feasible?
- Would the supporting task be effective in avoiding or reducing future losses?
- Is there an established program already in place to implement the proposed task?
- Does the proposed task require lengthy permitting and approval processes (an answer of "No" satisfies this criterion)?
- Does the cost seem reasonable for the size of the problem and likely benefits?
- Does the task aid in the ability of Darien to warn its townspeople about approaching severe weather or other hazards?
- The anticipated time frame for implementation.

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Darien's planning process can be found in Appendix C and Appendix D respectively.

Darien Mitigation Strategies

Goal *Reduce the loss of life, property and economic consequences as a result of flooding, high winds, severe storms and dam failure.*

Objective 1. ◇ *Educate the public in the areas of natural disasters, mitigation activities and preparedness.*

Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1. Enhance Community preparedness programs.	*EM*	*Medium*	*TBD*	*All*
• Explore developing a "phased approach" to citizen preparedness (i.e. introductory brochures identifying simple and inexpensive tasks, and more advanced brochures with additional tasks and actions to be done to prepare you family and home for a natural disaster that may be more sophisticated in nature or more expensive).	*EM*	*Medium*	*TBD*	*All*
• Provide "welcome kits" to new home owners for properties located within the flood plain, or with a significant risk of flooding.	*EM*	*Low*	*TBD*	*Flooding*
2. Develop a series of additional brochures promoting 'best management practices' for natural resources targeted to homeowners. Mail these brochures to all Darien homeowners annually, in concert with other mailings and provide materials on the town website. Topics to be covered in the brochures include:	*Planning, DPW*	*Low*	*TBD*	*Flooding, Coastal Storms*
• Sound landscaping practices and stormwater management.	*P&Z, DPW*	*Low*	*TBD*	*Flood,*
• How to protect wetlands.	*P&Z, DPW*	*Low*	*TBD*	*Flood, Coastal Storms*
• Understanding tidal wetlands.	*P&Z, DPW*	*Low*	*TBD*	*Flood, Coastal Storms*

Ongoing Practices	Who	Priority*	Hazard Addressed
Visit schools and educate children about the risks of floods and other natural hazards and how to prepare for them.	*Police, Fire*	*High*	*All*

Make available literature on natural disasters and preparedness at Darien Town Hall and at the Darien Library. *All education materials and brochures developed by the town are made available at the town library.	*Building, Library*	*High*	*All*
Make available information on natural disasters and preparedness on Darien's website with links to state and federal resources.	*EM*	*High*	*All*
Inspect and maintain drainage catch basins and systems to provide adequate and optimal flow.	*Public Works*	*High*	*Flooding, Coastal Storms, Hurricane*
Review and update Darien's GIS system with information on Natural Disasters that can be accessed for emergency as well as planning.	*Planning & Zoning, EM*	*High*	*All*

Objective 2. ◇ *Ensure proper functioning of critical facilities and reduce business disruptions as a result of Natural Hazards.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Inventory condition of town-owned culverts and bridges.	*DPW*	*Medium*	*TBD*	*Flooding, Coastal Storms, Hurricane*
2.	Encourage the study of alternative systems for delivering reliable power to residents.	*DPW, P&Z*	*Low*	*TBD*	*All*
3.	Encourage wherever possible the under-grounding of all utilities to minimize service disruptions due to inclement weather. Require all new development and subdivisions to install underground utilities.	*P&Z*	*Medium*	*TBD*	*Windstorms, Tornadoes, Severe Winter Storms, Hurricanes, Coastal Storms*
4.	Work with CT DOT and DEP to maintain flow of streams through expansive wetlands.	*P&Z, DPW*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricane*
5.	Continue to incorporate recommendations from the Stony Brook Watershed Study.	*P&Z, DPW*	*Medium*	*TBD*	*Flooding, Coastal Storms, Hurricane*
6.	Consider conducting drainage and watershed evaluations for the remaining waterbodies in the town.	*P&Z, DPW*	*Medium*	*DEP*	*Flooding, Coastal Storms, Hurricane*
7.	Support activities and policies that preserve the quantity and quality of drinking-water aquifers and protect primary and secondary aquifer recharge areas.	*HD, P&Z*	*Medium*	*N/A*	*Drought*
8.	Replace or repair culverts or bridges as needed.	*DPW*	*Medium*	*Capital Improvement, FEMA, DOT*	*Flooding, Coastal Storms, Hurricane*

9.	Bridges and roadways over navigable waterways should be maintained, operated, repaired, built to avoid or reduce potential for any significant adverse impacts on navigation, safety, environmental quality.	*DPW*	*Medium*	*Capital Improvement, FEMA, DOT, ACOE*	*Flooding, Coastal Storms, Hurricane*
10.	Review and consider new regulations of DEP on stormwater retention including the use of rain gardens.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricane*
11.	Maintenance of an emergency operations center or equipment to sustain critical facilities in the event of a disaster (i.e. obtain additional generators).	*EM, Fire, Police*	*High*	*TBD*	*All*
12.	Assess vulnerability of critical facilities to earthquakes, hurricanes, tornadoes and flooding.	*DPW, Building*	*Medium*	*TBD*	*Earthquake, Hurricanes, Tornadoes, Flooding, severe storms*
13.	Evaluate the town's sheltering needs for severe storm events.	*EM, Fire, Police*	*High*	*TBD*	*All*
14.	Replace drainage culvert under I-95 to handle peak storm flows and make any other necessary improvements downstream to prevent flooding in the vicinity of Heights Road.	*CTDOT*	*Medium*	*CTDOT as funding becomes available*	*Flooding, Coastal Storms, Hurricane*
15.	Evaluate vulnerability of critical facilities to hazards related to sea level rise and climate change.	*P&Z, DPW, Building, HD, EM*	*Low*	*TBD*	*Sea Level Rise*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Inspect and maintain drainage catch basins and systems to provide adequate and optimal flow.	*DPW*	*High*	*Flooding, Coastal Storms, Hurricane*

Objective 3. ◇ *Improve the ability of Darien residents to prepare and respond to Natural Hazards.*

	Supporting Recommendation	**Who**	**Priority***	**Potential Funding Source**	**Hazard Addressed**
1.	Upgrade and maintain emergency notification system.	*EM*	*High*	*TBD*	*All*
2.	Take advantage of Darien's web site to disseminate information to residents (http://www. darienct.gov).	*EM, DPW, EM, HD, P&Z, CEO*	*Medium*	*TBD*	*All*

3.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, but encourage development to be located outside flood-prone areas wherever possible, including increased setbacks to account for sea level rise.	*P&Z*	*High*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
4.	Establish a practice of distributing recommended 'best-management-practices' for water resource protection brochures to all applicants for subdivision, zoning, and building permit approval.	*P&Z*	*Medium*	*TBD*	*Flooding, Drought, Coastal Storms, Hurricanes*
5.	Support and encourage the development of Long Range Water Supply Plans, to meet the future water supply needs.	*P&Z, HD, DPW*	*Low*	*TBD*	*Drought*
6.	Ensure that redevelopment does not increase runoff from current conditions.	*P&Z*	*High*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
7.	Encourage landowners to retain storm water, such as by using rain barrels or planting rain gardens.	*P&Z*	*High*	*TBD*	*Flooding, Coastal Storms, Hurricanes*

Objective 4. ◇ *Improve the ability of the town of Darien to prepare for and respond to natural hazards.*

	Supporting Recommendation	**Who**	**Priority***	**Potential Funding Source**	**Hazard Addressed**
1.	Hold annual meetings with departments that may need to respond to natural disasters, focused on sharing information, coordination, and developing protocols.	*EM, DPW, Fire, Police, HD, P&Z, CEO*	*Low*	*TBD*	*All*
2.	Develop a secure website to be used to share data and information with emergency management and the EOC during a natural disaster.	*EM, P&Z, DPW*	*Medium*	*TBD*	*All*
3.	Identify ways to improve the use of GIS for identifying areas and facilities vulnerable to disasters and for use to enhance emergency management.	*EM, P&Z, DPW*	*High*	*TBD*	*All*
4.	Work with DEMHS to enhance Training and exercises on disaster responses and education on Property damage assessment forms.	*EM, DPW*	*Low*	*TBD*	*All*
5.	Work with DEMHS to complete and enhance the state and regional debris management plan.	*EM, DPW*	*Medium*	*DEMHS*	*All*

6.	Support regulatory changes recommended in the POCD regarding Zoning, Subdivision, Inland Wetlands and Watercourses regulations; and Harbors Ordinances.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
7.	Continue to develop ways to protect open space, particularly coastal lands and land within the flood plain.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
8.	Conduct a land use/build-out analysis to determine the potential for increase of impervious surfaces, particularly within the flood plain.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
9.	Encourage acquisition of wetlands beneficial to the Town.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
10.	Encourage the preservation of undeveloped lands within the 100-year flood zone with the use of Open Space purchase, donation or conservation easement.	*P&Z*	*High*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
11.	Pursue acquisition of waterfront land and easements when opportunities arise.	*P&Z*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
12.	Continue to provide capital budget funds for drainage projects and investigation of drainage problems.	*DPW*	*High*	*Capital Improvement*	*Flooding, Coastal Storms, Hurricanes*
13.	Continue to encourage best management practices, including innovative Low-Impact Development (LID) practices, for managing stormwater runoff.	*P&Z*	*Medium*	*TBD*	*Flooding, Coastal Storms, Hurricanes*
14.	Continue monitoring community demographics to ensure vulnerable populations are not at a disproportionately higher risk to severe storm events.	*P&Z*	*Medium*	*TBD*	*All*
15.	Evaluate vulnerability of Town landmarks, monuments, and historically and architecturally significant buildings.	*P&Z, Building*	*Low*	*TBD*	*All*
16.	Support local, regional and state efforts to provide protection and preservation of groundwater aquifers.	*HD*	*Low*	*TBD*	*Drought*
17.	Continue work with Aquarion to upgrade and maintain infrastructure to ensure proper water delivery for use by fire and emergency responders.	*DPW*	*Low*	*TBD*	*All*
18.	Consider Properties prone to flooding for elevation or acquisition as needed.	*P&Z, DPW, EM*	*Low*	*TBD*	*Flooding, Coastal Storms, Hurricanes*

Ongoing Practices	Who	Priority*	Hazard Addressed
Review and update Darien's GIS system with information on Natural Disasters that can be accessed for emergency as well as planning.	*P&Z, EM*	*High*	*All*

Who: BOS = Board of Selectmen; Building = Town Building Department; CC = Conservation Commission; CTDEP = CT Department of Environmental Protection; CTDOT = CT Department of Transportation; DEMHS 1= CT Department of Emergency Management and Homeland Security Region 1; DPW = Department of Public Works; EM = Emergency Management (Director of EM, Fire and Police); FM = Fire Marshal; IT = Town Information Technology Department; IWC = Inland Wetlands Committee; HD = Health Department; P&Z = Planning and Zoning Commission; Staff = Various Town Staff; SWRPA= South Western Regional Planning Agency.

Greenwich

Existing Mitigation Strategies

The Town of Greenwich has been proactive in working to reduce its vulnerability to natural disasters. Regulations have been used as means to protect the community and the natural environment from a variety of hazards. As the Town's Building Zone Regulations states, "The FHO [Flood Hazard Overlay] zone is intended to add additional safeguards to those areas of Greenwich subject to riverine and coastal flooding," and "Promote the public health, safety and general welfare and to minimize public and private losses due to flood conditions in specific areas." Early in 2010, Greenwich revised the existing flood damage prevention regulations in accordance with the most recent State DEP and FEMA requirements. Changes in regulations generally coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County in June 2010. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

Besides regulations, Greenwich has taken a proactive approach towards addressing drainage issues, debris management and emergency operations and preparedness. The Town has completed a town-wide inventory of municipally owned trees, which was used to develop a maintenance program. The Department of Public Works has completed drainage studies for most of the major drainage basins within the Town and for a number of smaller drainage networks which experience localized flooding. Emergency mangement has also worked to improve the ability of the Emergency Operation Center to function during a severe storm event and is in the process of installing a new generator at one of the Town's emergency shelters.

The Town also works closely with the state and local utilities to monitor the condition of the six Class C Dams within the Town of Greenwich. A number of practices are in place to coordinate efforts and notification policies between the State of Connecticut DEP, the Town, Aquarion Water Company and private sector entities to further dam safety.

Additional Mitigation Strategies include:

- All projects in flood zones and coastal areas are subject to flood zone and coastal regulations, which are enforced by the Planning and Zoning Commission and Zoning Enforcement Officer with the assistance of CTDEP and FEMA.
- Site plan and project review process requires a sediment and erosion control plan to help ensure proper functioning of manmade and natural drainage systems.
- The Town reviews building permit applications for compliance with flood regulations in Connecticut State Building Code (CSBC).
- The Planning and Zoning Department, Zoning Enforcement Officer and DPW-Building Inspection ensure conformance by requiring elevation certificates prior to issuance of a Certificate of Occupancy.
- DPW Building Division inspects flood damaged structures for damaged mechanical, electrical systems, as well as structural damage.
- DPW–Building Inspection and DPW-Engineering review storm drainage related to the review of building applications.

- Conservation Commission provides technical assistance to Planning and Zoning in the review of planting plans focusing on vegetation that may slow or reduce flooding.
- Conservation Commission reviews and comments on site plan and subdivision applications to the Planning and Zoning Commission for impervious cover and soil types (percolation rates).
- Conservation Commission reviews site plans and subdivisions from a seasonal perspective considering the effects of frozen conditions on flooding and planting to mitigate flooding.
- Inland Wetlands and Watercourses Agency (IWWA) enforces regulations to direct development away from wetlands and flood plains.
- During its review process and inspections of violations IWWA enforces the removal of obstructions from watercourse that could cause debris loads then lead to increased flood hazards.
- IWWA regulations require management practices and measures that prevent flooding and improve water run-off from sites for a 25-year storm event.
- DPW–Engineering maintains a Town Drainage Manual that requires zero increase in water run-off from new developments for a 25-year storm event. The Manual also regulates the existing and proposed storm drainage system requirements such as four foot sumps, hoods, etc.
- DPW–Engineering and Highway Divisions continually perform drainage projects as found in their DPW Capital Improvement Plan.
- DPW–Highway Division performs regular maintenance and cleaning of catch basins, grate tops and cleans pipes in the town drainage system.
- DPW-Highway Division monitors weather reports and maintains equipment and loaded trucks in preparation for storm events.
- DPW-Highway performs snow removal for downtown business district and management of snow removal for all schools.
- DPW-Highway and the Fleet Department perform an ongoing maintenance and replacement program of vehicles and provide mechanical assistance.
- DPW-Highway maintains all of its own supplies, and after each storm supplies are reordered for preparation of the next storm event.
- DPW-Highway and Park and Recreation performs continual roving patrols and monitoring of the Town during storm events, including hurricanes, and alerts Police Department and utility companies of any damaged or fallen lines.
- DPW-Building Inspection reviews plans and construction for compliance with CSBC regulations for snow loading and wind loading requirements.
- Police Department possesses emergency equipment (traffic cones, signs, barricades, etc.) on a trailer ready to be deployed when needed during flood or storm events.
- Police Department possesses an amphibious vehicle capable of reaching areas of town that have been affected by flooding.
- Fire Department is prepared to handle life safety issues including high angle rescue, cold-water rescue, confined space and trench rescue.
- Fire Department is equipped with detection equipment in case hazardous materials become a danger as a result of a storm event. This includes infra-red detection, mercury detection and containment, flammable and combustible vapor detection, radiological material detection, Carbon Monoxide

detection, and Oxygen deficiency. The Greenwich Fire Department is a member of the Fairfield County hazards materials team and the training and the equipment to deal with mass contamination.

- Parks and Recreation performs a tree maintenance program organized into three priority groups: 1. Trees that pose potential hazards to vehicles and pedestrians; 2. Trees that pose potential hazards to nearby utilities; 3. Trees that do not pose a direct threat to vehicles, pedestrians, or utilities.
- Parks and Recreation responds upon request to fallen trees in streams and rivers to keep them clear for storms and flood events.
- Parks and Recreation makes recommendations to Planning and Zoning and DPW for appropriate species and location of tree planting near utility lines and buried infrastructure.
- Parks and Recreation performs ice breaking near town marinas at Grass Island and Mianus.
- Procedures are in place to open and maintain the Emergency Operations Center by the Emergency Management Director, Police Chief, Fire Chief, EMS Director and First Selectman.
- Town of Greenwich Emergency Management has developed an emergency preparedness booklet for residents and periodically hosts preparedness programs and events at the local library.
- Emergency Management provides shelters for any evacuees due to significant flooding, and maintains agreements with the Greenwich Chapter of the American Red Cross to manage the shelters.
- Emergency Management maintains memorandums of understanding with transportation providers in order to transport the evacuees from areas affected by floodwaters.
- IWWA reviews plans for the appropriate plant species in and around drainage basins based on the depth and stabilization of the basin.
- The Town has developed a telephone number to broadcast emergency information, and the USGS has installed a stream gage in the Byram River, which may be used to warn residents in particular flood prone and flood zone areas.
- The Town has provided an Emergency Information Telephone number ((866) 245-4260) that will provide information relative to an ongoing or experienced emergency situation. This info line is accessible by simply dialing the well-publicized number. Several officials have access to placing messages so there is assurance that the system will have information for those seeking guidance. The declaration of a snow emergency would be an appropriate use for this system.
- State of Connecticut DEP maintains records and performs inspections of all dams in Town.
- DPW-Engineering also maintains records and performs inspections for all Town of Greenwich owned dams (Mianus Park Pond, Cos Cob Pond, Wooley Pond, East Pond, Mianus River, Montgomery Pond, and Old Pond).
- Each dam owned by Aquarion Water Company has an Emergency Operation Plan, safety plan, and all Class C dams undergo an annual inspection and regular maintenance. A notification protocol in place where the event of a dam disaster to notify first the Town Police Department and Fire Department, and second the chief elected official. Police Department would assist with the warning of residents near the dam.
- Conservation Commission has instituted education and outreach programs that encourage business owners and residents to conserve water.
- During drought conditions, Conservation Commission and Health Department would enforce restrictions through the use of drought permits.

- The Town has a Water Supply Team comprised of the Conservation Director (head), Health Director, Fire Chief, and First Selectman.
- The Police Department is prepared to enforce any emergency passed by the proper authority.
- The Town currently has a Drought Management Plan for public drinking water supplies.
- *Water Use, Ground-Water Recharge and Availability, and Quality of Water in the Greenwich Area, Southwestern Connecticut* was completed by the Conservation Commission in cooperation with the USGS after a two year study of ground-water resources as mandated by Section 7.2 of the *Town of Greenwich Plan of Conservation and Development*.
- Aquarion Water Company has a three tiered drought management plan utilizing the Southwest Regional Pipeline to transfer untreated water and treated water between area plants as needed.
- Office of Emergency Management may activate the Emergency Operation Plan in order to coordinate the acquisition and distribution of needed water supplies through the Emergency Operation Center.
- Office of Emergency Management may use the Emergency Information Line, the emergency email system, as well as the media to notify residents of the locations of distribution of water supplies.

Challenges

1. Several A-Zones still exist where no elevations have been determined on the FIRM maps which make it difficult to apply appropriate standards during the review process.
2. The cumulative impact of development in riverine flood areas poses new issues that need to be addressed in the flood sections of the Building Zone Regulations.
3. The Town has developed a telephone number to broadcast emergency information, but the notification process for warning residents' town-wide or in particular storm hazard areas can be further addressed.
4. Information on emergency preparedness for residents would help educate about potential hazards and risks and provide information that can be used to prepare for such events.
5. DPW-Highway facility at Indian Field Road does not have generator independence and a loss of power could affect radio communications and fueling functions at the facility.
6. DPW-Highway employees on plow and salt and sand routes must rest according to requirements during long and frequent shifts.
7. DPW-Highway vehicles must return to the southern portions of Town to reload sand and salt which may require driving miles from their plow routes.
8. Use of GIS resources would allow the Town to study (estimate) the number and location of properties and structures within areas that could be affected by dam failure.
9. Groundwater/ surface water studies should be expanded to include private wells.
10. Dry hydrants that work or do not work during drought conditions have not been identified.
11. Droughts may occur during winter months when irrigation and pool filling are not yet factors contributing to the drought.
12. Opportunity exists to improve the state drought plan to address regional drought issues Proposed Mitigation Strategies

Proposed Mitigation Strategies

Greenwich personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the review and development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- Does the supporting recommendation contribute to continued compliance with NFIP?
- What is the anticipated time frame for implementation?

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Greenwich's planning process can be found in Appendix C and Appendix D respectively.

Greenwich Mitigation Strategies

Goal 1. *To reduce the loss of life and property and economic consequences as a result of natural disasters.*

Objectives:

- *Expand maintenance activities and execute specific projects that address known drainage issues within the municipality.*
- *Review use of town regulations to minimize the impacts of new development on man made and natural drainage systems and to insure development within flood zones is appropriate.*
- *Petition FEMA to update the Flood Insurance Rate Maps and Floodway Maps.*
- *Improve and expand current flood warning systems and flood response procedures.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Focus on implementing public safety projects identified in the town drainage studies.	*DPW*	*High*	*Capital Improvements, CTDOT*	*Flooding*
2.	Conducting drainage and watershed evaluations for all waterbodies in the town.	*IWWA*	*Medium*	*Town, CTDEP*	*Flooding*
3.	Continue to work to identify proper frequency of storm drain clean out.	*DPW*	*Low*	*TBD*	*Flooding*
4.	Continue to provide capital budget funds for drainage projects and investigation of drainage problems.	*BET, DPW*	*High*	*Capital Improvements*	*Flooding*
5.	Work with the Army Corps of Engineers to address flood-prone areas, such as the Route 1 bridge, Byram and Pemberwick.	*DPW*	*High*	*Capital Improvements*	*Flooding*
6.	Evaluate stormwater funding options to pay for needed stormwater improvements.	*DPW*	*Medium*	*Capital Improvements*	*Flooding*
7.	Work with the state to inventory condition of town owned culverts, bridges and dams.	*DPW, CTDEP, CTDOT*	*Medium*	*Capital Improvements*	*Flooding*
8.	Replace or repair culverts or bridges as needed.	*DPW, CTDOT*	*Low*	*FEMA, Capital Improvements*	*Flooding*
9.	Improve drainage systems in Bruce Park to reduce flooding issues.	*P&R*	*Low*	*TBD*	*Flooding*
10.	Evaluate Binney Park storage shed to determine appropriate flood proofing method, such as raising its elevation.	*P&R*	*Low*	*TBD*	*Flooding*

11.	Implement improvements described in the Old Greenwich Business District and Surrounding Streets- Drainage Study.	*DPW*	*Medium*	*TBD*	*Flooding*
12.	Recommend strengthening regulations to include requirements to maintain vegetation in riparian and flood prone areas	*P&Z, IWWA*	*Medium*	*N/A*	*Flooding*
13.	Request that FEMA and Army Corps of Engineers assist with the reevaluation of Flood Insurance Rate studies for riverine sections	*P&Z, ZEO*	*Medium*	*ACOE, FEMA*	*Flooding*
14.	Recommend strengthening regulations to include requirements to prevent mowing of tidal wetlands	*P&Z, IWWA*	*Medium*	*N/A*	*Flooding*
15.	Consider regulations to require that elevations be provided for development in A-Zones where no elevations have been determined on the FIRM maps	*P&Z, ZEO*	*Medium*	*N/A*	*Flooding*
16.	Review and make appropriate changes to regulations concerning impervious surface cover in flood prone areas	*P&Z,*	*Medium*	*N/A*	*Flooding*
17.	Review and modernize flood sections of the Building Zone Regulations and add standards for riverine flooding, taking into consideration the cumulative effect of development	*P&Z*	*Medium*	*N/A*	*Flooding*
18.	As needed consider mitigation of properties identified as Severe Repetitive Loss Properties by the NFIP.	*FECB, P&Z*	*Low*	*FEMA*	*Flooding*
19.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, and encourage development to be located outside flood-prone areas wherever possible, including increased setbacks or elevations to account for sea level rise.	*CEO, P&Z, DPW*	*High*	*N/A*	*Flooding*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Develop clean out schedules for all catch basins and drainage facilities.	*DPW*	*Medium*	*Flooding*
Maintain and update all notification systems and make sure warning equipment is immediately available.	*EOM, Police*	*High*	*Flooding*
Maintain available shelters and certification by the American Red Cross.	*EOM, Red Cross*	*Medium*	*Flooding*
Review and update memorandums of understanding as needed with Red Cross and transportation providers to make sure they meet the needs of the Town in the event of a flood event.	*EOM, Health*	*Medium*	*Flooding*

	Update town Drainage Manual to include requirements for maintenance of private drainage facilities for proposed development as called for and defined in P&Z regulations.	*DPW, P&Z*	*Medium*	*Flooding*
	Update town Drainage Manual to conform with CT DOT & CT DEP regulations for storm drainage.	*DPW*	*Medium*	*Flooding*
	Study the use of V-Zone standards for foundation design in coastal A-Zones	*P&Z, ZEO, Building*	*Medium*	*Flooding*
	Continue to maintain and prepare vehicles to be used in the event evacuations are required during flooding	*Police*	*Medium*	*Flooding*
	Maintain USGS Stream Gauge in Byram River	*Conservation*	*Medium*	*Flooding, Dam Failure*
	Continue to review and investigate flood damage to structures with permit application and upon complaints.	*Building*	*High*	*Flooding*

Goal 2. Reduce the risks of damage to private and public facilities caused by severe storms.

Objective

- *Continue and expand current maintenance activities, inspections, and requirements and education programs that reduce the vulnerability of existing and new development to severe storm damage.*
- *Continue and expand activities related to severe storm warning and emergency preparedness.*
- *Improve and expand the town's current severe storm response capabilities.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	As needed procure equipment to sustain critical facilities in the event of a disaster (i.e. obtain additional generators) to enhance EOC capabilities.	*EOM*	*Low*	*DEMHS*	*All*
2.	State to evaluate and monitor conditions of all of dams and to enforce existing citations for dam violations.	*CTDEP*	*Medium*	*CTDEP*	*Dam Failure*
3.	Continue to inventory condition of town owned culverts and bridges.	*DPW, CTDOT*	*Medium*	*CTDOT*	*Flooding*
4.	Explore improvements to telecommunications systems to minimize disruption and delays during an emergency.	*Utilities*	*Low*	*Utilities*	*All*

5.	Evaluate municipalities' sheltering and evacuation needs for a variety of storm scenarios.	*EOM, DEMHS, SWRPA*	*Low*	*DEMHS*	*Hurricane, Severe Storms, Tornado, Earthquake*
6.	Continue to maintain emergency notification system and upgrade as needed.	*EOM*	*Low*	*Capital Improvements*	*All*
7.	Continue to enhance community preparedness programs.	*EOM*	*Medium*	*TBD*	*All*
	• Explore developing a “phased approach” to citizen preparedness (i.e. introductory brochures identifying simple and inexpensive tasks, and more advanced brochures with additional tasks and actions to be done to prepare you family and home for a natural disaster that may be more sophisticated in nature or more expensive).				
	• Continue to provide education materials on preparing for natural disasters.				
8.	Work with State to enhance local information and data sharing using WEB EOC 7.1.	*EOM*	*Medium*	*DEMHS*	*All*
9.	Continue to identify ways to improve the use of GIS for identifying areas and facilities vulnerable to disasters and for use to enhance emergency management	*GIS, EOM*	*Low*	*TBD*	*All*
10.	Continue to work with DEMHS to enhance training and exercises on disaster responses and education on Property damage assessment forms.	*EOM*	*Low*	*DEMHS*	*All*
11.	Work with DEMHS and the DEP to complete and enhance the state and regional debris management plan.	*EOM*	*Medium*	*TBD*	*Severe Storm, Hurricane, Tornado*
12.	Complete the Public Safety Complex and improve the emergency communications systems.	*DPW, EOM*	*Medium*	*Capital Improvements*	*All*
13.	Work with Aquarion Water Company to encourage appropriate water line extensions to meet fire protection needs.	*Fire*	*Low*	*Capital Improvements*	*All*
14.	Construct a new firehouse on Upper King Street near the Griff Harris Golf Course.	*DPW, Fire*	*Medium*	*Capital Improvements*	*All*
15.	Work with neighboring municipalities to complete a Tree Inventory to assess potential damage for severe storm events.	*TW*	*Low*	*FEMA*	*All*

Ongoing Practices	Who	Priority*	Hazard Addressed
Maintain available shelters and certification by the American Red Cross.	*EOM, Red Cross*	*Medium*	*All*
Install Emergency Notification System (Reverse 911) to provide emergency information to residents in the entire town or in a specific geographic location within the Town. It is expected to be able connect to as many as 6,000 phones per minute. This notice will provide not only warning of impending situation by also info regarding how to prepare for particular situation.	*EOM*	*High*	*All*
Maintain the town Drainage Manual to conform with CTDOT & CTDEP regulations for storm drainage.	*DPW*	*Medium*	*Flooding*
Continue process of reviewing plans to ensure compliance with snow and wind load requirements.	*DPW*	*High*	*Severe Storm*
Continue program of obtaining new and up-to-date equipment for snow removal and sand/salt operations	*DPW*	*Medium*	*Severe Storm (Winter)*
Maintain identified snow emergency routes for DPW sand/salt and plow operations, update as needed.	*DPW*	*Medium*	*Severe Storm (Winter)*
Continue practice of monitoring of weather updates.	*DPW, EOM, Police*	*Medium*	*All*
Review and update memorandums of understanding as needed with Red Cross and transportation providers to make sure they meet the needs of the Town in the event of a flood event.	*EOM, Health*	*Medium*	*Flooding*
Review and update mutual aid agreements with surrounding municipalities for fire services.	*Fire*	*Medium*	*All*
Continue to review Erosion and Sedimentation Control Plans and ensure that controls are installed properly prior to any storm event.	*P&Z, IWWA, Building, Conservation*	*Medium*	*Flooding, Severe Storm*

Goal 3. Implement and expand drought mitigation plans and initiatives.

Objective

- *Update Drought Management Plan and review and update regulations as necessary.*
- *Educate the public through additional outreach and notification processes.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Work to improve communications between the town, state and Aquarion prior to and during drought conditions.	*Conservation*	*High*	*TBD*	*Drought*
2.	Work with State to update the Drought Management Plan.	*Conservation*	*Medium*	*TBD*	*Drought*
3.	Study effectiveness of regulations during drought conditions.	*Health, Aquarion, Conservation*	*Medium*	*TBD*	*Drought*
4.	Review USGS groundwater study and make recommendations for regulations to protect groundwater quality and quantity.	*Conservation*	*Medium*	*TBD*	*Drought*
5.	Work with Aquarion Water Co. on infrastructure improvements, both in town and inter-town.	*Aquarion, Conservation*	*Medium*	*TBD*	*Drought*
6.	Update drought management plan to be in alignment with State of Connecticut Drought Management plan.	*Aquarion, Conservation*	*High*	*TBD*	*Drought*
7.	Identify which dry hydrants work in drought conditions and which do not. Evaluate which hydrants may need to be deeper and areas where more hydrants need to be installed.	*Fire, Conservation*	*Medium*	*TBD*	*Drought*
8.	Consider if underground storage tanks for fire protection need to be required for new development.	*Fire, Conservation*	*Medium*	*TBD*	*Drought*
9.	Review winter drought restrictions and conservation measures, and evaluate possible education and outreach programs that may be helpful.	*Aquarion, Conservation*	*Low*	*TBD*	*Drought*
10.	Continue outreach programs encouraging water conservation.	*Health, Aquarion, Conservation*	*Medium*	*TBD*	*Drought*
11.	Develop and continue programs to educate the public on measures to take during winter drought conditions.	*Aquarion, Conservation*	*Medium*	*TBD*	*Drought*

	12.	Maintain Emergency Operation Plan and specific information needed to respond to drought conditions.	*EOM, Cons, Health*	*Medium*	*TBD*	*Drought*

Who: Building = Building Department; CEO = Chief Elected Official/First Selectman; Cons = Conservation; CTDEP = CT Department of Environmental Protection; CTDOT = CT Department of Transportation; DEMHS = CT Department of Emergency Management & Homeland Security; DPW= Department of Public Works; EOM = Emergency Operations Manager; FECB = Flood & Erosion Control Board; Fire = Fire Department; GIS = Geographic Information Systems Department; Health = Health Department; IWWA= Inland Wetlands $ Water Agency; P&Z = Planning & Zoning; TW = Tree Warden; Utilities = Local Utility Companies; ZEO = Zoning Enforcement Officer

New Canaan

Existing Mitigation Strategies

The Town of New Canaan is one of the three communities in the Region without any coastal frontage, with its town center is located well above the 100-year floodplain of the Five Mile River. New Canaan has a relatively low vulnerability to flooding and subsequently took a modest approach towards natural hazard mitigation.

New Canaan uses regulations as a proactive means to protect the normal functioning of the natural drainage systems and to prevent inappropriate development in floodplains. For instance, *Zoning* and *Inland Wetland Regulations* require all new construction in flood zones to have the lowest floor, including basement, elevated to or above the base flood level. Any improvement to existing structures that results in a twenty-five percent increase in cubic content or ground area occupied shall be elevated to or above the base flood level. In addition, a permit is required for all filling or excavation in excess of 200 cubic yards. Any development that disturbs more than one half acre is required to have a soil erosion and sediment control plan that meets State of Connecticut guidelines. Furthermore, the *Zoning* and *Inland Wetland Regulations* call for the conservation, preservation and protection of wetlands, marshes, streams, rivers and ponds as well as natural resources to avoid flooding, erosion and pollution.

Likewise, the Environmental Commission, through its *Flood Damage Prevention Regulations*, works toward the conservation of wetland resources through avoiding impacts from development on functional wetlands and watercourses. Excavation cannot extend within 50 feet of wetlands and 50 feet of watercourse, stream, pond or river unless specifically authorized by the Environmental Commission. For instance, these regulations prohibit all development in floodways that would result in any increase in flood levels. The Commission also seeks to restore and enhance wetlands that have been degraded. Furthermore, the Building Department ensures conformance with the Connecticut State Building Code including flood resistant construction and with elevation certification (Section 3107). These land-use and building regulations are described in detail in the zoning, subdivision, and flood damage prevention regulations available through the New Canaan Town Hall.

Besides regulations, New Canaan carries out other preventive measures to reduce the likelihood and costs associated with flooding, damaging winds, and heavy snow. For instance, whenever possible, public works examines and clears public storm drains and grates of debris during periods of rainfall, snowfall, and storms. New Canaan also has contracts with commercial vendors to dispose of bulk wood debris.

Challenges

New Canaan's town center is a very pleasant and pedestrian-friendly commercial district frequented by patrons throughout the year. However, heavy snow often interferes with the commercial activity because snow is piled along the edge of the sidewalks and interferes with pedestrian circulation. In response, the *Plan of Conservation and Development* proposed a designated disposal area for snow from the Town Center area. The Public Works Department built a designated snow disposal area in 2007.

The natural and artificial drainage system is negatively impacted by silting. For instance, Mill Pond and Mead Park Pond needed to be dredged because silt had reduced their flood storage capacity. Mill Pond is the only significant Town-owned body of water on the Five Mile River. It was dredged to a maximum

depth of nine feet in 2008. Likewise, the Mead Park Pond is the only significant Town-owned body of water on the Noroton River. It is currently being dredged to a maximum depth of thirteen feet.
A fire horn mounted on the roof of the Fire Department at 60 Main Street served as the heart of New Canaan's emergency warning systems through 2001. This system was deactivated in 2001 because it became too costly to maintain, and pagers became the preferred method to notify emergency personnel. New Canaan has also instituted a Reverse 911 System to notify residents, emergency personnel and staff of emergency situations.

Saxe Middle School and New Canaan High School serve as emergency shelters. The middle school and the high school have power generators to use in emergencies, but they are not powerful enough to provide adequate heat or cooling in areas used for shelters. The Town is currently reviewing these facilities for upgrades to their generators.

Many of the residents located along the Five Mile River experience flooding, even after regular rain events. The town invested in a hydrologic study of the watershed to assess vulnerable areas and identify possible recommendations to alleviate flooding along the river. The study identified a number of recommendations, primarily engineering solutions, which have proven to be expensive and cost prohibitive.

Many New Canaan home and business owners have not had a major disaster and may underestimate the potential for a severe storm event, hurricane or other natural disaster to impact the community. High winds often damage trees and result in power outages, road closures, disrupted communication systems and damaged property. New Canaan has many beautiful tree lined streets that are admired by residents and passersby. Unfortunately, October rains often wash fallen leaves towards storm drains, which become clogged and cause localized flooding.

Proposed Mitigation Strategies

New Canaan personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. Town staff worked together to develop mitigation strategies and devised internal systems to evaluate and prioritize proposed strategies. New Canaan gave a "High" priority rating towards reconstructing the Nursery Road Bridge and installing adequate generators to provide adequate cooling and heating capabilities at the Town's Shelters. All other supporting tasks were assigned a "Medium" or "Low" priority rating based upon projected budgetary requirements and coordination with other federal and state mandates, (e.g. Phase II Stormwater).

New Canaan Mitigation Strategies

Goal *To reduce the loss of life and property and economic consequences as a result of natural disasters.*

Objective 1: ◇ *To reduce the likelihood of flooding by improving existing natural and artificial drainage systems.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Reconstruct Nursery Road Bridge to widen waterway opening and mitigate flooding issues.	*DPW*	*High*	*TBD*	*Flooding*
2.	Purchase properties known to have flooding problems and that reside within the 100 year floodplain.	*DPW*	*Medium*	*FEMA*	*Flooding*

Objective 2: ◇ *Reduce the amount of debris from severe storms through preventive tree maintenance.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Budget appropriate money necessary to maintain and remove dead, dying, dangerous or diseased trees.	*DPW*	*Medium*	*Capital Funding*	*Severe Storm, Hurricane, Tornado*

Objective 3: ◇ *Improve and expand current natural hazard emergency response capabilities.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Maintain a reverse 911 or similar system to alert residents of natural phenomena and if necessary, evacuation procedures.	*Fire, Police*	*Medium*	*TBD*	*All*
2.	Develop a strategy and obtain the necessary equipment to provide adequate heat at emergency shelters.	*DPW*	*High*	*TBD*	*All*

Objective 4: ◇ *Whenever practical, incorporate natural hazard mitigation strategies into existing municipal projects.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Review plans that fulfill DEP Storm Water Management, Phase II requirements and identify projects that may be eligible for FEMA natural hazard mitigation grants.	*Wetlands*	*Medium*	*FEMA*	*Flooding*
2.	Review recently completed drainage study of Five Mile River with an eye to adopting and instituting mitigation measures.	*DPW*	*Medium*	*TBD*	*Flooding*

Norwalk

Existing Mitigation Strategies

Prevention

Norwalk has rigorous land use regulations designed to protect natural resources and restrict development in flood zones and other hazard-prone areas. Norwalk participates in the Community Rating System (CRS) of the National Flood Insurance Program (NFIP) and continues to be proactive in working to reduce flood hazards throughout the city. Early in 2010 Norwalk revised the existing flood damage prevention regulations in accordance with the most recent state DEP and FEMA requirements. Changes in regulations coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the NFIP standards and recently enacted state floodplain management requirements. These regulations help prevent the loss of life and property by preventing inappropriate development in flood zones and reducing the amount of stormwater discharge that may exacerbate flooding.

The *Zoning Regulations* restrict all new construction and substantial improvements in the 100-year floodplain as depicted on the most recent revision of the Flood Insurance Rate Map. Substantial improvements mean any combination of repairs, reconstruction, alteration, or improvements to a structure taking place during a ten-year period, the cost of which equals or exceeds 50% of the market value either before the improvement or repair is started or, if the structure has been damaged, before the damage occurred. In these cases, all residential construction must be elevated to or above the base flood elevation. Likewise, all non-residential construction must be elevated or flood-proofed to or above the base flood elevation. In regards to elevated buildings, the areas below the base flood elevation must allow floodwater to flow in all directions, and the building must have at least one access route above the base flood elevation. In addition, the regulations prohibit all encroachments in regulated floodways.

The *Subdivision Regulations* build upon the *Zoning Regulations* to offer additional preventive measures during the site plan submittal process. Specifically, the regulations require a storm drainage plan that minimizes runoff and maximizes infiltration before discharging stormwater into wetlands and watercourses. If stormwater discharge will overload existing downstream drainage facilities, the storm drainage plan must provide adequate retention or detention of the runoff. Furthermore, the regulations require the protection of natural features including those that contribute to the natural functioning of the natural drainage system. In addition to flooding, the regulations address damaging winds as a result of severe storms. For instance, utility lines are required to be buried for new subdivisions and are encouraged for certain projects such as major road projects. These land use regulations are described in detail in the *Zoning Regulations* and *Subdivision Regulations* available through Norwalk City Hall.

The Building Department, the Inland Wetland Commission and Public Works Department carry out additional activities that help prevent the loss of life and property as a result of natural disasters. These agencies work very closely with public safety agencies to address such issues beyond mitigation.

1. The Building Department ensures conformance with the Connecticut State Building Code including flood resistant construction and with elevation certification (Section 3107).
2. The Inland Wetlands Commission, through its Inland Wetlands and Watercourses regulations, works toward the conservation of wetland resources through avoiding impacts from development on functional wetlands and watercourses. The Commission also seeks to restore and enhance wetlands that have been degraded.

3. Norwalk assesses the conditions of trees throughout the city, working with Norwalk Clean and Green and Norwalk Tree Alliance, and an as-needed program for tree maintenance is in place.
4. Whenever possible, Public Works examines and clears public storm drains and grates of debris during periods of rainfall, snowfall, and storms.
5. All city agencies and departments are being trained in the use of National Incident Management System (NIMS) and Incident Command System (ICS) and are an integral part of all plans and notification procedures. Indeed, Public Works, the Police Department and Emergency Management along with the Chief Executive recently established the procedures for the implementation of a snow emergency ordinance. This teamwork resulted in significant improvement of snow removal in a recent blizzard as well as reduced stress on infrastructure and emergency response systems.
6. All City departments and City-related agencies are being organized and blended into the emergency management systems as Emergency Support Functions (ESFs).

Emergency Services

Norwalk employs warning systems and emergency planning to help protect life and property before, during and after a natural disaster. For instance, the City of Norwalk Emergency Operations Plan outlines emergency procedures for natural and other disasters. Norwalk has established the position of Director of Combined Dispatch and Emergency Preparedness Planning, thus raising Emergency Management and Planning from part-time to an integral part of a full-time position and giving the position department head rank.

Norwalk is in the process of designing and building a new Fire Station at the site of the existing Volk Station, the new facility will include a state of the art Emergency Operations Center (EOC). This facility will be connected to all public buildings including schools throughout the community via a fiber optic network now being installed.

The City is training at all levels in the NIMS and the ICS. The City will be NIMS compliant later this year. Norwalk continues to mitigate potential hazards as described below and has made these actions a part of everyday actions as such agencies as Building and Zoning and is integrating long range emergency planning into these departments via the emergency planning department.

Public Education

The City of Norwalk has undertaken a number of projects and initiatives to help improve public awareness of the City's vulnerability to natural disasters. The City successfully launched the "Plan 9" campaign, which provided information on nine important items to have during a disaster, informational materials were printed on water bottles, reusable bags and brochures, which were distributed across the City. A number of other brochures and information are posted on the emergency management website. Norwalk has also worked to ensure that information is available to all members of the public. Extra efforts have been taken by the city to reach out to vulnerable populations. The Office of emergency mangement works closely with community organizations and many of educations brochures are available in several other languages.

Norwalk also uses the "Notify Norwalk System" as a means to notify and alert residents in the event of an emergency. The "Notify Norwalk System" allows residents to register multiple phone numbers (including mobile phones) and email addresses. An Emergency Alert Icon and webpage have also been added to the City of Norwalk's home page. When an alert is active the icon changes to flashing or solid red indicating emergency conditions exist, and information is posted on the emergency alert website.

Natural Resource Protection

Norwalk acquires open space to provide recreational opportunities and/or to help preserve or restore the functions of natural systems. For example, the *Norwalk Plan of Conservation and Development* supports a multi-use trail along the Norwalk River/Route 7 Corridor. In addition, the *Norwalk Harbor Management Plan* calls for the protection of coastal resources such as tidal ponds. Norwalk maintains a Law Enforcement marine unit that trains annually with the Department of Environmental Protection and the United States Coast Guard in coastline environmental security. The Marine unit regularly patrols the coastline and accessible river areas.

Norwalk River Watershed Initiative

Norwalk supports the goals of the *Norwalk River Watershed Action Plan* prepared in October 1998 and updated in June 2004 by the Norwalk River Watershed Initiative (NRWI). NRWI successfully implemented many aspects of its action plan including those that mitigate flood hazards. For instance, NRWI organized workshops and prepared outreach materials on stormwater and floodplain management. In addition, NRWI actively promoted open space preservation and protection adjacent to the Norwalk River and other critical areas to ensure the proper functioning of the watershed. Furthermore, a list of non-structural flood control measures was prepared for each existing flood-prone structure in the Norwalk River Watershed. Ongoing efforts were initiated to implement the non-structural measures. Lastly, NRWI has explored the removal of the Cannondale, Merwin Meadows, and Flock Process Dams to restore the normal functioning of the Norwalk River. These dams no longer serve their intended purposes and lack flood control or protection benefits.

Challenges

1. Due to migration, many Norwalk residents have not experienced a flood, hurricane or other natural disaster and may underestimate Norwalk's vulnerability to natural hazards.
2. Norwalk is the most densely populated municipality in the South Western Region, which increases the potential loss of life and property from a natural disaster.
3. Based on land use and development patterns throughout the city, urban flooding is a chronic problem, and often occurs as a result of regular rain events.
4. The dam failure of the Browns and Grupes Reservoir Dams would result in catastrophic loss in the Silvermine Watershed and lower Norwalk River Watershed. These dams have sound structures, but the flood spillways of the Browns and Grupes Reservoir Dams do not meet State standards. The States of Connecticut and New York recommend dam improvements to address these deficiencies.

Proposed Mitigation Strategies

Norwalk personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the review and development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?

- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation contribute to continued compliance with NFIP?
- What is the anticipated time frame for implementation?

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Norwalk's planning process can be found in Appendix C and Appendix D respectively.

Norwalk Mitigation Strategies

Goal *Reduce the loss of life and property and economic consequences as a result of flooding, high winds, severe winter storms and dam failure.*

Objective ◇

Improve the ability of Norwalk departments to prepare and respond to severe weather and other natural emergencies.

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Provide adequate back-up generators at critical facilities.	Multiple	High	Pending Funding Availability	All
	• City Hall		Low		
	• Sanitary sewer pumping stations (in progress)		High		
	• Storm water pumping stations		Medium		
	• Shelters (shelter area and beyond). BMHS/NHS done		High		
	• Alternate EOC at Norwalk Fire Dept		High		
2.	Ensure the ability of Departments to function beyond first 24 hours by executing pre-positioned contracts for logistical support.	OEM Purchasing/ Finance	High		All
3.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, but encourage development (especially higher density) to be located outside flood-prone areas wherever possible, including increased setbacks to account for sea level rise .	P&Z	High		Flooding

Ongoing Practices	Who	Priority*	Hazard Addressed
Continue to maintain an emergency telephone notification system that allows the municipality to alert various segments of the population depending on the nature of the emergency. Encourage residents and businesses to update their contact information within the system.	OEM	High	All
Plan for the activation of the Emergency Operations Center and an alternate location, including equipment and staff with trained personnel.	OEM	High	All

	Identify and prepare and/or update site-specific emergency evacuation plans for critical facilities such as Norwalk Hospital, King Industries, Merritt 7, Norden Place office park and other significant complexes as well as the gas pipeline.	*Public Safety*	*Medium*	*All*
	Perform hazard analysis at WWTP/DPW center to identify areas of concern.	*DPW*	*Medium*	*All*
	Evaluate municipalities' sheltering and evacuation needs and how these needs can be met through local and regional sheltering concepts.	*OEM*	*Medium*	*All*

Objective

◇ *Through education and outreach activities, improve the ability of Norwalk residents and business to prepare and respond to severe weather and other natural emergencies.*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Add natural hazards information to the annual Fire Dept Open House, web site and the public access channel.	*OEM*	*High*	*All*
Identify special-needs populations for various hazards.	*Public Safety*	*Medium*	*All*
Provide presentations and workshops to community groups, non-profits and businesses to increase their ability to prepare and respond to emergencies.	*OEM*	*High*	*All*

Objective

◇ *Whenever practical, incorporate natural hazard mitigation strategies into existing City projects.*

	Supporting Recommendation	**Who**	**Priority***	**Potential Funding Source**	**Hazard Addressed**
1.	Expand maintenance activities such as more frequent catch basin, storm drainage facilities and channel cleaning	*DPW*	*High*	*Pending Available Funding*	*Flood*
2.	Request capital funding for drainage and flood mitigation projects throughout the City.	*DPW*	*Medium*	*Capital Improvement*	*Flood*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Increase homeowners' awareness about mitigation activities.	*OEM*	*Medium*	*All*

Objective ◇ *Reduce the likelihood and potential loss of life and property as a result of dam failure.*

Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1. Upgrade the flood spillway of the Browns and Grupes Reservoir Dams.	*1st District Water*	*Low*	*1st District Water*	*Dam Failure*

Objective ◇ *Reduce the amount of debris from severe storms through preventive tree maintenance and debris planning*

Ongoing Practices	Who	Priority*	Hazard Addressed
Encourage more citizen participation to inventory and identify condition of street trees and integrate with City's GIS to optimize tree	*DPW*	*Medium*	*Severe Storms, Tornado, Earthquake*
Continue to fund the citywide tree planting and maintenance program. Assess condition of trees and work with Norwalk Tree Alliance in this effort.	*DPW*	*Medium*	*Severe Storms, Tornado, Earthquake*
Prepare and maintain a debris management plan	*DPW*	*Medium*	*Severe Storms, Tornado, Earthquake*
Replace diseased trees, plant new trees and improve street tree maintenance	*DPW*	*Medium*	*Severe Storms, Tornado, Earthquake*

Stamford

Existing Mitigation Strategies

Prevention

The City of Stamford uses land use regulations to minimize the impacts of new development on the natural drainage system, to ensure the proper functioning of critical facilities during floods and to ensure appropriate development in floodplains. Early in 2010 Stamford revised the existing flood damage prevention regulations in accordance with the most recent state DEP and FEMA requirements. Changes in regulations coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

These land use regulations are enforced by the Land Use Bureau, the Engineering Bureau, the Environmental Protection Board, the Zoning Board, Zoning Board of Appeals, Zoning Enforcement Officer, and in some instances, the Connecticut Department of Environmental Protection.

In addition to land use regulations, Stamford has several ongoing activities that help reduce the likelihood of floods. For instance, the Highway Department performs regular maintenance and inspections of the drainage system. As part of Stamford's capital improvement program, it installs storm drains, catch basins, and curbs to increase drainage efficiency and to upgrade the infrastructure. Furthermore, the Citizens Service Bureau in the Operations Department records all complaints about drainage issues, forwards complaints to Highways or Engineering as is appropriate and keeps records of the work done.

Public Education and Awareness

The following public education and outreach efforts help Stamford increase awareness about flood-prone areas and flood preparedness.

1. The Environmental Protection Board sends out a flood preparedness brochure to all 4,600 residents living within the floodplain annually.
2. The Environmental Protection Board provides Flood Insurance Rate Map (FIRM) information to people who inquire, and publicizes this service by writing annually to the realty and insurance organizations.
3. The Environmental Protection Board assembled flooding and flood protection publications, recommended by the Federal Emergency Management Agency (FEMA) that the public library has entered into its cataloging system.

Stamford's Department of Health worked with the Red Cross to complete a shelter plan for the city that includes a map showing shelters and mass vaccination/medical supply distribution sites along with floodplains, critical facilities and vulnerable populations. The City has also launched a "Be Prepared Stamford" website (www.bepreparedstamford), which is linked to the City's homepage. The site provides information on preparing for and responding to various hazards and natural disasters, as well as public health information.

Emergency Services

Stamford takes the following multi-faceted approach to help protect life and property before, during and after a natural disaster.

1. An automated flood warning system monitors the Rippowam/Mill, Mianus, and Noroton rivers, rainfall, and weather conditions and prepares forecasts of river levels.
2. The City installed a "Reverse 911" system in January 2009**.** It is a web-based program that uses a combination of databases and GIS technologies enabling the City to quickly target a precise geographic area and saturate it with thousands of calls, emails, and instant messages per hour. The City can also create a list of individuals with common characteristics (such as membership in a Neighborhood Crime Watch group, or emergency personnel) and contact them rapidly whenever necessary.
3. A temporary helicopter-landing zone was installed in August 2004 to allow the City to bring in heavy equipment and additional personnel when ground transportation is not viable. A permanent helicopter-landing zone will eventually replace the temporary one.
4. Stamford has made improvements to the existing Emergency Operations Center (EOC) and back up EOC, and is constructing a state of the art EOC at the police headquarters.
5. The City maintains various emergency response plans that protect life and property through pre-established procedures for responding to a natural event.

Natural Resource Protection

Natural resource protection helps preserve or restore the functions of natural systems. Altogether, the City of Stamford has over 345 acres of preserved space within flood zones. This acreage accumulated through a series of small and large open space projects. On the small side, developers conveyed land within the floodplain along Stamford Harbor/East Branch (205 Magee Ave). Afterwards, three buildings were demolished to create 3.3 acres of open space. On the large side, the City recently acquired 35 acres in 2000 to add to Mianus River Park, which is a 220-acre parcel shared by Greenwich and Stamford. In 2006, the National Park Service produced a management plan for the park, which includes trail improvement, riverbank restoration, and erosion mitigation strategies. The Friends of Mianus River Park, City staff, the National Park Service, Trout Unlimited, and the CTDEP have partnered on the completion of many of them and their work is ongoing.
In addition, Stamford is implementing the Mill River Corridor Project, which contains the following features that would reduce the City's vulnerability to floods and other natural disasters.

1. The Mill Pond Dam was removed by the Army Corps of Engineers in order to restore the natural functioning of the Mill River. The dam removal has helped to reduce both the height and extent of the floodplain in downtown, having a major impact on potential losses due to flooding.
2. Seventeen flood-prone buildings along the Mill River have been demolished or relocated between 1986 and 2000 to create open space. Since 2000, Stamford has acquired seven additional properties to be maintained as open space.
3. The City has officially accepted the former vehicular bridge on West Main Street as a pedestrian bridge, and it will be rebuilt as a pedestrian-only bridge (and emergency vehicles) above the 100-year floodplain. In addition, eight of the nine piers will be removed and the elevation of the bridge deck will be raised. Design for the renovation will begin in late 2010.

Other

Stamford has additional existing mitigation strategies that address hurricanes, drought and severe winter storms. In regards to hurricanes, a hurricane barrier in Stamford Harbor at the end of the East Branch inlet gets raised during severe storms. In regards to drought, the City Ordinance permits the Mayor to declare certain water uses to be unlawful in the event of a water emergency. For severe winter storms, the Public Services Department recently developed more efficient routes and acquired high-powered snow

blowers to accommodate heavy snowfalls like those that occurred in the winters of 1995-96, 2002-03 and 2003-04.

Challenges

The following list provides insight into the specific challenges that Stamford faces in its natural hazard mitigation efforts.

1. Holly Pond is in need of dredging, particularly north of Mathew Street up to East Main Street. The cost to dredge Holly Pond was estimated to cost $12-16 million. Currently funds do not exist within the City's budget to cover the cost of dredging.
2. The seawall along this section of Holly Pond is in need of repair, which can not be done until Holly Pond is dredged.
3. The Public Services Department would like to acquire a 1-acre piece of property currently being used as a junkyard. This property is just south of downtown at 128 Magee Ave., next to I-95, and located in the middle of public services facilities including a sewage treatment plant, Public Services vehicle maintenance garage, and a regional firefighters training center. The property could be used in conjunction with snow-melting machines and a storm-filtering station to serve as a melting station for excess snow. In addition, the property could be used as a staging area for large wood waste and for uniformed services.
4. The Parks Maintenance Department lacks the resources or equipment necessary to perform preventative tree maintenance.
5. The Mill River Corridor Project is very ambitious and will require diverse funding sources to accomplish all the action items such as those listed below.
    a. The City is seeking funds to rebuild the closed vehicular West Main Street Bridge as a pedestrian bridge with a walking surface above the 100-year floodplain level. The City is preparing a contract for design of the replacement bridge, and there is $1.5 million in place from ISTEA funding to build it, although this is not likely to be sufficient to meet the actual cost.
    b. Although a number of key properties were purchased and structures cleared, several critical properties, both residential and commercial, remain to be acquired. They include two commercial properties (0.25 acres total) and three residential properties (4 acres total). Thus far, the properties have been purchased with a combination of city funds, CTDEP open space grants, and Federal NOAA grants. The City plans to pursue similar funding sources for the remaining properties.
6. The City wants to widen and raise the I-95 overpasses at Atlantic Street, Canal Street and Elm Street. These bridges range in height from 12 feet 6 inches to 13 feet and 1 inch and are subsequently too low for many trucks. In addition, these bridges are vulnerable to flooding, and the drainage issues would be addressed during the course of renovation.
7. The City of Stamford works to regularly maintain and service the storm drain system, and to monitor complaints received by citizens; however an improved recordkeeping system is needed to track complaints and maintenance, which can be accessed by other city departments as needed.
8. The stormwater runoff systems cannot currently handle 50-year storms. In general, the City needs to improve storm drain maintenance (inlets, outlets, culverts, and catch basins), maintain better records on the maintenance of the storm drainage infrastructure, and try to eliminate cross connections between the sanitary and storm systems.

9. Address drainage problems at the I-95 overpasses (between I-95 and Metro North train lines) located at Atlantic Street, Canal Street, and Elm Street. There is currently a feasibility study being done.
10. In the event of a natural disaster, over ten departments may need to provide a coordinated response. While there is a protocol for snow emergencies, additional protocols need to be developed for hurricanes and severe storms.
11. Some repairs were made in 2000 on the seawall at the south end of the Noroton River on Weed Avenue between Mathews Street and Cove Road; however, additional recommended repairs have been put on hold due to limited resources.

Proposed Mitigation Strategies

Stamford personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation contribute to continued compliance with NFIP?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- What is the anticipated time frame for implementation?

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Stamford's planning process can be found in Appendix C and Appendix D respectively.

Stamford Mitigation Strategies

Goal. *To reduce the loss of life and property and economic consequences as a result of natural disasters.*

Objective 1. ◇ *Improve the City of Stamford's ability to prepare for and providing emergency and other public services in the event of a natural disaster.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Continue to hold annual meetings with departments that may need to respond to natural disasters, focused on sharing information, coordination and to develop protocols.	*EM*	*High*	N/A	*All*
2.	Update the EOC plan book with current contact information for "key" department personnel, resources and facilities; and all pertinent maps and city plans. Provide copies to each department head and "key" staff.	*EM, Operations*	*High*	*TBD*	*All*
3.	Quarterly review and update the EOC plan book.	*EM, Operations*	*High*	*TBD*	*All*
4.	Develop a secure website to be used to share data and information with emergency management and the EOC during a natural disaster.	*EM, TMS, Operations*	*Low*	*TBD*	*All*
5.	Work with police to improve communication shared information between the newly designed EOC at police headquarters and the existing EOC in the Government Center.	*EM, Police, Operations*	*Medium*	*TBD*	*All*
6.	Evaluate the 911 center's ability to function during an emergency or natural disaster and increase and cross train personnel to accommodate the city's needs during a disaster.	*EM, Operations*	*High*	*TBD*	*All*
7.	Work with 911 center and emergency management to develop a system to handle call backs and coordination; and improve direct communications between the 911 center and emergency responders.	*EM, Operations*	*Medium*	*TBD*	*All*
8.	Work to develop a direct communications link between the EOC and 911 communications center.	*EM, Operations*	*High*	N/A	*All*
9.	Identify ways to improve the use of GIS for use in identifying areas and facilities vulnerable to disasters and for use to enhance emergency management.	*TMS, EM, Operations*	*High*	*TBD*	*All*

10.	Refine and provide usable sewer and drainage system maps to EOC and Emergency responders.	*TMS, EM, Operations*	*High*	*TBD*	*All*
11.	Ensure that all critical systems maps are easily accessible to 911 and the EOC.	*EM, TMS, Operations*	*Medium*	*TBD*	*All*
12.	Develop evacuation plan and routes for moving traffic north-south, and east-west in the event of a large scale disaster. Also consider how signal timing will be handled if trained staff are not available.	*EM, Operations, LU, Engineering*	*Low*	*TBD*	*All*
13.	Continue working with the Red Cross to maintain and update the city's shelter plan.	*LU, EM*	*Medium*	*TBD*	*All*
14.	Evaluate current sheltering location's ability to handle large scale evacuations.	*EM, Operations, LU, Engineering*	*Low*	*TBD*	*All*
15.	Develop a sheltering/evacuation process to improve collaboration between the Health Department, Operations, Fire and Police and review the process regularly to ensure each department knows there responsibilities and where resources are located.	*EM, Operations, Fire, Police, Red Cross*	*Low*	*TBD*	*All*
16.	Explore having pre-recorded messages for a variety of scenarios for use by the City's Reverse 911 system.	*EM, DoEC*	*Low*	*TBD*	*All*
17.	Consider having pre-recorded messages available in additional languages.	*EM, DoEC*	*Low*	*TBD*	*All*
18.	Develop information educating citizens on registration and use of the emergency notification system and investigate the possibility of providing information in other languages.	*EM*	*Medium*	*TBD*	*All*
19.	Work with DEMHS to enhance training and exercises on disaster responses and education on property damage assessment forms.	*EM, DEMHS*	*Low*	*TBD*	*All*
20.	Reduce impervious surfaces by adopting impervious coverage allowances for all zoning districts or amending regulations to decrease need for impervious surfaces.	*LU*	*Medium*	*TBD*	*Flooding, Hurricanes, Severe Storms*
21.	Acquire snow melting machines to melt excess snow from severe winter storms.	*Operations*	*Low*	*Pending Available Funding*	*Severe Storms (Winter)*
22.	Acquire the site at 128 Magee Avenue as a staging area for excess snow, large wood waste and uniformed services.	*Operations*	*Low*	*Pending Available Funding*	*All*

23.	Assess vulnerability of critical facilities to earthquakes, hurricanes, tornadoes and begin to evaluate the potential impact sea level rise may have on these facilities.	*Engineering*	*Low*	*TBD*	*Earth Quake, Hurricane, Tornado, Sea Level Rise*
24.	Begin to investigate potential impacts resulting from sea level rise.	*LU*	*Low*	*TBD*	*Sea Level Rise*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
"Be Prepared Stamford" website (www.bepreparedstamford), was launched, with a link on the City's home page. The site gives information on being prepared for and responding to a disaster, includes fact sheets on various hazards, and provides public health information.	*HD, Red Cross*	*Low*	*All*

Objective 2. ◇ *Whenever practical, incorporate natural hazard mitigation strategies into existing City projects and plans.*

	Supporting Recommendation	**Who**	**Priority***	**Potential Funding Source**	**Hazard Addressed**
1.	Continue to incorporate recommendations from the Mill River Corridor Plan.	*LU, Grants, MRC*	*Low*	*FEMA, ACOE, CTDEP*	*Flooding*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Incorporate natural hazard awareness, mitigation activities and preparedness into public outreach efforts.	*HD*	*Low*	*All*
Encourage were ever possible the under-grounding of utility lines to minimize service disruptions due to inclement weather. Require all new development and subdivisions install underground utilities.	*LU*	*Medium*	*Severe Storms, Hurricane, Tornado*
Review the Mill River Corridor Project and identify projects that may be eligible for FEMA natural hazard mitigation grants.	*LU, Grants*	*Medium*	*Flooding*

Objective 3. ◇ *Reduce the likelihood of floods.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Move forward with plans to rebuild the West Main Street Bridge for use by pedestrians and emergency vehicles only. Plans shall include elevating the bridge deck above the 100-year flood plain and removing several piers.	*City of Stamford*	*Medium*	*TBD*	*Flooding*
2.	Encourage acquisition of wetlands beneficial to the City.	*LU, Grants*	*Low*	*TBD*	*Flooding*
3.	Encourage the preservation of undeveloped lands within the 100-year flood zone with the use of Open Space purchase, donation or conservation easement.	*LU, Grants*	*Low*	*TBD*	*Flooding*
4.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, but encourage development (especially higher density) to be located outside flood-prone areas wherever possible, including increased setbacks to account for sea level rise.	*LU*	*High*	*TBD*	*Flooding*
5.	Pursue acquisition of waterfront land and easements when opportunities arise.	*LU, Grants*	*Low*	*TBD*	*Flooding, Hurricane, Sea Level Rise*
6.	Enhance storm drain maintenance activities.	*Operations*	*High*	*TBD*	*Flooding*
	• Maintain records for storm drain maintenance.			*TBD*	
	• Continue to work to increase frequency of storm drain clean out.			*TBD*	
	• Continue to identify and eliminate cross connections between storm and sanitary sewer systems.			*TBD*	
7.	Continue to provide capital budget funds for drainage projects and investigation of drainage problems.	*BOF*	*High*	*TBD*	*Flooding*
8.	Ensure that redevelopment reduces runoff from current conditions.	*LU*	*Medium*	*TBD*	*Flooding*
9.	Continue to encourage best management practices, including innovative Low-Impact Development (LID) practices, for managing stormwater runoff.	*LU*	*Low*	*TBD*	*Flooding*
10.	Work with Aquarion and the state to evaluate and monitor conditions of all dams and to identify properties that may be impacted by a dam failure for all high risk dams in Stamford.	*Engineering, CTDEP, Aquarion*	*Medium*	*TBD*	*Dam Failure*

Objective 4. ◇ *Reduce the frequency and severity of power outages and road closures as a result of storm events.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Support applications and use for tree management software by the parks department to ease the burden or responding to complaints; improve preventative maintenance for use as an overall planning tool.	*Parks, Operations, LU, Grants*	*Medium*	*Capital Budget/FEMA*	*Severe Storms, Hurricane, Tornado*
2.	Work with the City Operations, Parks and Highways Dept. staff, and Connecticut Light and Power staff, to develop a plan for clearing debris in the event of a severe storm.	*EM, Operations Parks, Engineering,*	*Low*	*TBD*	*Severe Storms, Hurricane, Tornado*
3.	Work with utility companies to improve communications during a storm event and identify a direct contact.	*Operations, Parks, Utilities*	*High*	*N/A*	*Severe Storms, Hurricane, Tornado*
4.	Explore methods to improve and enhance telecommunications.	*EM*	*Low*	*N/A*	*All*
5.	Encourage the study of alternative systems for delivering reliable power to residents.	*LU*	*Low*	*TBD*	*Severe Storms, Hurricane, Tornado*
6.	Work with DEMHS to complete and enhance the state and regional debris management plan and to address local needs.	*Operations, EM*	*Medium*	*N/A*	*Severe Storms, Hurricane, Tornado*
7.	Conduct a town-wide inventory and assessment of street trees; consider conducting the inventory in conjunction with other municipalities in the region.	*Parks*	*Medium*	*Capital Budget*	*Severe Storms, Hurricane, Tornado*
8.	Continue to commit capital funding annually for public tree maintenance and plantings.	*Parks, BOF*	*Medium*	*Capital Budget*	*Severe Storms, Hurricane, Tornado*

Ongoing Practices	Who	Priority*	Hazard Addressed
Continue with preventative tree maintenance.	*Parks*	*Medium*	*Severe Storms, Hurricane, Tornado*

Who: BOF = Board of Finance; CTDEP = CT Department of Environmental Protection; DoEC= = Department of Emergency Communications; DEMHS = CT Department of Emergency Management and Homeland Security; EM = Emergency Management; Engineering = Engineering Bureau; Grants = Grants Administration Office; HD = Department of Health; LU= Land Use Bureau; MRC = Mill River Collaborative; Operations = Office of Operations; Parks = Parks Department; TMS = Technology Management Services; Utilities = Local Utility Companies.

Weston

Introduction

Weston is the least populated municipality in the Region. According to the 2000 Census of Population and Housing, Weston had a total population of 10,037 persons and a population density of 507 persons per square mile. Weston has worked to preserve its rural charm through minimum 2 acres zoning and a limited commercial area. Like New Canaan and Wilton, it lacks coastal frontage, but like the rest of the region continually experiences flooding as a result of even moderate rain events. Weston is vulnerable to severe winter storms, hurricanes and other high wind events. Drought is another significant hazard in the Town of Weston. As there is no public water supply serving the town, the potential for health consequences is high, and low water levels may impact the fire departments ability to respond. In addition, Weston could experience tragic loss in the event that the Samuel Senior Dam fails; this dam impounds the Saugatuck River and has a storage capacity of 42,000 acre feet of water.

Existing Mitigation Strategies

Weston uses regulations as a proactive means to protect the normal functioning of the natural drainage systems and to prevent inappropriate development in floodplains. These local ordinances comply with FEMA guidelines intended to mitigate flood damage. For example, all exterior walls are required to be designed to collapse outward, instead of inward and all electrical equipment must be elevated above the 100-year base flood level. The Conservation Commission enforces inland wetlands regulations that minimize intrusion in or near wetland areas. These regulations minimize the potential for damage to the environment with the additional benefit of reducing property damage in the event of a flood. Furthermore, the Building Inspector ensures conformance with the Connecticut State Building Code including flood resistant construction and with elevation certification (Section 3107). These land use and building regulations are available through Weston Town Hall and have been posted on the Town's website.

Early in 2010 Weston revised the existing flood damage prevention regulations in accordance with the most recent state DEP and FEMA requirements. Changes in regulations coincided with adoption of the Updated Flood Insurance Rate Maps (FIRM) for Fairfield County. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

In addition, Weston is diligent about maintaining its roadways and storm culverts. Weston budgets for scheduled road maintenance and repaving and maintains a year-round maintenance schedule for all storm culverts in the municipality. In addition, the Police Department conducts an annual review of road and accident data to determine if engineering changes to roads could reduce accidents. For example, one review led to improvements on Route 57 where flooding occurred even after a moderate storm. Lastly, the Department of Public Works is equipped to remove fallen trees and branches from the roadways.

Weston is poised to respond to emergency conditions including those invoked by a natural event. Weston's "Emergency Operations Team" is made up of more than two-dozen officials including police, public works, the Executive Director of the Weston-Westport Health District, certain private aid groups, and other municipal personnel. The Town of Weston has a two-phase plan that coordinates emergency communications in the most efficient manner to mitigate risks and protect the Town. Emergency response is greatly facilitated by the centralized municipal complex that hosts its Police, Fire Department, EMS, Town Hall and schools. In fact, a school serves as the current emergency shelter, and the new

intermediate school building was designed with storm resistant interior corridors to provide a sturdy emergency shelter.

Besides the Town of Weston, Aquarion Water Company of Connecticut is also involved in reducing the risk of natural hazards in the municipality. Aquarion owns the Samuel Senior Dam. Aquarion implements a preventative maintenance schedule on the dam and its infrastructure. In addition, the Samuel Senior Dam has a relief valve between it and the Hemlocks Reservoir in Easton so that Aquarion can change the level of water in either reservoir.

Weston uses public awareness and involvement to help reduce the loss of life and property. For instance, Weston encourages its residents to participate in the volunteer fire department and emergency medical services squad. Each year, the League of Women Voters of Weston organizes an event called "Speak Up" where all Town Boards and Commissions, Westport-Weston Health District, fire and police department leaders and the Board of Selectmen meet the public. At this forum, ordinary citizens often come forth with specific suggestions about mitigating natural hazards on both small and large scale.

Challenges

The Town of Weston relies on a volunteer fire department and an emergency medical services squad to provide 24/7 coverage. Fortunately, volunteers continue to step up to provide these life support services willingly and without salary. Weston provides incentives to volunteers through property tax relief and inclusion in Weston's medical plan. Nevertheless, it is a major challenge to keep Weston the kind of community where "neighbors help neighbors" (the EMS expression).

Like many other municipalities, Weston is experiencing a steady increase in automobile traffic on state highways. The increased traffic volume has also impacted emergency response, particularly along Route 57. Congestion at the intersection of Route 57 with School House Road continually hinders passage of emergency vehicles and during a severe storm event may prevent access to the emergency shelter. The intersection of Route 57, Route 53 and Georgetown Road is another area that provides a challenge for emergency responders. In addition to congestion, the geometry of the intersection creates an obstructed view and is difficult for emergency vehicles to maneuver through. This increase in traffic volume may lead to an increase in accidents including weather-related incidents and may exacerbate the impacts of closed roads due to fallen debris.

Due to mitigation and recent weather patterns, many Weston residents have not experienced a hurricane or other natural disaster and may underestimate Weston's vulnerability to natural hazards. The Town is working to increase awareness of the community's vulnerability to natural disasters.

Proposed Mitigation Strategies

Weston personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?

- Does the supporting recommendation contribute to continued compliance with NFIP?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- What is the anticipated time frame for implementation?

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Weston's planning process can be found in Appendix C and Appendix D respectively.

Weston Mitigation Strategies

Goal *To reduce the loss of life and property and economic consequences as a result of natural emergencies*

Objective 1. ◇ *Whenever practical, incorporate natural hazard mitigation strategies into existing City projects.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Weston's Beautification Committee and public works should work with residents on proper tree maintenance to minimize debris created during a storm event.	*DPW, BOS, Beautification Committee*	*Low*	*TBD*	*Severe Storm, Hurricane*
2.	Town Government should actively seek opportunities to purchase or solicit the donation of additional open space, particularly properties located within the flood plain	*BOS, CC*	*Medium*	*TBD*	*Flooding*
3.	Begin to investigate how sea level rise and climate change may impact the community	*CC, P&Z*	*Low*	*TBD*	*Sea Level Rise*
4.	Implement recommended improvements from the Route 57 and School Road engineering study to ensure safe access to emergency shelters and to facilitate emergency response.	*DPW*	*Medium*	*CTDOT, FHWA*	*All*
5.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, but encourage development to be located outside flood-prone areas wherever possible, including increased setbacks to account for sea level rise.	*CC, P&Z, DPW*	*High*	*TBD*	*Flooding, Severe Storm*
6.	The Conservation Commission should explore LID methodology and, together with the Planning and Zoning Commission, promulgate regulations for Weston that embrace that approach, including revisiting and strengthening regulations controlling changes in rates and direction of runoff from roadways and lots; encouraging retention of existing forests, outcrops, ridges and stone walls; urging selective rather than clear cutting of trees; and updating the Weston Environmental Resources Manual	*CC, P&Z*	*Medium*	*TBD*	*Flooding*

7.	Develop a GIS application to assist personnel in the event of an emergency or natural disaster.	*BOS, EM*	*High*	*TBD*	*All*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Publish all Town Ordinances on the Town website including those that mitigate natural hazards.	*BOS*	*Medium*	*All*

Objective 2. ◇ *Continue and expand current maintenance activities, inspections, and requirements.*

	Supporting Recommendation	**Who**	**Priority***	**Potential Funding Source**	**Hazard Addressed**
1.	Institute water volume monitoring program.	*BOS*	*High*	*TBD*	*Flooding, Drought*
2.	Examine possible regulation requiring engineered systems to control runoff from new subdivision roads and parking lots.	*P&Z, Building*	*Medium*	*TBD*	*Flooding*
3.	Examine possible regulation of erosion and runoff.	*P&Z & CC*	*High*	*TBD*	*Flooding*
4.	Town Government, together with the Fire Department, Police Department and Town Engineer, should promulgate regulations for all Weston roads to ensure ease of emergency access.	*DPW, P&Z, EM*	*High*	*TBD*	*All*
5.	Consider developing a town wide driveway ordinance to accommodate emergency vehicles	*P&Z, EM*	*High*	*N/A*	
6.	Consider Properties prone to flooding for elevation or acquisition as needed.	*P&Z*	*Medium*	*FEMA*	*Flooding, Severe Storm, Hurricane*
7.	Consider a town-wide investigation of culverts or bridges that may need to be replaced or repaired. Conduct necessary repairs or replacement as needed.	*DPW*	*Medium*	*FEMA*	*Flooding, Severe Storm, Hurricane*
8.	Work with DEP to enforce existing citations for dam violations	*DPW, P&Z*	*Low*	*DEP*	*Dam Failure, Flooding*
9.	Continue to monitor dam conditions and to identify any unpermitted changes to a dam structure that may impact the dam's integrity or alter the flood path.	*DPW*	*Low*	*DEP*	*Dam Failure, Flooding*
10.	Assess vulnerability of existing critical facilities to earthquakes, hurricanes, tornadoes	*EM, Building*	*Medium*	*TBD*	*Earthquake Hurricane, Tornado*
11.	Consider participation in an inter-municipal tree condition inventory.	*CC, P&Z, BOS, SWRPA*	*Low*	*FEMA, DEP, Municipal Funds*	*Hurricane, Severe storm*

Ongoing Practices	Who	Priority*	Hazard Addressed
Ensure that tree maintenance is being performed along private roads.	*DPW*	*High*	*Severe Storms, Hurricane, Tornado*

Objective 3 ◇ *Continue and expand activities related to natural hazard warning and emergency preparedness.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Continue working to expand further development of fire ponds and cisterns.	*FM*	*High*	*TBD*	
2.	Work with home owners in the vicinity of Cobs Mill Pond and Beaver Brook to remove silt and debris and consider use as fire ponds.	*DPW, FM*	*Low*	*Home Owners, Town, ACOE*	*Flooding, Severe Storm*
3.	Investigate ways to enhance telecommunication infrastructure and emergency communication throughout the town.	*P&Z, DPW, CC, EM*	*High*	*TBD*	*All*
4.	Identify equipment and resources to sustain critical facilities in the event of a disaster (i.e. obtain additional generators), and procure items as needed.	*EM*	*Medium*	*DEMHS*	*All*
5.	Work with DEMHS to complete and enhance the state and regional debris management plan.	*EM, DPW*	*Medium*	*DEMHS*	*All*
6.	Evaluate municipalities' sheltering and evacuation needs for a variety of storm scenarios.	*EM, Red Cross*	*Low*	*DEMHS*	*All*
7.	Continue to upgrade and maintain emergency notification as necessary.	*EM*	*High*	*TBD*	*All*
8.	Continue to work with DEMHS to conduct training and exercises on disaster responses and education on Property damage assessment forms.	*EM*	*Medium*	*DEMHS*	*All*
9.	Work with property owners to elevate critical systems (i.e. electrical boxes, hot water heaters etc.) in wet and flood prone areas.	*Building, P&Z*	*Low*	*TBD*	*Flooding*
10.	Encourage the study of alternative systems for delivering reliable power to residents.	*P&Z, DPW*	*Low*	*TBD*	*All*
11.	Encourage wherever possible the under-grounding of all utilities to minimize service disruptions due to inclement weather. Require all new development and subdivisions to install underground utilities.	*P&Z, DPW*	*Low*	*TBD*	*All*

12.	Enhance Community preparedness programs:	*EM, BOE*	*Medium*	*TBD*	*All*
	· Develop educational materials and brochures promoting emergency preparedness and 'best management practices' for natural resources, targeted to homeowners.				
	· Explore developing a "phased approach" to citizen preparedness (i.e. introductory brochures identifying simple and inexpensive tasks, and more advanced brochures with additional tasks and actions to be done to prepare your family and home for a natural disaster that may be more sophisticated in nature or more expensive).				
	· Provide "welcome kits" to new home owners for properties located within the flood plain, or with a significant risk of flooding.				

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Maintain emergency generators and infrastructure.	*EM*	*Medium*	*All*

Who: BOS = Board of Selectmen; CC = Conservation Commission; P&Z = Planning and Zoning Commission; BOE = Board of Education; DPW = Department of Public Works; EM = Emergency Management (Director of EM, Fire and Police); FM = Fire Marshal

Westport

Flooding

Existing Mitigation Strategies

The Town of Westport was a pioneer in flood hazard mitigation in Connecticut and participated in several FEMA mitigation programs prior to the Disaster Mitigation Act of 2000. Specifically, the flood mitigation efforts were guided by the *1995 Repetitive Loss Plan*, *1997 Hazard Mitigation Plan*, the *2000 Floodplain Management Plan*, and the Community Rating System (CRS) of the National Flood Insurance Program (NFIP). These plans proposed methods to minimize loss due to flooding through mitigation strategies in the following categories: education, flood insurance, CRS, risk assessment data, grant funded projects, regulatory improvement, stream channel and drainage system maintenance and improvement, construction and structural flood mitigation, and flood warning. In 1999, Westport was chosen by FEMA to be a Project Impact community and was awarded a $500,000 grant to implement flood mitigation strategies. Westport has made flood hazard mitigation a continuing priority as demonstrated by the proactive approach taken by the Town and the activities incorporated in town projects, plans, and daily operations.

The Town of Westport also uses regulations to protect the normal functioning of the natural drainage systems and to prevent inappropriate development in flood plains and coastal areas. Early in 2010 Westport revised the existing flood damage prevention regulations and in accordance with the most recent state DEP and FEMA requirements. Changes in regulations coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

Challenges

- Many Westport home and business owners have not resided in the town long enough to experience major flooding. Therefore, these property owners may mistakenly believe that the routine street flooding and abnormally high tides represent the extent of the effects of flooding in Westport.
- Approximately 1290 flood insurance policies are in effect in Westport. However, a vulnerability assessment indicated that approximately 3,000 structures are in flood zones. This comparison indicates a significant gap in coverage. Westport has made progress, increasing coverage of vulnerable properties. Since 2005 over 300 policies have been added.
- The FEMA Flood Insurance Rate Maps (FIRMS) and Floodway Maps are the most widely used means of assessing the risk of flooding associated with a property. The recent FIRM map update (Fairfield County maps effective June 2010) have addressed many of problems and discrepancies associated with the previous maps. However, there are still sections of Westport represented by unnumbered A Zones (zones for which elevations have not been determined) that may be vulnerable to flooding.
- Some of the undeveloped land in flood prone areas is not protected against future development. In addition, some repetitive loss properties cannot be easily protected against future damage from floods.
- In June 1988, the Army Corps of Engineers released a report entitled, “Water Resources Study – Long Island Sound, Tidal Flood Management West Central Connecticut”. This report identified

three areas most affected by tidal flooding: Compo Beach, Old Mill Beach, and Saugatuck Shores. In its assessment of mitigation opportunities, the report concluded that relocation of homes out of this area was not feasible due to the "large size and market value associated with many of the homes, in addition to the problem of moving people from what they consider to be a very desirable location". The report emphasized that elevating homes, flood warning, and evacuation would be more effective in reducing flood damage and loss of life.

- Sasco Creek experiences significant ice jamming problems in the vicinity of Grist Mill Lane and the adjacent Aspetuck Land Trust parcel to the south. Although ice jams deep within the Land Trust parcel are generally not a problem and are looked upon as a natural occurrence, jams due to debris at the north end of the parcel sometimes create flooding threats to several upstream properties on Grist Mill Lane.
- Pussy Willow Brook is in danger of ice jams similar to those experienced on Sasco Creek. The areas of Pussy Willow Brook that could experience ice jamming are on private property.
- Though Project Impact funds were used to evaluate and prepare plans for repair of the Bulkley Pond dam, it is privately owned and the likelihood of repair by the owner is slim given the cost. This leaves several dozen properties downstream vulnerable in the case of dam failure and the loss of valuable wildlife habitat that has been present for more than 200 years.
- It is still a problem that several areas in town were not studied during the preparation of the FIRMS. This leads to known areas of town susceptible to flooding because our floodplain regulations do not apply.

Proposed Mitigation Strategies

Westport personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation contribute to continued compliance with NFIP?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- What is the anticipated time frame for implementation?

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Westport's planning process can be found in Appendix C and Appendix D respectively.

Westport Mitigation Strategies

Proposed Mitigation Strategies - Flooding

Goal. *Reduce the loss of life and property as a result of floods.*

Objective 1. ◇ *Educate the public in the areas of storm damage potential, mitigation activities and preparedness.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Provide "welcome kits" to new home owners for properties located within the flood plain, or with a significant risk of flooding.	*EM, CC*	*Low*	*TBD*	*Flooding*
2.	Encourage landowners to retain storm water, such as using rain barrels or planting rain gardens.	*CC*	*Medium*	*N/A*	*Flooding*
3.	Encourage private property owners in the potentially troubled areas to properly maintain the stream channel. If necessary, Westport can pursue clearing rights on these parcels using provisions of the state drainage statutes.	*CC, DPW*	*Low*	*N/A*	*Flooding*

Ongoing Practices	Who	Priority*	Hazard Addressed
Adopt a Natural Hazards Awareness Week complete with public outreach activities focused on flooding and other natural hazards.	*EM*	*Medium*	*Flooding*
During the Natural Hazards Awareness Week, conduct an annual workshop so that residents, business owners, insurance and real estate agents, and all interested parties can familiarize themselves with functions of a floodplain, the laws governing development in a floodplain, mitigation alternatives, and precautions necessary for living in flood prone areas.	*EM, P&Z*	*Medium*	*Flooding, Severe Storm, Hurricanes*

Objective 2. ◇ *Acquire flood prone properties and those which provide valuable recreational opportunities, and flood storage potential and benefit the greatest number of Westport residents.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Identify properties prone to flooding that may be considered for elevation or acquisition; consider implementing as necessary or as funding becomes available.	*P&Z, CC, DPW*	*Low*	*FEMA*	*Flooding*

Ongoing Practices	Who	Priority*	Hazard Addressed
Review the Westport Plan of Conservation and Development and other relevant plans to identify open space projects that preserve or restore the functions of natural systems and may be eligible for funding under mitigation grants.	*CC, P&Z*	*Medium*	*Flooding*

Objective 3. ◇ *Use town regulations and ordinances to minimize the impacts of new development on the natural drainage system and to ensure appropriate development occurs in floodplains.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Identify and publicize regulations that will preserve and protect watercourses, waterbodies, wetlands, steep slopes, and floodplains, and those that will conserve floodplain fringe areas, wellhead areas, areas of high groundwater availability, and unique/special habitat areas.	*P&Z*	*High*	*N/A as staff & resources permit*	*Flooding*
2.	Further control building in floodplain areas.	*P&Z*	*High*	*N/A as staff & resources permit*	*Flooding*
3.	Minimize the amount and intensity of development in coastal "V" flood zones: Eliminate new non-water dependent development from "V" zones and only allow new structures that meet current "V" zone construction.	*P&Z*	*Medium*	*N/A as staff & resources permit*	*Flooding*
4.	Require, to the extent possible, minimization of site imperviousness, maintenance of natural buffers, and use of natural drainage systems.	*CC, Staff*	*Low*	*N/A as staff & resources permit*	*Flooding*

5.	Change the floodplain regulations to require at least one foot of freeboard for new or substantially improved homes.	*P&Z, Town*	*High*	*N/A as staff & resources permit*	*Flooding*
6.	Require approval and drainage review before clear cutting for new and redevelopment, especially near steep slopes or with a certain percentage of impervious surface.	*P&Z, CC, IWC, RTM, DPW*	*Medium*	*N/A as staff & resources permit*	*Flooding*
7.	Reduce impervious surfaces by adopting impervious coverage allowances for all zoning districts or amending regulations to decrease need for impervious surfaces. Ensure that redevelopment reduces runoff from current conditions.	*CC, P&Z, DPW*	*Low*	*N/A as staff & resources permit*	*Flooding*
8.	Recommend strengthening regulations to include requirements to maintain vegetation in riparian and flood prone areas.	*CC, P&Z, IWC*	*Medium*	*N/A as staff & resources permit*	*Flooding*
9.	Recommend strengthening regulations to include requirements to prevent mowing of tidal wetlands.	*CC, P&Z, IWC*	*Medium*	*N/A as staff & resources permit*	*Flooding*
10.	Review and make appropriate changes to regulations concerning impervious surface cover in flood prone areas.	*CC, P&Z,*	*Medium*	*N/A as staff & resources permit*	*Flooding*
11.	Review and modernize flood sections of the Building Zone Regulations and add standards for riverine flooding, taking into consideration the cumulative effect of development.	*CC, P&Z,*	*Medium*	*N/A as staff & resources permit*	*Flooding*
12.	Study the use of V-Zone standards for foundation design in coastal A-Zones.	*CC, P&Z, Building*	*Medium*	*N/A as staff & resources permit*	*Flooding*
13.	Review the existing Waterway Protection Line ordinance and consider amendments that place the responsibility for stream channel maintenance on the property owner and give Westport enforcement power. Such ordinances would include stream dumping, channel maintenance, and land clearing disturbances. These ordinances would reduce the likelihood of localized flooding and could lead to additional points toward CRS reclassification.	*CC, DPW*	*Medium*	*N/A as staff & resources permit*	*Flooding*
14.	Evaluate the zoning regulations for ways to reduce land coverage and building size.	*P&Z, Town*	*Medium*	*N/A as staff & resources permit*	*Flooding*

Ongoing Practices	Who	Priority*	Hazard Addressed
Regularly review subdivision regulations and make appropriate changes to encourage alternatives to placing lots in flood prone areas and to minimize impermeable ground coverings, if necessary.	*P&Z*	*Medium*	*Flooding*
Regularly review subdivision regulations and make appropriate changes that place further limitations on areas of impermeable surfaces in new subdivision developments in flood prone areas.	*P&Z*	*Medium*	*Flooding*

Objective 4. ◇ *Expand maintenance activities and execute specific projects that alleviate riverine related flooding in addition to the restoration and improvement of natural floodplain and wetland areas.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Address Saugatuck River, Sherwood Mill Pond and Sasco Creek/ Pond maintenance and management with strategies to address silting.	*SMPC, SCPC, CC,PRC*	*High*	*TBD*	*Flooding*
2.	Undertake preparation of an update to the 1970 master drainage plan (the "Jackson" study).	*DPW, RTM*	*Low*	*TBD*	*Flooding*
3.	Identify and address storm drainage and flooding issues on private property and in the streets.	*DPW, RTM*	*High*	*TBD*	*Flooding*
4.	Address the effect of groundwater on drainage.	*DPW, RTM*	*High*	*TBD*	*Flooding*
5.	Include provision for street drainage improvements and maintenance projects in the municipal budget on an annual basis.	*RTM, BOF*	*High*	*TBD*	*Flooding*
6.	Work with CTDOT and DEP to maintain flow of streams through expansive wetlands.	*CC*	*Medium*	*TBD*	*Flooding*
7.	Maintain catch basins regular maintenance schedule, develop a plan for dealing with backups/failing.	*DPW*	*High*	*TBD*	*Flooding*
8.	Westport will encourage the Aspetuck Land Trust to initiate a maintenance program for Sasco Creek as it passes through their property, in an attempt to foster an understanding that maintaining a clear channel in the northern section of the parcel will reduce flooding occurrences on Gristmill Lane. If necessary, Westport can pursue clearing rights on this parcel using provisions of the state drainage statutes.	*DPW, CC Aspetuck Land Trust*	*Low*	*TBD*	*Flooding*

Objective 5. ◇ *Mitigate against flood damage by undertaking cost effective structural projects.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Undertake a comprehensive study with state and federal agencies to recommend specific strategies for effective erosion abatement.	*CC, Staff*	*Low*	*DEP*	*Flooding*

Objective 6. ◇ *Improve and expand current flood warning systems and flood response procedures.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Investigate and pursue the purchase of an automated sand bagger.	*EM*	*Medium*	*TBD*	*Flooding*
2.	Identify funding sources and install additional staff gauges for smaller streams, including (but not limited to) Sasco Creek, Muddy Brook and Upper Willow Brook.	*EM*	*Medium*	*ACOE*	*Flooding*

Objectives:
- ◇ *Westport will endeavor to support increased awareness and purchases of flood insurance.*
- ◇ *Increase Westport's CRS rating to further reduce flood insurance premiums.*
- ◇ *Work with FEMA to include more detailed data on the Flood Insurance Rate Maps and Floodway Maps, particularly in unnumbered A-Zones.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Provide the updated FIRM maps and information on the National Flood Insurance Program on the Town's website.	*P&Z, IT*	*Medium*	*N/A*	*Flooding*
2.	Request that FEMA continue to work to improve the accuracy of the updated FIRM maps, with special attention paid to unnumbered A-zones.	*DPW, CC, P&Z*	*Medium*	*N/A*	*Flooding*
3.	Provide new data to FEMA as it becomes available to enhance efforts already under way.	*DPW, CC, P&Z*	*Low*	*N/A*	*Flooding*

Ongoing Practices	Who	Priority*	Hazard Addressed
Make necessary changes to the Floodplain Zoning Regulations so that all insured residents can be eligible for the additional mitigation coverage (coverage for increased cost of compliance with flood regulations).	*P&Z, DEP*	*High*	*Flooding*

Severe Storms and Tornadoes

Severe storms—which includes hurricanes, tropical storms, tornadoes, severe thunderstorms, severe winter storms (blizzards and ice storms), nor'easters and other coastal storms —are characterized by intense precipitation and damaging winds that often cause costly property damage and business disruption through power outages and road closures. Although flooding in the region is often associated with severe storms, the following strategies focus on damaging winds and tornadoes, rather than on flooding which was addressed in the previous section.

Existing Mitigation Strategies

Westport has also taken a proactive approach to address wind damage. Recommendations from the *1997 Hazard Mitigation Plan* and the *Predisaster Mitigation Strategy Document, Connecticut's South Western Region* (2005) aimed to reduce Westport's vulnerability to severe storms by implementing strategies addressing flood and wind damage. Specifically, these strategies reduced the likelihood of property damage from storm surges, utility damage and ice jams. In addition, Westport regularly reviews their snow removal procedures and seeks opportunities to reduce costs whenever possible. Westport has also identified strategies to reduce the amount of debris generated during severe storms. Westport has a part time tree warden, an annual tree maintenance program for public property, and the Public Works Department maintains the necessary equipment to clean up downed tree limbs and brush following major wind events. Procedures are also in place to deal with debris after wind storms. Staging areas were identified for short-term storage and an agreement was reached with Sherwood Island State Park for temporary storage and processing after a major storm event.

Education and preparedness are important components in reducing vulnerability to severe storm events. Westport officials continue to visit schools and educate children about the risks of wind events and other natural hazards and how to prepare for them. Town staff has also attended trainings on mitigation measures from FEMA, Building Officials & Code Administrators International Inc., and the CTDEP. Information was made available to all building permit applicants and incorporated into the natural hazards reduction information in the town library. Commercial building owners or managers (of buildings with large population clusters) were encouraged to prepare a hazard mitigation plan in addition to their emergency response plans and a mass notification system is also in place to alert residents of an impending storms and other emergencies.

In addition, the Town has devoted significant resources to ensure that emergency responders are prepared when a severe storm occurs. A weather monitoring station is employed and emergency communications facilities have recently been updated to withstand high wind. The Westport/Weston Health District, in cooperation with the American Red Cross, the Westport Housing Authority, the Department of Human Services and the local Visiting Nurse agencies continued to maintain a list of residents needing additional services and support during emergencies. The Town also regularly reviews the *Westport Emergency Operations Plan* and updates the plan as needed.

Challenges

- Many Westport residents have not experienced a hurricane or tornado event and may mistakenly underestimate the potential impacts of high winds.
- Above-ground utilities are prone to wind damage.
- Falling trees or falling branches damage structures due to improper or inadequate pruning.
- High winds often damage trees and result in power outages, disrupt communication systems and damage property.

- Westport lacks a comprehensive policy that addresses debris from storms.
- Westport lacks a formal program for assessing damage after a severe storm event.
- Westport has limited tree planning education programs or tree trimming/maintenance programs for private citizens.
- Unanchored mobile homes, marinas and yacht clubs are particularly vulnerable to wind damage.
- Damage to structures from severe storm events, especially older buildings is significant.
- Flooding occurs from obstructed drainage paths, which may be exacerbated by storm debris.
- Winter storms often lead to slippery conditions and road accidents.
- Snow and ice could damage communications and power lines and result in power and telecommunication outages.
- Structures may be damaged by the weight of snow and ice and falling trees and branches.
- Winter storm debris may trigger road closures and flooding.
- Freezing temperatures can lead to burst pipes, ruptured water mains and frozen fuel lines.

Proposed Mitigation Strategies

The following proposed mitigation strategies were developed using the same techniques discussed under the "*Flooding*" section on Page 96.

Proposed Mitigation Strategies - Severe Storms and Tornadoes

Goal 1. Educate the public of wind damage potential, mitigation activities and preparedness.

Objectives:

- *Provide education opportunities to the affected community, builders, developers and town officials so that future construction and landscaping associated with construction is designed to minimize wind damage and retrofitting of existing structures and maintenance of property are implemented to the benefit of public safety and property loss reduction.*
- *Ensure clear and concise severe weather alerts reach 100% of the population in Westport.*
- *Minimize property loss/damage and personal safety risk due to falling tree damage following a severe storm event.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Maintain the severe weather forecasting and warning systems.	*EM*	*High*	*TBD*	*Severe Storm, Hurricane, Tornado*

Ongoing Practices	Who	Priority*	Hazard Addressed
Educate the public about the meaning of National Weather Service announcements, such as winter storm watch, winter storm warning, ice storm warning, heavy snow warning, blizzard warning, severe blizzard warning and high wind warning.	*EM*	*High*	*All*
During the Natural Hazards Awareness Week conduct an annual workshop so that local building contractors, residents, business owners, insurance and real estate agents, and all interested parties can familiarize themselves with wind associated risks, retrofitting techniques, importance of evacuation, and the understanding of warning mechanisms used by Westport.	*Fire, Building*	*Medium*	*Severe Storm, Hurricane, Tornado*
During the Natural Hazards Awareness Week, educate residents, business owners, insurance and real estate agents, and all interested parties on the history of Natural Hazards in Connecticut and the risk of such events in Westport.	*EM*	*Medium*	*All*

	Continue to hold “Severe Weather Awareness” week in March and a “Winter Weather Awareness” week in October. Disseminate information prepared by the Connecticut State Emergency Management Office during these events.	*EM, CEO*	*Medium*	*Severe Storm, Hurricane, Tornado*
	Promote the use of functional shutters for properties located along the coast to guard against window breakage which can result in structural failure. Investigate funding sources to promote this relatively inexpensive type of retrofitting on a large scale.	*EM, Building*	*Medium*	*Severe Storm, Hurricane, Tornado*
	Advise people of the potential dangerous driving conditions during inclement weather and storm events, and warn them that doing so can be a risk to their lives. Produce a series of announcements on what to do if you are trapped in your car during a severe storm.	*EM, Police, Fire*	*Low*	*All*
	Encourage the Westport Garden Club, the Beautification Committee and the Tree Board to sponsor events that educate the public about wise landscaping techniques, locating trees away from utilities and wind resistant tree species.	*DPW, CC*	*High*	*Severe Storm, Hurricane, Tornado*
	Publish a special section in the local newspaper with emergency information about severe storms. The publications should emphasize emergency procedures when caught out in the open or in a vehicle during a severe storm.	*EM*	*Medium*	*All*
	Provide a reliable emergency communication system for use in notifying the elderly and disabled.	*EM, Human Services, WWHD*	*Low*	*All*

Goal 2. Reduce the risk of damage to utility infrastructure in Westport as a result a severe storm event.

Objectives:

- *Ensure falling trees or branches do not damage utility lines during a severe storm event.*
- *Ensure improvement of emergency power and communication capabilities during a severe storm event.*
- *Keep drainage paths open.*
- *Limit damage to utility lines and property and injury or loss of life by fallen trees, tree limbs, and brush.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Regularly evaluate the health of town roadway trees; trim or remove dangerous branches and remove unhealthy trees.	*DPW*	*Medium*	*TBD*	*Severe Storm, Hurricane, Tornado*
2.	Evaluate the feasibility of moving trees out of the right of way and onto the edge of properties to protect above ground utilities.	*DPW, P&Z*	*Medium*	*TBD*	*Severe Storm, Hurricane, Tornado*
3.	Continue to explore moving existing utilities underground and requiring underground utilities for new developments and subdivisions.	*P&Z, DPW*	*Low*	*TBD*	*All*

Ongoing Practices	Who	Priority*	Hazard Addressed
Determine how to reuse disposed brush within the community to reduce costs of exporting from Westport (chips, firewood, composting).	*Public Works*	*Medium*	*Severe Storm, Hurricane, Tornado*
Move as many utility lines underground as possible.	*P&Z, DPW*	*Low*	*Severe Storm, Hurricane, Tornado*
Place deflectors on key utility lines to reduce accumulation of ice or snow.	*Utilities*	*Medium*	*Severe Storm, Hurricane, Tornado*
Encourage appropriate streetscaping and planting, particularly around utilities.	*DPW, P&Z*	*High*	*Severe Storm, Hurricane, Tornado*
Continue tree trimming and maintenance program for trees on public roads.	*Public Works, Utilities*	*High*	*Severe Storm, Hurricane, Tornado*
Establish protocols to check drainage paths (i.e. catch basins and culverts) prior to a severe storm.	*Public Works*	*Medium*	*Severe Storm, Hurricane, Tornado*

Goal 3. *Broaden response capabilities of emergency responders in dealing with the preparation and aftermath of a severe storm event.*

Objectives:

- *Ensure municipal facilities are adequately supplied and equipment is in proper working order.*
- *Ensure there are damage assessment capabilities for emergency response personnel following a severe storm event.*
- *Improve and expand current severe weather warning systems.*
- *Improve and expand response capabilities that serve the disabled, elderly, and vulnerable population groups.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Complete and implement a study to address the needs of the Police/ Emergency Medical services.	*RTM*	*High*	*TBD*	*All*
2.	Identify person to work with Emergency Management at the EOC during an emergency to provide information system support.	*GIS, DPW*	*High*	*TBD*	
3.	Work to update vulnerable population database on a quarterly basis.	*DPW*	*High*	*As funding and staffing allows*	*All*
4.	Promote an adequate supply of public water to serve the domestic, commercial and fire protection requirements of Westport.	*Town*	*High*	*TBD*	*All*
5.	Identify additional sites for yard waste and storm debris.	*DPW*	*High*	*TBD*	*All*
6.	Continue to support the extension of public water service and fire hydrants throughout Westport.	*Town*	*Low*	*TBD*	*All*
7.	Improve telecommunications.	*Town*	*Medium*	*TBD*	*All*
8.	Evaluate municipality's sheltering and evacuation needs for a variety of storm scenarios.	*EM, WWHD, Human Services*	*Low*	*TBD*	*All*
9.	Maintain emergency notification system and update as needed.	*EM*	*Medium*	*TBD*	*All*
10.	Work with DEMHS to complete and enhance the state and regional debris management plan.	*EM, DPW*	*Medium*	*DEMHS*	*All*
11.	Conduct training and exercises on disaster responses and education on property damage assessment forms.	*EM, DEMHS*	*Low*	*TBD*	*All*

Ongoing Practices	Who	Priority*	Hazard Addressed
Incorporate notification of severe weather events into the town mass notification system.	*EM*	*High*	*All*
Train emergency response personnel to assess damage to buildings and their electrical, plumbing and heating systems.	*EM, Fire, Police*	*Medium*	*All*
Review the Emergency Operating Plan and emergency protocols to ensure that emergency responders can perform critical duties in the event of an extended power outage, limited fuel access, and reduced communication capabilities.	*EM, Fire, Police*	*Medium*	*All*
Perform regular inspections of cones, barricades, sandbags, salt, portable power generators, and bunk trailers to ensure that they are adequate and in good repair in the event of a severe storm.	*EM, DPW*	*High*	*All*

Goal 4. Reduce losses to public and private structures in Westport from severe storm events.

Objectives:

- *Ensure existing buildings and historically significant buildings are inventoried to identify potential losses from severe storm events.*
- *Encourage implementation of preventive measures for existing development to reduce the vulnerability to severe weather damage.*
- *Ensure mobile homes and mobile home parks throughout Westport are inventoried to identify potential for losses from severe storm events.*
- *Ensure that critical facilities are protected against wind damage.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Inventory condition of problem culverts and bridges and consider repairs or replacement as necessary or as funding becomes available.	*DPW*	*Medium*	*TBD*	*All*
2.	Develop a notification system reminding critical facilities to evaluate storm preparedness every 5 years.	*EM*	*Low*	*TBD*	*All*
3.	Develop a notification system for mobile home owners/residents to evaluate storm preparedness every 5 years or when ownership changes.	*EM*	*Low*	*TBD*	*All*

Ongoing Practices	Who	Priority*	Hazard Addressed
Implement specific physical actions that help protect public critical facilities against wind damage as funds become available.	*EM, DPW*	*Low*	*Severe Storm, Hurricane, Tornado*
Encourage private marinas and yacht clubs to develop management plans that address pollution prevention and hazard mitigation.	*CC, P&Z, EM*	*Medium,*	*All*
Provide information to contractors and owners of mobile homes on ways to anchor their structures to minimize damage from severe storms.	*EM, Housing Authority*	*Low*	*Severe Storm, Hurricane, Tornado*
Update local building codes to reference the most current standards as needed.	*Building*	*Low*	*All*
Initiate storm alerts earlier to allow citizens more time to prepare their structures for severe storm events.	*EM*	*High*	*All*

Earthquake

Existing Mitigation Strategies

Although the threat of a severe earthquake is low, decision makers were concerned about the suddenness of earthquakes and lack of seismic design in many Westport structures. Therefore, Westport addressed earthquakes in its *1997 Hazard Mitigation Plan* and successfully implemented a number of mitigation strategies aimed at reducing the risk primarily focused on educating the community about the risks (Appendix C). Builders and design professionals active in the town have been provided copies of recommendations and best practices on reducing the risk of earthquake damage. The Town has also begun to evaluate municipally-owned buildings for their ability to withstand earthquakes and wind loading.

Challenges

- Many Westport residents have not experienced an earthquake and may mistakenly underestimate the potential impacts.
- Although unlikely, many structures in Westport are prone to earthquakes due to lack of seismic design.
- Many critical facilities in Westport have not been assessed for their vulnerability to earthquakes.

Proposed Mitigation Strategies

The following proposed mitigation strategies were developed using the same techniques discussed under the "*Flooding*" section on page 96.

Proposed Mitigation Strategies - Earthquake

Goal 1. To reduce loss of life and property as a result of earthquakes.

Objectives:

- *Educate the public about the threat of earthquakes.*
- *Assess the vulnerability of critical facilities to earthquakes.*
- *Ensure that future construction of critical facilities is scrutinized more than other developments to determine the suitability of locations in the event of earthquakes hurricanes and tornadoes.*
- *Ensure that emergency responders have the ability to communicate and respond effectively in the event of an earthquake.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Work to harden critical facilities and shelter locations to withstand significant weather events, for public use during an emergency.	*EM, Building*	*High*	*TBD*	*All*
2.	Begin to evaluate the structural integrity of Town-owned Critical Facilities and buildings and their ability to withstand earthquakes.	*Building, EM*	*Low*	*TBD*	*Earthquake*
3.	Encourage privately owned critical facilities to evaluate the ability of the buildings to withstand earthquakes and tornadoes, and to address and deficiencies identified.	*Building, EM*	*Low*	*TBD*	*Tornado, Earthquake,*
4.	Develop a notification system reminding critical facilities to evaluate storm preparedness every 5 years.	*EM*	*Low*	*TBD*	*All*
5.	Develop a notification system for mobile home owners/residents to evaluate storm preparedness every 5 years or when ownership changes.	*EM*	*Low*	*TBD*	*All*
6.	Zoning regulations and other ordinances and municipal laws governing the siting of new development, (new subdivisions of more than 10 houses and critical facilities), will be examined to determine if site geology is properly considered in the siting of critical use facilities. If deficiencies are identified, necessary changes will be studied and incorporated into the review of proposals for the development of such facilities.	*P&Z, Building, DPW*	*Low*	*TBD*	*Earthquake*

Ongoing Practices	Who	Priority*	Hazard Addressed
During the Natural Hazards Awareness Week include activities, workshops and materials about all natural hazards.	*EM, Building*	*Medium*	*All*
Continue to make FEMA's Emergency Management Institute classes available to Town Employees, including Rapid Visual Screening Techniques, designed to teach skills necessary for inventorying earthquake-susceptible commercial buildings. Skills acquired by attending this course could be utilized in implementing the Predisaster Mitigation Plan.	*Town, EM*	*Low*	*All*
Provide the earthquake-related publications to the public library for inclusion with the other natural hazard publications.	*EM, Library*	*Low*	*All*
Request that the Town, including the Board of Education, if applicable, retain the services of a professional engineer to survey all municipally owned buildings for their ability to withstand earthquake and wind loading. Prioritize any retrofitting, giving those buildings to be used as shelters the highest priority. If analysis reveals that a particular building is better suited as a shelter than one that is currently being used, then consider relocating the shelter to that location.	*EM, BOE*	*Low*	*Hurricane, Tornado, Earthquake,*
Maintain and update as needed The Westport Emergency Operations Plan to address earthquakes and other natural disasters.	*EM*	*Medium*	*All*

Dam Failure

Existing Mitigation Strategies

The Town of Westport and the State of Connecticut monitor high risk dams in an effort to minimize the likelihood of dam failure. Owners of Class C dams are required to maintain emergency operations plans (EOP's) for their dams. Builders of new Class B dams are also required to develop EOPs. Many existing class B dam owners have EOPs. Westport, with the assistance of the State DEP, requested a copy of the emergency operations plan from each dam owner. Westport has obtained all available copies of failure inundation maps from the owners of all Class B dams in Westport and from the owners of the Saugatuck Reservoir Dam (Class C) in Weston. Westport also prepared maps of known or expected dam failure inundation areas for the dams currently without inundation mapping and determined to present the greatest threats.

Following moderate to major flooding events, staff of the Westport Engineering Department attempt to visually inspect Class B dams and report any obvious problems to the Dam Safety Unit of the DEP. The DEP inspects these dams in approximately 5-year intervals. Dams may be inspected more frequently if problematic conditions are expected or reported. The town also included the amount of time needed to warn vulnerable populations in their inundation areas as part to the EOP.

Challenges

- Nash Pond Dam in Westport and the Saugatuck Reservoir Dam in Weston pose the greatest risk to Westport. Based on information currently on file in the Westport Emergency Management Office, warning time between dam failure of the Saugatuck Reservoir Dam and flooding in Westport is less than fifteen minutes.
- The Bulkley Pond Dam on Sasco Creek is a low priority dam but in immediate danger of failing leaving many properties in Westport and Fairfield vulnerable. The dam is privately owned and funds to repair the dam are scarce.

Proposed Mitigation Strategies

The following proposed mitigation strategies were developed using the same techniques discussed under the "*Flooding*" section on page 96.

Proposed Mitigation Strategies- Dam Safety

Goal. *To reduce the loss of life and property as a result of dam failure.*

Objectives:
- ◇ *Help private dam owners obtain financial assistance for dam repairs.*
- ◇ *Improve and expand current dam failure warning systems.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Work with the State and property owners to identify funding and repair of the Bulkley Pond Dam on Sasco Creek.	*DEP, CC*	*Low*	*TBD*	*Dam Failure*
2.	Continue to install warning gauges on local dams as the opportunity or need arises.	*DPW*	*Medium*	*TBD*	*Dam Failure*

Proposed Mitigation Strategies- Drought

Goal. *Implement and expand drought mitigation plans and initiatives.*

Objectives: ◇ *Update Drought Management Plan and review and update regulations as necessary.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Study effectiveness of regulations during drought conditions.	*CC,WWHD, Aquarion*	*Medium*	*As funding and staffing allows*	*Drought*
2.	Review USGS groundwater study and make recommendations for regulations to protect groundwater quality and quantity.	*CC*	*Medium*	*As funding and staffing allows*	*Drought*
3.	Work with Aquarion Water Co. on infrastructure in town and inter-town.	*CC, Aquarion*	*Medium*	*As funding and staffing allows*	*Drought*
4.	Update drought management plan to be in alignment with State of Connecticut Drought Management plan.	*CC*	*Medium*	*As funding and staffing allows*	*Drought*
5.	Review winter drought restrictions and conservation measures, and evaluate possible education and outreach programs that may be helpful.	*CC, P&Z*	*Low*	*As funding and staffing allows*	*Drought*
6.	Consider if underground storage tanks for fire protection need to be required for new development.	*Fire, P&Z, CC*	*Medium*	*As funding and staffing allows*	*Drought*

Sea Level Rise

Existing Mitigation Strategies

Scientific evidence has shown the threat of climate change and the associated risks may be visible during the next century. Sea level rise has been identified as one of the major threats related to climate change. With its expansive coastline, the Town of Westport has begun to examine the community's vulnerability to sea level rise and to identify critical facilities that may be impacted by increased sea levels.

Challenges

- Much of the development in the Town of Westport occurred before the threat of Sea Level Rise was realized, making existing structures in coast areas particularly vulnerable.
- Models for sea level rise are continually changing as new data becomes available and therefore the true extent of the town's vulnerability is still unknown

Proposed Mitigation Strategies

The following proposed mitigation strategies were developed using the same techniques discussed under the "*Flooding*" section on page 96.

Proposed Mitigation Strategies- Sea Level Rise

Goal. *To reduce the potential vulnerability for loss of life and property as a result of sea level rise.*

Objectives:

- ◇ *Ensure that town facilities are able to withstand the potential impacts of sea level rise.*
- ◇ *Educate the town and it's citizens as to the potential loss that may result in sea level rise do to climate change.*
- ◇ *Work to minimize increased vulnerability to new construction in areas that may be impacted by sea level rise.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Continue to monitor information on global sea level rise.	*CC, Staff*	*High*	*TBD*	*Sea Level Rise*
2.	Evaluate how to best prepare for the implications of global sea level rise to best balance public health, safety, and welfare.	*P&Z, Town*	*High*	*TBD*	*Sea Level Rise*
3.	Minimize the amount and intensity of development in coastal "V" flood zones: Eliminate new non-water dependent development from "V" zones and only allow new structures that meet current "V" zone construction.	*P&Z*	*Medium*	*TBD*	*Sea Level Rise*

Who: BOS = Board of Selectmen; Building = Town Building Department; CC = Conservation Commission; CEO = Chief Elected Official; CTDEP = CT Department of Environmental Protection; CTDOT = CT Department of Transportation; DEMHS 1= CT Department of Emergency Management and Homeland Security Region 1; DPW = Department of Public Works; EM = Emergency Management (Director of EM, Fire and Police); FM = Fire Marshal; IT = Town Information Technology Department; IWC = Inland Wetlands Committee; WWHD = Weston Westport Health Department; P&Z = Planning and Zoning Commission; Staff = Various Town Staff; SWRPA= South Western Regional Planning Agency.

Wilton

Existing Mitigation Strategies

Prevention
Wilton has rigorous land use regulations designed to protect natural resources and restrict development in flood zones and other hazard-prone areas. These regulations help prevent the loss of life and property by preventing inappropriate development in flood zones and reducing the amount of stormwater discharge that may exacerbate flooding.

Early in 2010 Wilton revised the existing flood damage prevention regulations and in accordance with the most recent state DEP and FEMA requirements. Changes in regulations coincided with adoption of the Flood Insurance Rate Maps (FIRM) for Fairfield County. The zoning regulations and the language regarding State and Federal permits associated with development permits were strengthened to maintain compliance with the National Flood Insurance Program (NFIP) standards and recently enacted state floodplain management requirements.

The *Zoning Regulations* restrict all new construction and substantial improvements in the 100-year floodplain as depicted on the most recent revision of the Flood Insurance Rate Map (FIRM). Substantial improvements mean any combination of repairs, reconstruction, alteration, or improvements to a structure taking place during a ten-year period, the cost of which equals or exceeds 50% of the market value either before the improvement or repair is started or, if the structure has been damaged, before the damage occurred. In these cases, all residential construction must be elevated to or above the base flood elevation. Likewise, all non-residential construction must be elevated or floodproofed to or above the base flood elevation. In regards to elevated buildings, the areas below the base flood elevation must allow floodwater to flow in all directions, and the building must have at least one access route above the base flood elevation. In addition, the regulations prohibit all encroachments in regulated floodways.

The *Subdivision Regulations* build upon the *Zoning Regulations* to offer additional preventive measures during the site plan submittal process. Specifically, the regulations require a storm drainage plan that minimizes runoff and maximizes infiltration before discharging stormwater into wetlands and watercourses. If stormwater discharge will overload existing downstream drainage facilities, the storm drainage plan must provide adequate retention or detention of the runoff. Furthermore, the regulations require the protection of natural features including those that contribute to the natural functioning of the natural drainage system. In addition to flooding, the regulations address damaging winds as a result of severe storms. For instance, utility lines are required to be buried for new subdivisions and are encouraged for certain projects such as major road projects. These land use regulations are described in detail in the *Zoning Regulations* and *Subdivision Regulations* available through Wilton Town Hall.

The Building Department, the Inland Wetland Commission, and the Public Works Department carry out additional activities that help prevent the loss of life and property as a result of natural disasters.

1. The Building Department ensures conformance with the Connecticut State Building Code including flood resistant construction and with elevation certification (Section 3107).
2. The Inland Wetlands Commission, through its Inland Wetlands and Watercourses regulations, works toward the conservation of wetland resources through avoiding impacts from development on functional wetlands and watercourses. The Commission also seeks to restore and enhance wetlands that have been degraded.
3. Wilton implements an as-needed program for tree maintenance.

4. Whenever possible, Public Works examines and clears public storm drains and grates of debris during periods of rainfall, snowfall, and storms.
5. Public Works corrected a drainage problem to prevent icing on Nod Hill Road, removed sediment in box culverts in the flood-prone Wilton Woods neighborhood, and cleaned the catch basins in low lying areas to maintain unobstructed drainage.

Emergency Services

Significant improvements have been made to the telecommunications systems used by emergency responders. Additional antennas were installed on schools and in other critical areas were radio communication problems existed. The system now provides 99% radio coverage to the town. Wilton also uses warning systems and emergency planning to help protect life and property before, during and after a natural disaster. For instance, the Board of Education has an Emergency Operations Plan that outlines emergency procedures for the school district. The plan has procedures in place for flooding, tornado, hurricane, and earthquake. In addition, the water level of the Norwalk River, rainfall, and weather conditions and forecasts are monitored for potential flooding in Wilton, Norwalk, Redding, and Ridgefield. A mass notification system is utilized to warn local residents of potential threats and the town is continually working to enhance the operations of the system. Currently Wilton is exploring options to allow residents to register non-typical devices to receive alerts (i.e. cell phones, black berries and electronic messaging systems).

Natural Resource Protection

Wilton has an aggressive open space acquisition policy that helps protect areas prone to flooding and other natural hazards from future development. For example, the *Wilton Plan of Conservation and Development* lists desired public open space acquisitions including properties with flood storage and other demonstrable mitigation benefits.

Norwalk River Watershed Initiative

Wilton supports the goals of the *Norwalk River Watershed Action Plan* prepared in October 1998 and updated in June 2004 by the Norwalk River Watershed Initiative (NRWI). NRWI successfully implemented many aspects of its action plan including those that mitigate flood hazards. For instance, NRWI organized workshops and prepared outreach materials on stormwater and floodplain management. In addition, NRWI actively promoted open space preservation and protection adjacent to the Norwalk River and other critical areas to ensure the proper functioning of the watershed. Furthermore, a list of non-structural flood control measures was prepared for each existing flood prone structure in the Norwalk River Watershed. Ongoing efforts were initiated to implement the non-structural measures. Lastly, NRWI explored the removal of the Cannondale, Merwin Meadows, and Flock Process Dams to restore the normal functioning of the Norwalk River. These dams no longer serve their intended purposes and lack flood control or protection benefits.

Education

The Town of Wilton has worked to ensure that citizens have the information needed to properly plan and prepare for natural disasters. A packet of comprehensive educational brochures and materials were developed and distributed to all local citizens. The brochures identified simple and inexpensive tasks, and more advanced brochures with additional tasks and actions to be done to prepare your family and home for a natural disaster that may be more sophisticated in nature or more expensive. All educational materials and brochures are made available at the local library. The Town's Fire department website has also been outfitted with a message banner that can be used to display real-time information during an emergency.

Challenges

- Wilton regularly receives proposals for commercial and multi-family housing projects along Route 7 and areas adjacent to the Norwalk River. Even though stormwater discharge is minimized through the municipality's regulations, the cumulative effect of relatively intense land use may increase the likelihood of flooding in commercial and densely populated areas in the Norwalk River floodplain.
- South Norwalk Electric and Water (SNEW) owns the Popes Pond and South Norwalk Reservoir Dams. Even though SNEW maintains an emergency operating plan for each dam, the plans lack dependable protocols to contact property owners in the event of a dam emergency. A reverse 911 or similar system could provide rapid notification of property owners in the event of a dam emergency.
- Flooding regularly occurs near the confluence of the Silvermine River and Comstock Brook. Flooding in this area is intensified when water is released from upstream reservoirs, often without warning.
- Tree debris often results in street closures. In addition, tree debris creates blockages in the Norwalk River, which sometimes lead to flooding on U.S. Route 7.
- Wilton has three emergency shelters with limited capacity, one of which lies in an area prone to flooding.
- Many Wilton residents have not experienced a hurricane or tornado event and may mistakenly underestimate the potential impacts of high winds.

Proposed Mitigation Strategies

Wilton personnel reviewed the "Hazard Evaluation and Risk Assessment," the strengths and weaknesses of its existing mitigation strategies, and the municipality's challenges. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate strategies and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

- Does the supporting recommendation mitigate multiple natural hazards?
- Is the supporting recommendation feasible?
- Would the supporting recommendation be effective in avoiding or reducing future losses?
- Does the cost of the supporting recommendation seem reasonable for the size of the problem and likely benefits?
- Does the supporting recommendation contribute to continued compliance with NFIP?
- Does the supporting recommendation improve upon existing programs or support other municipal priorities?
- The anticipated time frame for implementation.

The public review and plan adoption process may have resulted in additional modifications. More information about the evaluation and Wilton's planning process can be found in Appendix C and Appendix D respectively.

Wilton Mitigation Strategies

Goal. *Reduce the loss of life and property and economic consequences as a result of flooding, high winds, severe winter storms and dam failure.*

Objective 1. ◇ *Improve the ability of Wilton residents to prepare for and respond to approaching severe weather.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Continue to enhance community preparedness programs.	*EM*	*Medium*		*All*
2.	Provide "welcome kits" to new home owners for properties within the flood plain, or with a significant risk of flooding.	*EM*	*Medium*		*All*
3.	Upgrade emergency notification system to incorporate cell phone numbers into the database.	*EM*	*High*		*All*
4.	Explore the use of social media networks to disseminate emergency notifications and severe weather warnings.	*EM*	*Low*		*All*
5.	Develop a prerecorded flood alert message for the emergency notification system to be activated prior to flood events.	*EM*	*High*		*Flooding*
6.	Develop a strategy to provide more information online.	*EM, IT*	*High*		*All*
7.	Work with telecommunications entities to promote a modern telecommunications network.	*P&Z, Utilities*	*Medium*		*All*
8.	Encourage the study of alternative systems for delivering reliable power to residents.	*EM, P&Z, Utilities*	*Low*		*All*

Ongoing Practices	Who	Priority*	Hazard Addressed
Continue to provide education materials on preparing for natural disasters.	*EM*	*Medium*	*All*
Develop a GIS application to assist personnel in the event of an emergency or natural disaster.	*EM, Police, Fire*	*Medium*	*All*

Objective 2. ◇ *Improve the Town of Wilton's ability to prepare for and respond to natural disasters and severe weather events.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Continue to hold regular meetings with town departments that may need to respond to natural disasters, focused on sharing information, coordination and developing protocols.	*EM, P&Z, DPW, Fire, Police, CC*	*High*	*N/A*	*All*
2.	Continue to work with DEMHS to enhance Training and exercises on disaster responses and education on Property damage assessment forms.	*EM, DEMHS*	*Medium*	*DEMHS*	*All*
3.	Develop a secure website to be used to share data and information with emergency management and the EOC during a natural disaster.	*EM, IT*	*Medium*		*All*
4.	Implement a town-wide GIS.	*IT*	*High*		*All*
5.	Identify ways to improve the use of GIS for use in identifying areas and facilities vulnerable to disasters and for use to enhance emergency management.	*EM,IT*	*High*		*All*
6.	Inventory and update conditions of town owned significant culverts and bridges. and consider repairs or replacement as necessary or as funding becomes available.	*DPW*	*Low*		*Flooding, Severe Storm, Hurricane*
7.	Continue to work with CT DOT and DEP to maintain flow of streams through expansive wetlands.	*DPW, CC, State*	*Low*		*Flooding, Severe Storm, Hurricane*
8.	Continue to provide capital budget funds for drainage projects and investigation of drainage problems.	*DPW*	*High*		*Flooding, Severe Storm, Hurricane*
9.	Continue to work to implement recommendations from the current storm water management plan.	*DPW, P&Z, CC*	*Medium*		*Flooding, Severe Storm, Hurricane*
10.	Enhance storm drain maintenance activities:				
	• Maintain records for storm drain maintenance.	*DPW*	*High*		*Flooding, Severe Storm, Hurricane*
	• Continue to work to increase frequency of storm drain clean out.	*DPW*	*Medium*		*Flooding, Severe Storm, Hurricane*
	• Continue to identify and eliminate cross connections between storm and sanitary sewer systems.	*DPW*	*Low*		*Flooding, Severe Storm, Hurricane*
	• Develop a plan for dealing with back-ups and failures.	*DPW*	*Low*		*Flooding, Severe Storm, Hurricane*

11.	Continue to assess the ecological and health implications of winter road salting and investigate alternatives.	*BOS, DPW*	*Low*		*Severe Storm (Winter)*
12.	Ensure that Fire Station 2 continues to serve western Wilton.	*BOS*	*High*		*All*
13.	Analyze options for meeting expansion needs of Fire Station 2 on-site, on other sites, or by sharing services with neighboring communities.	*EM, BOS*	*High*		*All*
14.	Continue to require the provision of fire water cisterns when development cannot be served by public water.	*EM, P&Z*	*Medium*		*All*
15.	Procure equipment to sustain critical facilities in the event of a disaster and to enhance EOC capabilities as needs are identified.	*EM*	*Low*		*All*
16.	Continue to monitor the condition of Merwin Meadows dam; if necessary, consider options for dam removal identified in the engineering study.	*DPW*	*Low*		*Dam Failure*
17.	Encourage evaluation of dams under the purview of the DEP.	*DPW, State*	*Low*		*Dam Failure*
18.	Work with Norwalk's First Taxing district to improve communications and coordinate the release of water from the Browns Reservoir.	*DPW, EM*	*High*		*Dam Failure, Flooding*
19.	Assess vulnerability of critical facilities to earthquakes, hurricanes, tornadoes.	*DPW, Building*	*Medium*		*Earthquake, Hurricane, Tornado*
20.	Evaluate municipalities' sheltering and evacuation needs for a variety of storm scenarios.	*EM, HD, Red Cross*	*Medium*		*All*
21.	Train additional volunteer personnel in shelter management and emergency supply distribution.	*EM, CERT, Red Cross*	*High*		*All*
22.	Establish a database on well water by using information submitted to the local health department for each new well and complaints received.	*HD*	*Low*		*Drought*
23.	Monitor well water quantity issues by reviewing data annually.	*HD, CC*	*Low*		*Drought*
24.	Explore the need for a drought ordinance.	*HD, CC,P&Z*	*Medium*		*Drought*
25.	Begin to investigate potential impacts resulting from sea level rise, with special attention paid to waste waters systems.	*CC, P&Z*	*Low*		*Sea Level Rise*

Ongoing Practices	Who	Priority*	Hazard Addressed
Require utility lines to be buried for all new subdivisions and encourage moving utility lines underground during certain projects such as major road projects.	*P&Z*	*High*	*Severe Storm, Hurricane, Tornado*

Objective 3. ◇ *Reduce the amount of debris from severe storms through preventive tree maintenance.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Work with DEMHS to complete and enhance the state and regional debris management plan and to address local needs.	*EM, DEMHS*	*High*		*Severe Storm, Hurricane, Tornado*
2.	Designate pre-planned locations for debris storage and management	*DPW*	*High*		*Severe Storm, Hurricane, Tornado*
3.	Conduct a Town-wide inventory and assessment of street trees, consider conducting the inventory in conjunction with other municipalities in the region.	*Tree Committee*	*Low*		*Severe Storm, Hurricane, Tornado*
4.	Continue to commit capital funding annually for public tree maintenance and plantings.	*BOS*	*Low*		*Severe Storm, Hurricane, Tornado*

Ongoing Practices	Who	Priority*	Hazard Addressed
Budget appropriate money necessary to maintain and remove dead, dying, dangerous or diseased trees in rights-of-way and on other town land.	*DPW*	*Low*	*Severe Storm, Hurricane, Tornado*
Seek financial assistance to manage tree debris in the Norwalk River.	*DPW*	*Low*	*Severe Storm, Hurricane, Tornado*

Objective 4. ◇ *Reduce the Town of Wilton's Vulnerability to Flooding.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Assure strict adherence to current flood plain regulations.	*P&Z, CC*	*High*		*Flooding*
2.	Consider conducting drainage and watershed evaluations for all problematic waterbodies in the town.	*CC, DPW*	*Low*		*Flooding*

3.	Maintain the Federal Flood Insurance Program which provides insurance for property owners in flood hazard areas, and encourage development to be located outside flood-prone areas wherever possible, including increased setbacks to account for sea level rise.	*P&Z, CC*	*High*		*Flooding*
4.	Encourage acquisition of wetlands beneficial to the Town.	*CC, IWC, BOS*	*Low*		*Flooding*
5.	Continue to encourage the preservation of undeveloped lands within the 100-year flood zone with the use of Open Space purchase, donation or conservation easement.	*P&Z, CC, BOS*	*Medium*		*Flooding*
6.	Revise subdivision regulations to require open space set aside to reflect upland to wetland ratio of parcel.	*P&Z*	*Medium*		*Flooding*
7.	Ensure that the Town is up-to-date in its storm water management planning (NPDES) requirements.	*DPW*	*High*		*Flooding*
8.	Ensure expert engineering review of projects with potential storm water impacts.	*P&Z, IWC*	*Medium*		*Flooding*
9.	Require drainage review for all projects that exceed a certain threshold of land clearing or a certain percentage of impervious surface.	*P&Z*	*Medium*		*Flooding*
10.	Consider requiring a drainage review when a certain amount of land is cleared of vegetation.	*P&Z, BOS*	*Medium*		*Flooding*
11.	Reduce impervious surfaces by adopting impervious coverage allowances for all zoning districts or amending regulations to decrease need for impervious surfaces.	*P&Z*	*Low*		*Flooding*
12.	Ensure that redevelopment reduces runoff from current conditions.	*P&Z, CC*	*High*		*Flooding*
13.	Consider requiring Low Impact Development (LID) techniques for all new development, including Town projects and road projects.	*P&Z, DPW*	*Medium*		*Flooding*
14.	Assist property owners along the Norwalk River with retrofitting properties using LID principles.	*CC*	*Medium*		*Flooding*
15.	Ensure that redevelopment incorporates measures to improve storm water quality and quantity.	*P&Z*	*Medium*		*Flooding*

16.	Promote infiltration rather than diverting runoff into the Town's drainage system.	*P&Z, DPW*	*Medium*		*Flooding*
17.	Encourage landowners to retain storm water, such as by using rain barrels or planting rain gardens.	*CC*	*High*		*Flooding*
18.	Educate on the benefits of riparian and wetlands protection.	*CC*	*Low*		*Flooding*

Ongoing Practices	**Who**	**Priority***	**Hazard Addressed**
Continue to use and enforce zoning and subdivision regulations to protect natural resources and restrict development in flood zones and other high risk areas.	*P&Z*	*High*	*Flooding*

Who: BOS = Board of Selectmen; Building = Town Building Department; CC = Conservation Commission; CTDEP = CT Department of Environmental Protection; CTDOT = CT Department of Transportation; DEMHS 1= CT Department of Emergency Management and Homeland Security Region 1; DPW = Department of Public Works; EM = Emergency Management (Director of EM, Fire and Police); FM = Fire Marshal; IT = Town Information Technology Department; IWC = Inland Wetlands Committee; HD = Health Department; P&Z = Planning and Zoning Commission; Staff = Various Town Staff; SWRPA= South Western Regional Planning

South Western Region

The municipalities of South Western Connecticut have taken a proactive approach to disaster mitigation as described above. Each municipality has developed a mitigation program that effectively addresses the needs of the community. During the development of the Plan several opportunities were identified to enhance inter-municipal collaboration. Regional recommendations focused on methods to assist the municipalities in enhancing the existing mitigation program and in facilitating inter-municipal cooperation.

Proposed Mitigation Strategies

Mitigation strategies were identified and reviewed by the Advisory Committee based on the "Hazard Evaluation and Risk Assessment," and mitigation priorities identified within the communities. This review was used in the development of the goals, objectives, proposed mitigation strategies and implementation schedule. The following criteria were used to evaluate recommendations and assign selected supporting recommendations a priority rating of "High," "Medium" or "Low:"

High	Recommendations identified as important to having significant impact on the Region and its residents, and expected to be implemented in 1-2 years from plan adoption (pending available funding and staff resources)
Medium	Recommendations identified as having moderate importance or impact to the Region and will be implemented in 3-4 years of plan adoption(pending available funding and staff resources)
Low	Recommendations identified as necessary or desirable but not of critical need. Project will be implemented in 4+ years of plan adoption or as funding/staff resources become available

Regional Mitigation Strategies

Goal *Reduce the loss of life, property and economic consequences as a result of Natural Disasters.*

Objective ◇ *Provide support and assistance to local municipalities.*

	Supporting Recommendation	Who	Priority*	Potential Funding Source	Hazard Addressed
1.	Work with the State to enhance the Debris management plan and to develop a document useful for the region's municipalities.	*SWRPA, DEMHS 1*	*Medium*	*DEMHS*	*All*
2.	Work with municipalities and DEMHS to develop shelter-evacuation routes for a variety of storm scenarios.	*SWRPA, DEMHS 1*	*Low*	*DEMHS Regional Grant*	*All*
3.	Encourage the state to evaluate large-scale evacuation scenarios for CT that includes a mass evacuation of New York.	*SWRPA, Local EM*	*Low*	*DEMHS*	*All*
4.	Work with Municipalities, DEMHS, and the Red Cross to explore shared/regional sheltering locations.	*SWRPA, DEMHS 1, Red Cross*	*Low*	*TBD*	*All*
5.	Work with DEMHS to complete and enhance the state and regional debris management plan and to address local needs.	*SWRPA, DEMHS 1*	*Medium*	*DEMHS*	*Flood, Severe Storm, Hurricane, Tornado*
6.	Encourage the development of a regional website with emergency management information (i.e. DEMHS site that can be linked to).	*DEMHS 1*	*Medium*	*DEMHS*	*All*
7.	Identify a Regional Resource for Benefit Cost Analysis	*SWRPA, DEP*	*High*	*N/A*	*All*
8.	Participate in the development of the state drought management plan.	*SWRPA, DEP*	*Medium*	*N/A*	*Drought*
9.	Hold Semiannual meeting with PDM Advisory Committee to discuss progress towards plan implementation, best practices, and collaboration.	*SWRPA, PDM AC*	*Medium*	*N/A*	*All*
10.	Work with local municipalities to identify and coordinate desired training programs that may be beneficial in improving mitigation practices in the region.	*SWRPA, DEMHS, DEP*	*Low*	*Identified as opportunities arise*	*All*
11.	Continue to work to have an Army Corps of Engineers Reconnaissance Study conducted of the Region's rivers and streams.	*SWRPA, Congress, ACOE*	*High*	*Congressional Authorization*	*Flood, Severe Storm, Hurricane, Tornado*

V. Plan Maintenance

Overview

The following information details the formal process that will ensure that, over time, the Plan remains relevant.

Monitoring, Evaluating and Updating the Plan

SWRPA, with the cooperation of the CTDEP and participating municipalities, will coordinate an initial review of the Plan within approximately one year of its formal adoption. After the first formal review, the Advisory Committee will annually assess progress in plan implementation and summarize mitigation activities that have taken place in each municipality. Additionally, the Advisory Committee (Table 2-1) will continually monitor the plan and the effectiveness of existing and proposed mitigation strategies prior to and following a natural hazard occurring in the region; and will coordinate the plan review within their respective municipalities. The tables of recommended strategies for each municipality included in Section IV of this plan, identifies the municipal department responsible for implementation; the same department will be responsible for monitoring and evaluating specific recommendations. Monitoring may include identifying areas which continue to experience loss after mitigation practices have been implemented; or recommending additional areas for mitigation that were not identified by the risk assessment. SWRPA will review and update the Plan every five years. Upon request by the participating municipalities or if a need for significant modifications to the Plan are identified during regular monitoring or annual plan review, a formal update of the Plan may occur prior to the scheduled five-year update.

During the initial year, the participating municipalities, DEP and SWRPA will pay particular attention to identifying specific sites and areas that are vulnerable to natural hazards and which could benefit from cost effective mitigation measures. One year after plan approval is received: SWRPA and the Advisory Committee will review the goals and mitigation strategies to determine their relevance to changing circumstances in their respective municipalities, as well as changes in state or federal policy, and to ensure they are addressing current and expected conditions. SWRPA will be responsible for coordinating meetings, compiling summary documents, and coordinating public involvement. The Advisory Committee will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data.

During the annual plan review, SWRPA will be responsible for coordinating meetings, compiling summary documents, and involving the public. The existing advisory committee will work with SWRPA to evaluate progress towards implementing mitigation strategies indentified in the Plan and how the plan has been incorporated into existing planning mechanisms for each municipality. SWRPA may also invite representatives from the Department of Environmental Protection or other state and federal agencies with hazard mitigation expertise to participate in the review process. Also, the list of critical facilities will be reviewed and, if necessary, enhanced with additional details. A status report will be prepared to note successes and recommendations implemented over the past year. Public involvement will be coordinated following the process and employing strategies identified in Region's current public participation plan. All comments made by members of the public considered and included as part of the status report.

SWRPA will be responsible for the five-year Plan update. Two years prior to the expiration of the Plan, SWRPA, with the assistance of the Advisory Committee will initiate the update process. A formal review

of the existing document will be made and a summary of implementation strategies will be developed. A review of all relevant municipal, state and regional plans and studies will be conducted, along with a survey of existing best practices and successful mitigation strategies implemented nationwide. The update will address any changes to the threat of natural disasters, and a new risk assessment will be conducted using currently available data. During the update process, municipalities will be asked to review the current goals and objects and evaluate their relevance based on the new risk assessment. Once goals and objective are in place, new mitigation strategies will be developed to minimize local vulnerability and reduce identified risks were ever possible. Proposed mitigation strategies will be reviewed and prioritized by each municipality following the FEMA *Local Multi-Hazard Mitigation Planning Guidance*.

The public will have a number of opportunities to participate in the planning process. In addition to a kick-off meeting for the plan update, several public information sessions will be held at key points in the planning process (i.e. as goals and objectives are being developed, and as mitigation strategies are identified). Public involvement will be coordinated following the process and employing strategies identified in Region's current public participation plan. Media releases will be issued for all advisory committee meeting and public information sessions and information will be posed online. Draft documents will be made available for a 30-day public review and comment period, and additional strategies to engage the community identified in the Region's public participation plan will be employed as appropriate.

Before the end of the five-year period, the updated Plan will be submitted to the DEP and FEMA for acceptance. SWRPA will notify all holders of the Plan and interested stakeholders when the updated plan is complete and once FEMA and State approval has been received.

Incorporation/Implementation through Existing Programs

Electronic copies of the Plan are provided to all town departments in each of the Region's municipalities. The process for inclusion and implementation of mitigation strategies will be handled individually by each municipality. The department responsible for implementation and review are indicated in the table of recommended strategies for each municipality in Section IV. Table 5-1 outlines the mechanisms available and previously used to incorporate mitigation strategies.

Table 5-1. Available Mechanisms for Incorporation of Existing and Proposed Mitigation Strategies.

Municipality	PoCD	EOP*	P&Z Regs	Flood Plain Mgmt. & Regs	Local Board & Commissions	FEMA CRS
Darien	✓	✓	✓	✓*	✓	
Greenwich	✓	✓	✓	✓*	✓	
New Canaan	✓	✓	✓	✓*	✓	
Norwalk	✓	✓	✓	✓*	✓	✓
Stamford	✓	✓	✓	✓*	✓	✓
Weston	✓	✓	✓	✓*	✓	
Westport	✓	✓	✓	✓*	✓	✓
Wilton	✓	✓	✓	✓*	✓	

Note: EOP = Emergency Operations Plans; * - Updated in 2010

Municipal departments which may be involved in natural hazard mitigation may include, but are not limited to: Building, Conservation, Emergency Management, Engineering Finance, Fire, Parks and Recreation; Planning and Zoning, Police, Public Works and various boards and commissions. Whenever

practical, the municipalities will incorporate the mitigation strategies outlined in this Plan into the following existing programs and activities.

- Local and Regional Plan of Conservation and Development – Each municipality in the region develops and updates a plan of conservation and development intended to guide future development in that municipality. Municipalities and SWRPA should take steps to ensure consistency between their plans of conservation and development and the Region's current PDM.
- Local and Regional All-Hazards Plans and Emergency Operations Plans – These plans are part of an overall emergency management program.
- Local Planning and Zoning Regulations – Each municipality maintains planning and zoning regulations governing development within their town. As regulations are reviewed and updated, recommendations in the Plan should be considered and efforts made to ensure consistency with recommendations in the Region's current PDM.
- Other plans, programs, studies and projects that would help the participating municipalities achieve the goals and objectives of this Plan. As projects, plans and studies are developed efforts should be made to incorporate recommended strategies and to ensure consistence with the Region's current PDM.
- Local Stormwater and Drainage Manuals – A number of the Region's municipalities maintain stormwater or drainage manuals as a resource for the community, as manuals are updated portions of this plan may be incorporated.
- A number of the Region's municipalities have departments, town boards or commissions tasked with flood control, wetland projection, and emergency response and preparedness. As new projects are proposed efforts are made to ensure consistency with current mitigation strategies and practices and those identified in the Plan. Potential risk and vulnerability of the proposed project to certain natural hazards may also be considered.
- FEMA's Community Rating System - Many existing and proposed mitigation strategies also contribute positively toward a community's score in this program, which impacts flood insurance rates (Norwalk, Stamford and Westport only).
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Plan Availability and Continued Public Involvement

After adoption, copies of the Plan will be catalogued and made available at SWRPA's office, other appropriate public agencies within the Region, and at the main libraries in each municipality. In addition, the Plan will be available on SWRPA's website at www.swrpa.org. The existence and location of these copies will be publicized in newspapers in the Region. In this way, the Plan's availability will further promote the goals and objectives of this Plan by increasing awareness about natural disasters and natural hazard mitigation.

During plan review, monitoring and updates SWRPA will be responsible for providing opportunities for public involvement, communities will effectively refer the public to SWRPA. Public involvement will be conducted following the practices and recommendations outlined in the *2009 Public Participation Plan for the South Western Region Metropolitan Planning Organization.* However each municipality will be responsible for coordinating any necessary public outreach associated with implementation of recommendations from this plan following local practices.

The public is invited to send written comments about the Plan for consideration for future Plan updates. Written comments should be addressed to:

South Western Regional Planning Agency
Attn: Predisaster Mitigation Project Manager
Stamford Government Center
888 Washington Blvd., 3rd Floor
Stamford, CT 06901

SWRPA will be responsible for making public comments available for consideration during the Plan review process discussed above.