Western Connecticut Council of Governments Multi-Jurisdiction Hazard Mitigation Plan Update 2021 – 2026

Municipal Annex
for
Greenwich, CT

101 Field Point Rd.
Greenwich, CT 06830
January 2021

Prepared for:
WESTERN CONNECTICUT
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MMI #3101-22

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ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

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1.0 INTRODUCTION

1.1 Purpose of Annex

The purpose of this Hazard Mitigation Plan (HMP) annex is to provide a community-specific hazard risk assessment, capability analysis, and evaluation and prioritization of hazard mitigation measures and projects. Background information and the regional effects of pertinent natural hazards are discussed in the main body of the Western Connecticut Council of Governments (WestCOG) Multi-Jurisdictional Hazard Mitigation Plan. This annex is designed to supplement the information presented in the Multi-Jurisdictional HMP with more specific detail for the Town of Greenwich and is not to be considered a standalone document.

The primary goal of this HMP, including this Municipal Annex, is to identify natural hazard risks and mitigation opportunities in order to reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources. This includes the reduction of public and private damage costs. Limiting losses of and damage to life and property will also reduce the social, emotional, and economic disruption associated with a natural disaster.

2.0 COMMUNITY PROFILE

2.1 Geography

2.1.1 Physical Setting

Declared a township in 1665, the Town of Greenwich is located in southern Fairfield County and home to a population of 61,171 (2010 U.S. Census). Greenwich is bordered by the municipalities of Stamford to the east, New York State to the west and north, and Long Island Sound to the south. Refer to Figure 2-1 for a map showing the regional location of Greenwich.

Greenwich is a coastal community, with several rivers and streams flowing throughout the community. The town is characterized by developed areas on lower elevations adjacent the shoreline, with suburban development sprawling northward. The Byram River flows south along the western side of town before it eventually meeting the Long Island Sound. Two large waterbodies are also located in Greenwich; Putnam lake and Rockwood Lake. The highest elevation in Greenwich is Round Hill Summit - about 564 feet in Glenville. With the southern area of Greenwich being at, or close to sea level. The varying terrain of Greenwich makes the town vulnerable to an array of natural hazards.

The Center for Land Use Education and Research (CLEAR) has developed a land cover dataset derived from 2016 satellite imagery to depict statewide land cover. The land cover by percent of total land for Greenwich can be found in Table 2-1.

Table 2-1: Land Cover by Area

Land Cover	Percent Total Land Area
Developed	31.2%
Turf & Grass	25.9%
Other Grasses	1.5%
Agricultural Field	0.74%
Deciduous Forest	26.1%
Coniferous Forest	8.5%
Water	2.7%
Non-Forested Wetland	0.07%
Forested Wetland	2.5%
Tidal Wetland	0.15%
Barren Land	0.05%
Utility Corridor	0.0%

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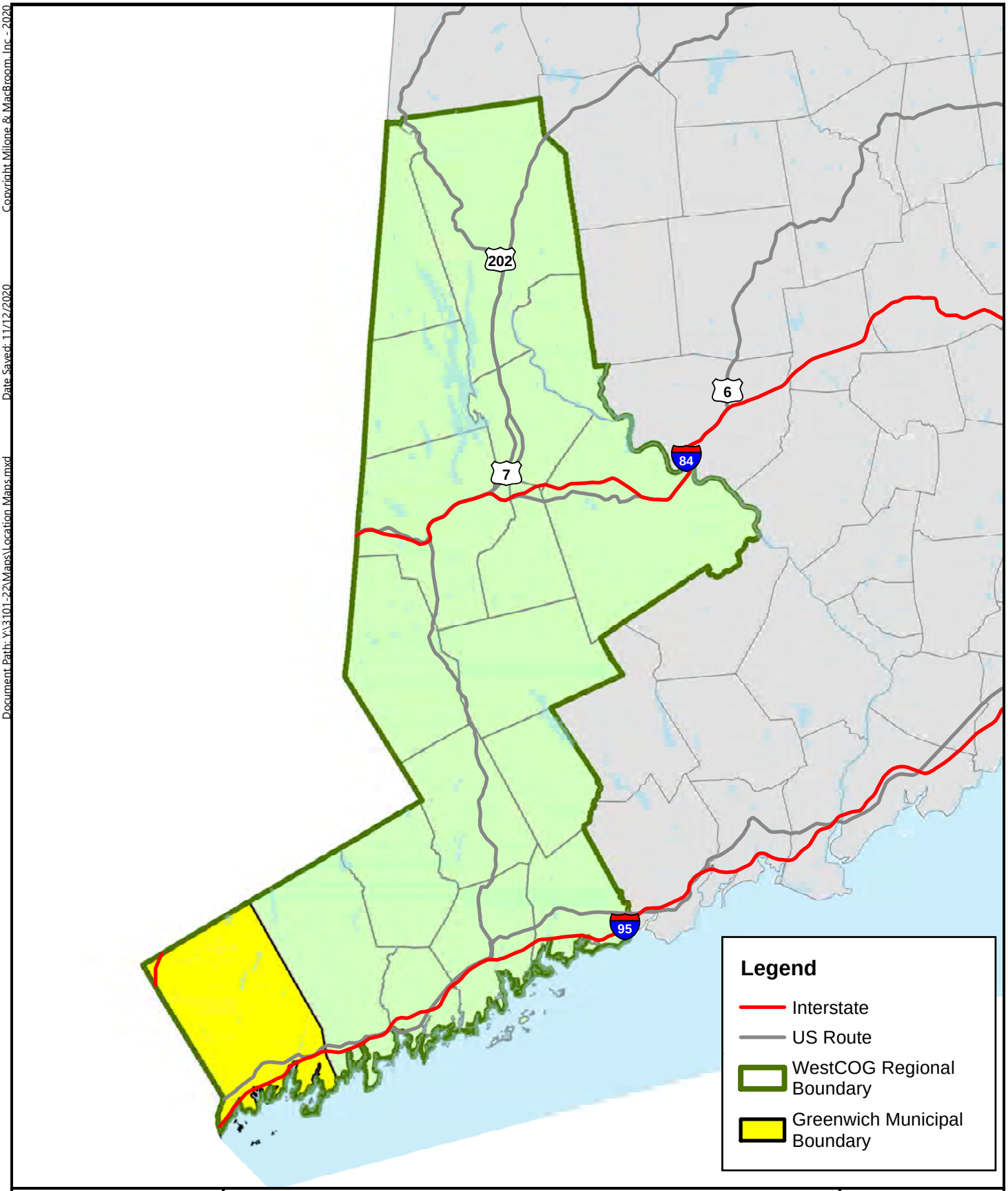

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Regional Location of Greenwich

WestCOG Hazard Mitigation Plan
Town of Greenwich

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SCALE	1 " = 82,167 '
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FIG. 2-1

2.1.2 Land Use

Greenwich is a large town with both highly developed areas, and suburban development. Most higher density development and commercial activity lies south of the Route 1, with the highest concentration of commercial activity focused around the Greenwich Train Station. The areas to the north are primarily larger lot residential neighborhoods.

According to the city's 2019 Master Plan, Greenwich is over 48 square miles (50 miles including islands). The Town defines 95% of its land use as "residential" (including housing, open space, municipal uses, places of worship, nurseries, and schools) and 5% as "commercial" (including multi-family development and office, retail, and service uses). The Town has over 21,000 taxable real-estate parcels. The Town has over 25,500 housing units, 70% of which are single-family homes and 30% of which are multi-family buildings.

2.1.3 Climate and Climate Change

Current Conditions

Over the course of the year, the temperature in Greenwich typically varies 24°F to 84°F and is rarely below 10°F or above 91°F. June 1 to September 15, with an average daily high temperature above 74°F. The hottest day of the year is July 20, with an average high of 84°F and low of 68°F. The cold season lasts from December 2 to March 11, with an average daily high temperature below 47°F. The coldest day of the year is January 29, with an average low of 24°F and high of 37°F.

Precipitation falls throughout the year in Greenwich. The wetter season lasts from March 31 to August 21, with a greater than 29% chance of a given day being a wet day. The chance of a wet day peaks at 36% on May 29. The smallest chance of a wet day is 22% on January 29.

The most rain falls during the 31 days centered around June 3, with an average total accumulation of 3.8 inches. The least rain falls around February 6, with an average total accumulation of 2.0 inches.

The snowy period of the year lasts from November 19 to April 5, with a sliding 31-day liquid-equivalent snowfall of at least 0.1 inches. The most snow falls during the 31 days centered around January 26, with an average total liquid-equivalent accumulation of 0.8 inches.

Climate data was sourced from Weather Spark based on analysis of the years 1980 to 2016.

Climate Change

Climate change projections for Connecticut were sourced from the 2019 Connecticut Physical Climate Science Assessment Report, which was developed by the University of Connecticut (UConn) Atmospheric Sciences Group, commissioned by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) with funding from the Department of Energy and Environmental Protection (DEEP). All projections are based on the IPCC high CO_2 emission scenario (RCP8.5).

Temperature

Annual temperatures have been increasing throughout Connecticut and is projected to continue to do so in the future. By mid-century, average annual temperature is projected to increase by

5°F. Seasonal average temperatures are also expected to rise, with the greatest increase (6°F) experienced in summer (June to August). The number of nights over which temperature remains above 68°F will quadruple from 10 days per year to more than 40 days, and the number of extremely hot days will increase from above 4 a year to 48 per year.

Precipitation

Rainfall data in "Technical Paper No. 40" by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961) dates from the years 1938 through 1958. According to these data, the 24-hour rainfall amount for a 50% annual-chance storm in Fairfield County is 3.3 inches.

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

The Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes (http://precip.eas.cornell.edu/). In 2020 this dataset listed the 24-hour rainfall amount for a 50% annual-chance storm in Greenwich as 3.45 inches.

The NOAA Atlas 14, released on September 30, 2015 puts the 24-hour rainfall amount for a 50% annual-chance annual storm in Greenwich at 3.58 inches.

These precipitation amounts, and more details, are summarized in Table 2-2, below.

Table 2-2: 24-Hour Rainfall Amounts by Annual-Chance Occurrence

Source	24-Hour Rainfall Amount (inches) by Annual-Chance Occurrence		
	50%	4%	1%
Technical Paper No. 40	3.3	5.7	7.2
NRCC	3.45	6.41	9.02
NOAA Atlas 14	3.58	6.57	8.34

Annual precipitation has been increasing statewide and is projected to continue to increase. By mid-century, annual precipitation is projected to increase by 8.5%, with the greatest increase (13.4%) occurring in the winter months. Extreme precipitation events are projected to increase in both frequency and magnitude. Based on this increase and the precipitation figures above, by 2050 Greenwich can expect the 24-hour rainfall amount for a 50% annual-chance storm to be around 3.7 to 3.9 inches or greater.

Impervious surfaces and infrastructure in town have increased over time as well, leading to increasing runoff and peak discharge values.

Despite overall increases in precipitation, drought risk is projected to increase, especially during summer, due to changing precipitation patterns and projected increases in potential evapotranspiration (plants taking up more water in hotter temperatures and longer growing seasons).

2.1.4 Drainage Basins and Hydrology

Greenwich is divided among seven sub-regional watersheds as shown in Table 2-3. The majority of the sub-regional basins drain into Long Island Sound. All of the water that passes through Greenwich eventually empties into Long Island Sound.

Table 2-3: Sub-Regional Drainage Basins

Drainage Basin	Overall Sub-regional Area (sq. mi)	Area within Town (sq. mi)	Area within Town (acres)	Percent of Town
Blind Brook	11.45	0.48	305.22	1%
Byram River	18.67	8.37	5,356.33	18%
East Branch Byram River	11.29	10.07	6,445.57	21%
Greenwich Creek	8.89	8.89	5689.47	19%
Horseneck Brook	6.52	6.52	4173.27	14%
Mianus River	28.64	6.21	3975.29	13%
Southwest Shoreline	8.83	6.93	4433.38	15%
Total	n/a	47.47	30378.53	

Source: Connecticut Department of Energy & Environmental Protection GIS Data

The majority of Greenwich is encompassed within the Southwest Coast drainage basin. The Southwest Shoreline is considered its own basin which also drains into the Sound. Of the seven subregional drainage basins and their respective streams, the East Branch of the Byram River running is the largest, followed by Greenwich Creek in the southeastern part of town.

The East Branch of the Byram River is approximately 17 miles, and originates at Lake Mead in northwest Greenwich and runs south until it eventually joins the Byram River.

Greenwich Creek is approximately 20 miles long, and originates between the Merritt Parkway and Londonderry Road. The basin drains 28.64 square miles directly into Long Island sound in Greenwich, Connecticut.

2.2 Society, Culture, and Government

2.2.1 Population and Demographic Setting

According to the 2010 U.S. Census, Greenwich had a population of 61,171, with 1,259 persons per square mile. According to the 2018 American Community Survey five-year estimates, Greenwich's population between 2013 and 2018 was approximately 62,574.

One important aspect of natural hazard mitigation planning is to identify a community's demographic trends in relation to natural hazards. The Center for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) is used to identify vulnerable populations in Greenwich. The SVI uses census data to identify populations within the town that may be more vulnerable to natural hazards. As a result of this analysis, the town is identified to have a certain level of overall social vulnerability with a rank of 0 to 1; 1 being the most vulnerable and 0 being the least.

To determine social vulnerability, the CDC incorporates 15 factors into the overall SVI calculation under four categories, or themes: socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. Figure 2-2 represents the breakdown of the SVI process. These themes and their ranking are based on census statistics. By evaluating these factors and determining a level of social vulnerability, a community can identify specific needs for before, during, and after an event. Such needs may include sheltering capacity, evacuation routes, or to decide how many emergency personnel may be required to respond after an event.

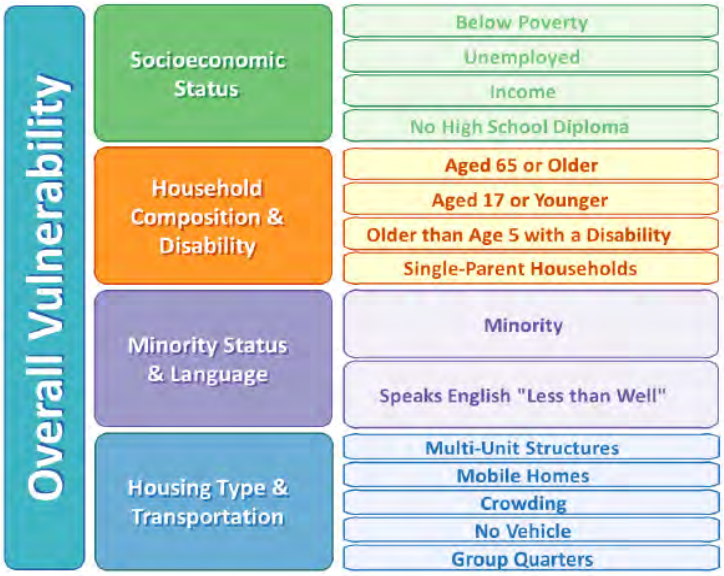

Figure 2-2: The CDC SVI Index Factors. Graphic: svi.cdc.com

The Town of Greenwich is considered to have a low to moderate overall vulnerability, with their most vulnerable social aspect being minority populations, and populations that speak English "less than well", along with populations with vulnerable household composition. The more vulnerable populations are concentrated in the southwestern tracts. Appendix B explores the SVI for Greenwich in more depth, including maps showing overall vulnerability, and theme vulnerability.

2.2.2 Development Trends

During the 18th century Greenwich was predominantly agriculture. The town grew after the construction of the New York and New Haven Railroad in 1848, linking it to New York City and eventually New Haven and beyond. In the late 19th century and early 20th century, the town had a resort industry with more than a dozen inns.

In 1938, the Merritt Parkway cut through the northern section of Greenwich, followed by I-95 to the south in 1957. New arrivals swelled the population of the town. The newcomers were typically employees of corporations leaving New York City for congenial suburban headquarters. While the beginning of the century saw the creation of great land estates, the post-World War II period witnessed their dissolution into smaller building lots to accommodate the new residents.

Economic activity continues to drive growth within the region, and the communities abutting Greenwich have grown rapidly in recent years. Population in Greenwich has remained relatively stable at around 60,000 for the last 50 years, though future growth is expected. There were 101 new residential permits issued in the 2017-2018 fiscal year.

The Greenwich POCD (2019) did not specifically reference locations within town for development or redevelopment, but it promotes the establishment of Village Districts for Banksville, Byram, Cos Cob, Chickahominy, Glenville, Old Greenwich, North Mianus, Pemberwick, and Riverside to foster individualized senses of place within a cohesive town-wide framework. The POCD encourages development of housing for seniors and affordable housing, preferably around transit. While transit-oriented development has not been specifically promoted, some potential exists. Town staff report that some development does take place in low-lying areas that may be at risk from flooding; however, all new development within mapped FEMA flood zones meets or exceeds current FEMA standards. Overall, given the measured pace of development and redevelopment in Greenwich, community vulnerabilities are not increasing.

2.2.3 Governmental Structure

The First Selectman of Greenwich serves as the Chief Executive and Chief Administrative Officer of the Town. Along with presiding over Board of Selectmen meetings, the First Selectman serves as an ex-officio member of all Town Boards, Commissions and Committees. The First Selectman acts as a link between Weston and State, regional, and federal agencies.

The Board of Selectmen Office is the focal point of Greenwich town government. Along with its many responsibilities and duties, constituent contact with the public is an extremely important function of the day-to-day business of the Office. Every effort is made to keep open all lines of communications between government and the people it serves.

The Selectmen's Office also supports and assists a variety of community interests, activities, and organizations through proclamations, statements, appearances as well as active participation. This continues a long-established tradition of proactive involvement by the First Selectman and Selectmen in all aspects of town life.

Town departments provide municipal services and day-to-day administration. Many commissions and departments play a role in hazard mitigation, including the Planning and Zoning, Environmental Protection Board, the Building Official, the Land Use Bureau, the Fire Department, Emergency Management, and the Public Works Department.

2.2.4 Historic and Cultural Resources

Historic and cultural resources include sites, structures, and objects that are significant in history, architecture, archaeology, engineering, and culture. Protection of these resources grows economies and enhances community character, and following a natural disaster they can help to reinforce neighborhood connections and reestablish a sense of community and normalcy. Consideration of these resources in this HMP is critical.

Historic preservation planning helps protect historic properties and cultural resources from demolition or alteration. **Hazard mitigation planning** helps protect life and property from damage caused by natural and manmade hazards. **Integrating** these two planning processes helps create safe and sustainable historic communities.
- Paraphrased from FEMA Report 386-6

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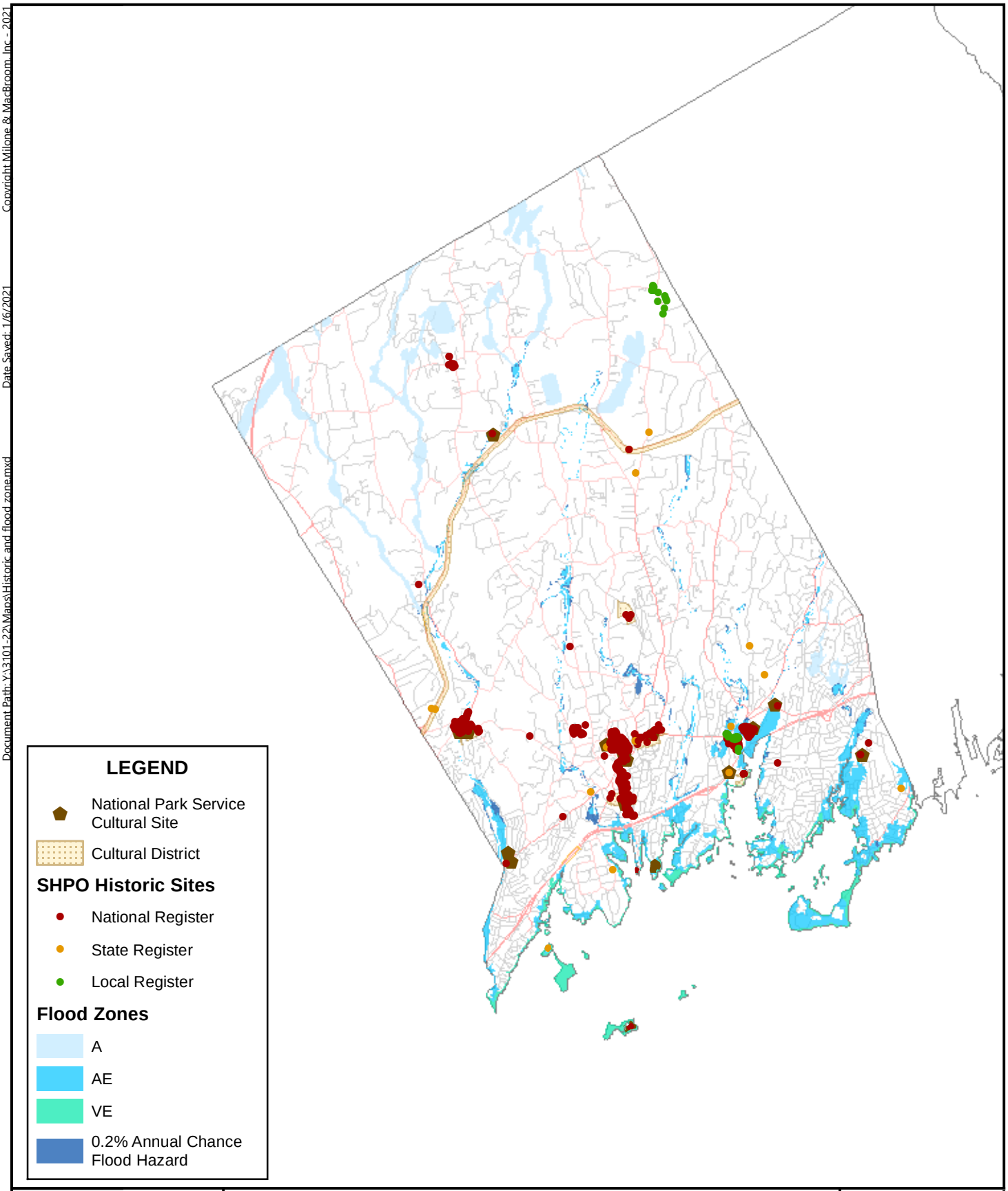

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Historic Resources with Flood Zones and Dam Failure Inundation Areas

WestCOG Hazard Mitigation Plan

Town of Greenwich

NPS: Cultural Resources CT DEEP: DFA FEMA: DFRIM & Q3

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SCALE 1 " = 8,935 '

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FIG. 2-3

Historic resources in Greenwich are concentrated within the John Street-Round Hill, Stanwich, Strickland Road, Stonybrook, Greenwich Municipal Center, Greenwich Avenue, Glenville, Nathaniel Witherell, Putnam Hill, River Road-Mead Avenue, and Fourth Ward Historic Districts. Greenwich historic resources also include the Indian Harbor Yacht Clubs, Mead Farm and French Farm, the Cos Cob Fire House, Ferris Farm Cemetery, Rosemary Hall, Montgomery Pinetum Greenhouse, the Cos Cob Power Station, and the Great Captain Island Lighthouse. Overall, there are over 600 historic sites, structures, and objects in Greenwich. See Figure 2-3 for a map of historic resources in the community.

Analysis of the State Historic Preservation Office (SHPO) database of historic resources shows that some of these resources are exposed to natural hazards, as shown in **Error! Not a valid bookmark self-reference.**.

Table 2-4: Number of Historic Assets Exposed to Different Hazards in Greenwich

Hazard	Count
Dam Failure	0
Earthquake	626
Flooding	-
1% Annual	0
0.2% Annual	2
Storm Surge	-
Category 1	14
Category 2	27
Category 3	39
Category 4	16
Hurricane/Tropical Storm	626
Sea Level Rise	2
Thunderstorm	626
Tornado	626
Winter Storm	626
Wildfire	44

Historic buildings and structures may be particularly susceptible to natural hazards because they were built prior to the establishment of more recent construction standards. Additionally, some of the structural integrity of these resources may have been degraded over the decades or centuries since their original construction. Structural retrofits and hazard mitigation methods may be challenging or restricted in cases where alteration of a resource will also diminish its cultural or historical aesthetic and value. Finally, miscommunications or lack of knowledge may lead to historic resources being damaged during the disaster recovery process.

Steps to incorporate historical and cultural preservation into hazard mitigation planning include:

- Inventory and survey historic and cultural resources
- Implement appropriate mitigation measures for those resources
- Take steps to move portable resources, such as artwork or documents, to safe locations prior to the occurrence of a hazard, if possible

- Consider these resources in emergency operations plans to prevent accidental damages during recovery efforts

Specific actions to mitigate natural hazard risks to historic resources are listed at the end of this Annex.

2.3 Infrastructure

2.3.1 Transportation

Major transportation routes in Greenwich include Interstate 95 and the Merritt Parkway (Route 15), which run north to south through the town. The Parkway runs through the central part of the town, while I-95 runs through the southern region of Greenwich.

In addition, the Metro North/Amtrak rail lines also run through the town, along Interstate 95. There are three stations, one in the downtown, Cos Cob, and Riverside. The CTtransit bus system is also active in town with several stops throughout the community.

2.3.2 Utilities

Aquarion Water Company owns and operates public water systems in Greenwich. This system provides water for the southern half of the city, with some northeastern service lines along Route 137 and west along Mill Road. The Brunswick Middle School in the northwest part of the Town is served by its own community water system, and a number of transient non-community public water systems exist throughout the northern part of Town. The remaining properties rely on a private well for drinking water.

Residents and businesses use oil, propane, or natural gas for heat. Natural gas is provided to the southern region of town by Eversource.

The Wastewater Division Manager, under direction of the Commissioner of Public Works, has charge of the construction, maintenance and repair of all sewers and sewerage systems, including the Grass Island Waste Water Treatment Plant and 28 pumping stations.

According to geoISP (geoISP.com), access to Broadband Internet is available to most residents in Greenwich. There are 4 DSL Providers (MegaPath, Verizon, Broadview Networks, XO Communications), 1 Cable Internet providers (CSC Holdings), and 5 Fiber Internet providers (CSC Holdings, Verizon, Fibertech Networks LLC, Level(3) Communications, and Connecticut Education Network). There are also 4 Mobile Broadband (cellular) providers with service available in Greenwich.

2.4 Planning and Regulatory Capabilities

Greenwich has in place a number of community planning mechanisms, regulations, and policies that serve to mitigate natural hazards by limiting development in hazardous areas, requiring buildings be constructed to certain standards, or otherwise directing development and construction toward increased resilience. These are summarized below.

2.4.1 Review of Existing Local Plans

Greenwich has a number of plans that are relevant to hazard mitigation. These are noted here:

- **Plan of Conservation and Development (POCD):** Greenwich's most recent POCD was adopted in 2019. It addresses natural hazard concerns within the community, and includes strategies that will mitigate risks from those hazards as the community continues to develop.
- **Stormwater Management:** Greenwich maintains a Stormwater Management Plan. This plan complies with the requirements of the US EPA 2017 updated *General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems* (MS4 General Permit). The Town also utilizes the *Town of Greenwich Drainage Manual: Low Impact Development and Stormwater Management,* developed in 2012 to guide stormwater planning.
- **Capital Improvement Plan (CIP):** Greenwich maintains a CIP that is updated annually and lays out capital investments for a five-year period. The CIP often includes road, drainage, and other infrastructure improvement projects relevant to hazard mitigation.
- **Economic Development Plan:** Greenwich is included within the Western Connecticut Economic Development Plan of 2017, developed by WestCOG. The plan aligns with the COG's other efforts to promote climate sustainability and resiliency in the region. The Town also has a local economic development plan called the Think Greenwich Campaign.
- **Emergency Operations Plan (EOP):** Greenwich's EOP is reviewed annually and updated as needed. Dam failure Emergency Action Plans (EAPs) for dams with failure inundation zones that may impact Greenwich, and for which EAPs are available, are on file locally.
- **Watershed Management Plan:** Watershed Management Plans have been developed for the Mianus River Watershed and the Byram River Watershed. The Mianus River Watershed Based Plan was developed for the South Western Regional Planning Agency (SWRPA) by AKRF, Inc. in 2012, while the Byram River Watershed Management Plan was developed for the Southwest Conservation District in 2011 by Steven Danzer Ph.D. & Associates, LLC, with support from the Town of Greenwich and the Byram Watershed Coalition. These plans are focused on water quality, but can help the community mitigate inland flood risks by incorporating watershed management best practices into its planning efforts.
- **Open Space:** Greenwich's most recent Open Space Plan was developed in 2015, and has been incorporated into the community's POCD as an addendum.

2.4.2 Review of Regulatory Structures

Greenwich regulates development through a number of regulations, codes, and ordinances. These are summarized below. More detailed information about how these regulations relate to specific natural hazards are described in Section 3.

- **Building Code:** Greenwich enforces the Connecticut State Building Code locally.
- **Zoning Regulations:** Most recently updated in August 2019.
- **Inland Wetlands and Watercourses Regulations:** Most recently updated in October 2015.
- **Subdivision Regulations:** Most recently updated in May 2005. Include provisions promoting control of stormwater runoff, installation of firefighting water sources, and burial of utilities.

2.5 Emergency Services, Critical Facilities, Sheltering, and Evacuation

The town considers its police, fire, and governmental facilities to be critical since these are needed to ensure that emergencies are addressed while day-to-day management of Greenwich continues. The city also considers various facilities housing higher-risk individuals (such as elderly individuals or children) and large populations to be critical facilities. Table 2-5 and Figure 2-4 identifies all of these critical facilities.

Table 2-5: Critical Facilities

Facility	Address or Location	Type	Emergency Power	Shelter	In 1% Floodplain
Town Hall	101 Field Point Rd	Town Hall	✓		
Western Greenwich Civic Center	449 Pemberwick Rd	Shelter	✓	✓	
Eastern Middle School	51 Hendrie Ave	Shelter	✓	✓	
Binney Park Shed	0 Sound Beach Ave	Public Works			
Bldg Maint/Construction	1 Newman St	Public Works			✓
Byram Hwy Shed	*[not mapped]*	Public Works			✓
Byram Park Dockmaster	0 Byram Shore Rd	Public Works			
Cos Cob Dockmaster	0 Strickland Rd	Public Works			
Indian Field Highway Shed and Fleet Maintenance (also known as Cos Cob / Boro Highway Shed)	100 Indian Field Rd	Public Works	✓		
Grass Island Waste Treatment Plant	0 Shore Rd	Public Works			✓
Greenwich Point - Dockmaster	0 Tods Driftway	Public Works			✓
Havemeyer (Shed)	381 North St	Public Works			
North Field Maintenance, Tree Crews; Animal Shelter	393 North St	Public Works	✓	✓	
Old Greenwich Hwy Shed	*[not mapped]*	Public Works			✓
Holly Hill Transfer Station	101 Field Point Rd	Public Works	✓		
Greenwich Police Department	11 Bruce Place	Police / EOC	✓		
Greenwich Police Marine Division	100 Arch St	Police			✓
Greenwich Hospital	5 Perryridge Rd	Hospital	✓		
Central Fire Station (Station 1 – Headquarters)	15 Havemeyer Place	Fire	✓		
Cos Cob Fire Station (Station 2)	200 East Putnam Ave	Fire	✓		
Byram Fire Station (Station 3)	264 Delavan Ave	Fire	*		
Glenville Fire Station (Station 4)	266 Glenville Rd	Fire	✓		
Sound Beach Fire Station (Station 5)	207 Sound Beach Ave	Fire	✓		✓
Round Hill Fire Station (Station 6)	166 West Old Mill Rd	Fire	✓		
North Street Fire Station (Station 8)	669 North St	Fire	✓		
Horseneck Fire Station	1 Horseneck Lane	Fire	✓		
Pemberwick Center	131 Pemberwick Rd	Community Center			
Senior Center	299 Greenwich Ave	Community Center			
Fairview Healthcare Center of Greenwich	1188 King St	Care Facility			
Family Centers, Inc.	20 Bridge St	Care Facility			
The Greens At Greenwich	1155 King St	Care Facility			
Greenwich Laurelton Nursing & Conv Home	1188 King St	Care Facility			
Greenwich Woods Health Care Center	1165 King St	Care Facility			
Greenwich Woods Rehabilitation	1165 King St	Care Facility			
Greenwich Youth Options	55 Old Field Point Rd	Care Facility			
Merry Go Round Alsa	1/2 Bolling Place	Care Facility			
Nathaniel Witherell	70 Parsonage Rd	Care Facility	✓		
Parsonage Cottage Senior Residence	88 Parsonage Rd	Care Facility			
Pathways, Inc	175 Milbank Ave	Care Facility			
Greenfield EMS Medic 4	143 Lower Cross Rd	Emergency	✓		

* Generator will be installed upon completion of ongoing renovations

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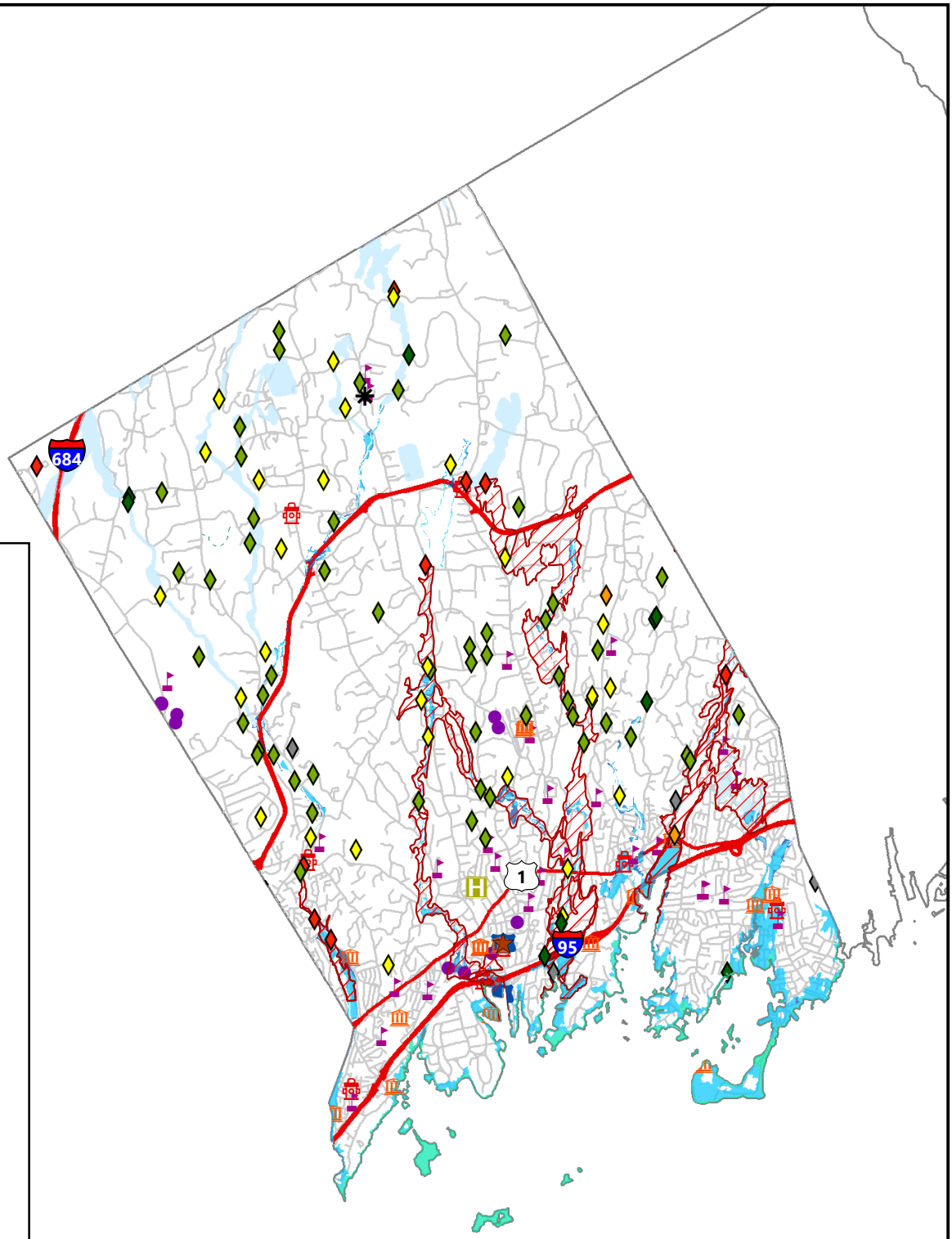

LEGEND

Dams

- Unclassified
- AA
- A
- BB
- B
- C
- Dam Failure Inundation Area
- Ambulance
- Care Facility
- Municipal
- EOC
- Fire
- Hospital
- Police
- School

Flood Zones

- A
- AE
- VE
- 0.2% Annual Chance Flood Hazard

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Critical Facilities with Flood Zones and Dam Failure Inundation Areas

WestCOG Hazard Mitigation Plan

Town of Greenwich

NPS: Cultural Resources CT DEEP: DFA FEMA: DFRIM & Q3

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SCALE 1 " = 8,935 '

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FIG. 2-4

The Greenwich Town Hall does not have full backup power, but certain systems within the facility are tied-in to an emergency generator. The Health Department, within the Town Hall, has its own backup power source to maintain refrigeration for medicines.

Emergency Shelters

The Western Greenwich Civic Center and Eastern Middle School are the Town's emergency shelters. The Town Hall can also serve as a backup shelter, though its capacity is limited in part by its incomplete backup power capabilities.

The North Field Maintenance facility on North Street serves as an emergency shelter for pets.

Emergency Response

The Greenwich Police Department on Bruce Place serves as the Town's Emergency Operations Center. Greenwich is also served by eight fire stations, two police stations, and a number of Ambulance centers (not included on the critical facilities list). Byram Fire Station (Station 3) was closed and undergoing renovations at the time of plan development; when the renovations are completed, the facility will have backup power.

Emergency Communication Capabilities

Greenwich has improved its internal emergency communication systems in recent years, minimizing the risk of disruption and delays during an emergency. The Town maintains a public emergency notification system, reviews its capabilities regularly, and makes upgrades as necessary. The Town participates in the statewide CTAlert system.

Schools

Greenwich has a large number of public and private schools. Eastern Middle School serves as a public emergency shelter; the other schools are not listed as critical facilities, but are still considered by the Town to be important community sites worth special care and attention. Public schools are managed somewhat independently by the Board of Education.

School	Address
Eastern Middle School	51 Hendrie Avenue
Brunswick School	100 Maher Avenue
Central Middle School	9 Indian Rock Ln.
Connecticut Institute of Art	581 West Putnam Avenue
Convent of The Sacred Heart	1177 King Street
Cos Cob School	300 East Putnam Ave.
Glenville School	33 Riversville Rd.
Greenwich Academy	200 North Maple Ave
Greenwich Catholic School	471 North Street
Greenwich Country Day School	401 Old Church Rd
Greenwich High School	10 Hillside Rd.
Greenwich Kokusai Gakuen	521 E Putnam Ave
Hamilton Avenue School	184 Hamilton Ave.
International School at Dundee	55 Florence Rd.
Julian Curtiss School	180 East Elm St.

School	Address
New Lebanon School	25 Mead Ave.
North Mianus School	309 Palmer Hill Rd.
North Street School	381 North St.
Old Greenwich School	825 Sound Beach Ave.
Parkway School	141 Lower Cross Rd.
Riverside School	90 Hendrie Ave.
The Greenwich Japanese School	15 Ridgeway
The Stanwich School	257 Stanwich Rd
Westchester Fairfield Hebrew Aca.	300 East Putnam Ave
Western Middle School	1 Western Junior Hwy.
Whitby School	969 Lake Avenue

3.0 HAZARD ASSESSMENT

3.1 FLOODING (COASTAL, INLAND, AND ICE JAMS)

3.1.1 Setting

The potential for flooding exists across Greenwich, with the majority of major flooding occurring along established riverine and coastal SFHAs. The areas impacted by overflow of river systems are generally limited to river corridors and floodplains. Indirect flooding that occurs outside floodplains and localized nuisance flooding along tributaries can also be a concern. This type of flooding occurs particularly along roadways as a result of inadequate drainage and other factors. Coastal flooding can occur during a severe storm event by way of storm surge, and can also occur as nuisance flooding, which is experience during extremely high tide events. The frequency of flooding in Greenwich is considered likely for any given year, with flood damage potentially having significant effects during extreme events.

A regulatory floodplain with AE designation has been mapped along Horseneck Brook. There are also regulatory floodplain areas with a VE or an AE designation along the Long Island Sound shoreline. The Areas identified as providing flood storage are identified with A Zone designations, meaning they are regulated as floodplain, but flood elevations have not been established. Rockwood Lake, Converse Lake and Converse Pond Brook, and the Byram River distribute these traits. Floodplain and floodway designations have also been established along the rivers with AE designations. Refer to Figure 2-4 for the areas of Greenwich susceptible to flooding based on FEMA flood zones.

In general, potential flooding problems in Greenwich are concentrated along the multiple rivers, and the coastline.

Coastal flood events, especially storm surge during hurricanes and tropical storms, can cause some of the most severe damage with high economic impacts to the town and residential properties. Figure 3-1 depicts storm surge inundation zones from hurricanes and tropical storms.

3.1.2 Capabilities

The Town primarily attempts to mitigate future flood damage and flood hazards by restricting building activities in floodprone areas. This process is carried out through both the Planning and Zoning process. All watercourses are to be encroached minimally or not at all to maintain the existing flood-carrying capacity. These regulations rely primarily on the FEMA-defined 1% annual chance flood elevations to determine flood areas.

Floodplain Management and NFIP

The town has consistently participated in the NFIP since October 18, 1974 and intends to continue participation in the NFIP. SFHAs in Greenwich are delineated on a Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS). The FIS and FIRMs for the town were most recently revised in 2013.

Greenwich has updated its zoning regulations over time to increase flood zone requirements. Changes have included:

- Stricter regulations encourage people to elevate homes
- Substantial Improvement definition calculates improvement cumulatively since property became out-of-compliance with regulation updates (as far back as 1986)

Greenwich's floodplain management efforts far exceed those of other communities with regards to bringing homes into compliance.

Ordinances, Regulations, and Plans

Regulations, codes, and ordinances that apply to flood hazard mitigation in conjunction with and in addition to NFIP regulations are listed below, with examples of sections and content with specific relevance to flood mitigation.

- ***Zoning Regulations***:
  - Section 6-139: Flood Hazard Overlay - intended to add additional safeguards to those areas of Greenwich subject to riverine and coastal flooding as shown on the Flood Insurance Rate Maps.

- ***Inland Wetland and Watercourse Regulations***:
  - Section 4: To carry out the purposes of this section, any person proposing to carry out a permitted or non-regulated operation and use of a wetland or watercourse that may disturb the natural and indigenous character of the wetland or watercourse shall, prior to commencement of such operation and use, notify the Agency on a form provided by it, and provide the Agency with sufficient information to enable it to properly determine that the proposed operation and use is a permitted or non-regulated use of the wetland or watercourse. The Agency shall rule that the proposed operation and use, or a portion of it, is a permitted or a non-regulated operation and use, or that a permit is required. Such ruling shall be in writing, shall state the factual bases for the ruling, and shall be made no later than the next regularly scheduled meeting of the Agency following the meeting at which the request was received. The Agency encourages the use of best management practices by those who conduct permitted and non-regulated operations and uses in order to minimize adverse impacts on wetlands and watercourses.

- ***Subdivision Regulations:***
  - Subdivision proposals must be consistent with the need to minimize flood damage.
  - Proposals must have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.
  - Proposals must provide adequate drainage to reduce exposure to flood hazards
  - Base flood elevation data shall be provided for all subdivision proposals greater than five acres or fifty lots in Zone A

Drainage and Street Flooding

Residents can submit flooding and drainage complaints by phone, email, or a form on the town webpage. Complaints are sent or forwarded to the Engineering Department. The department compiles a list of complaint locations and tracks locations of concern over time. Complaints are often minor, requiring only minor maintenance or cleanings to address. The Town has, however, been receiving a larger volume of more significant complaints over time.

Actions Completed and New Capabilities

Greenwich has performed many drainage-improvement projects over the last five years. These include:

- Replacing a 12-inch pipe with a 42-inch pipe under one roadway
- Completing drainage network rehabilitation on Route 1 near Mason Street (including a distance down Mason Street). This project helps protect a critical telecommunication facility on Sherwood Avenue.
- Completing a major drainage improvement project in Old Greenwich, along Park Avenue, Highview Avenue, Sound Beach Avenue, and Arcadia Road.

The Town has elevated three sewer pump stations in the coastal area:

- Ballwood Pump Station
- Heusted Pump Station
- Meadow Pump Station

Greenwich has initiated a study to determine how to best protect and floodproof the Grass Island Waste Treatment Plant. This study will be completed within the next year, and should inform mitigation actions moving forward.

The Town has also elevated a public restroom and a new pool in a public park.

Other actions Greenwich has taken to mitigate flood risks in recent years include:

- In 2019 Greenwich explored participation in FEMA's Community Rating System (CRS) program, after WestCOG encouraged them to do so. Ultimately the Town decided not to pursue participation.
- Greenwich had over 20 homes elevated as part of an HMGP grant associated with Superstorm Sandy. Additionally, many more properties were elevated without HMGP assistance, making the total number of homes elevated in recent years significantly higher.

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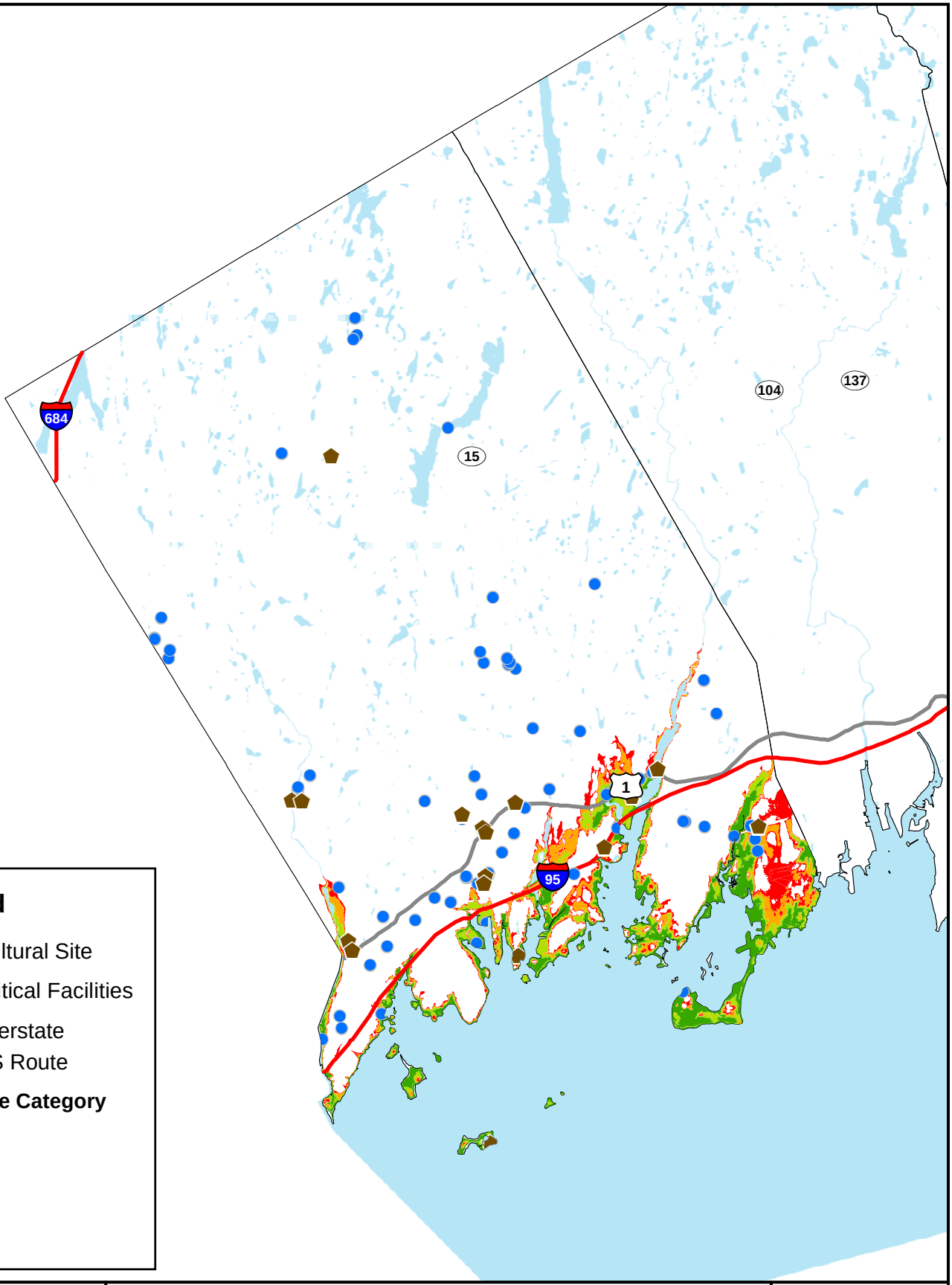

Legend

- Cultural Site
- Critical Facilities
- Interstate
- US Route

Hurricane Category

- 1
- 2
- 3
- 4

MILONE & MACBROOM
99 REALTY DRIVE
CHESHIRE, CT 06410
203.271.1773
WWW.MMINC.COM

Hurricane Storm Surge Inundation Areas

WestCOG Hazard Mitigation Plan
Town of Greenwich

NPS: Cultural Resources
DEEP: Storm Surge Areas

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Feet

SCALE	1 " = 8,323 '
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FIG. 3-1

3.1.3 Vulnerabilities and Risk Assessment

Repetitive Loss Properties

There are 117 repetitive loss properties (RLPs) located in the Town of Greenwich; 109 are residential and 8 are non-residential. Most are along the coast of the Long Island Sound.

Critical Facilities

There are nine facilities located within the 1% annual chance flood zones. Of these facilities, the Sound Beach Fire Station is critical to emergency response during a hazard event and has been identified as an emergency shelter also critical during a natural hazard event.

The at-risk facilities include:

- Sound Beach Fire Department, Station 5
- Greenwich Police Marine Division
- Cos Cob School
- Building Maintenance/ Construction on Putnam Ave
- Grass Island Maintenance Shed
- Byram Highway Shed
- Old Greenwich Highway Shed
- Cos Cob Dick Master
- Green Point Dock Master

At-Risk Areas

Figure 2-4 depicts FEMA flood zones in Greenwich. Figure 3-1 shows hurricane storm surge inundation zones.

Flooding is a concern at the following locations:

- Sound Beach Avenue in Old Greenwich
  - Town staff have observed road flooding more frequently in recent years. Coastal flooding and poor drainage flooding both impact the area.
  - Flooding impacts emergency access. Town has explored alternative routes for emergency access, but flooding also floods those alternative routes.
- Shore Road, near Greenwich Point
  - Town reports "nuisance" flooding
- Byram River between Route 1 and Comly Avenue
  - Flooding is a problem in the Pemberwick Neighborhood
  - Town has been working on a study with CT DOT since 2012 for this area. A draft Feasibility Study for proposed improvements to the area is nearing completion. The study addresses replacing bridges on Route 1 at the state line, so New York DOT is also involved.
- Greenwich Creek at East Putnam Avenue and Hillside Road, near Greenwich High School
  - Flooding has been a problem here in the past.
  - CT DOT will be redoing the bridge at East Putnam Avenue and Hillside Rd in 2020.

Town staff has also noted a concern with regard to privately-owned and maintained roads; the associations responsible for these roads sometimes do not perform the maintenance or upgrades necessary to ensure adequate drainage and flood control. This can result in blocked or washed-out roads, and a need for municipal intervention to perform emergency stabilization or resident rescues.

Brothers Brook & Mianus River Pond

Southern reaches of theses waterbodies have large delineated floodplains, and therefore may be considered to be the most at-risk areas along the river. Within this southern half there are 18 RLPs, indicating past flood challenges. There are road and rail crossings over this area, which may present challenges in regard to infrastructural capacity during a heavy event.

Long Island Sound Coastline

The shoreline of Greenwich is primarily residential, with pockets of commercial activity. The entire coastline, specifically Old Greenwich Point Park, Old Greenwich, and Cos Cob, are all identified to have low lying, coastal stretched which may be at risk of both nuisance and storm surge flooding.

Other Challenges

Town staff noted that many property owners don't have flood insurance, or don't file claims following damage, so information is missing about damages and risk. Data on damages and costs of flooding reflects less damage and lower costs than what is actually happening.

3.2 DAM FAILURE

3.2.1 Setting

Dam failures can be triggered suddenly, with little or no warning, and often from other natural disasters such as floods and earthquakes. Dam failures often occur during flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail. While flooding from a dam failure generally has a moderate geographic extent, the effects are potentially catastrophic. Fortunately, a major dam failure is considered very unlikely in any given year.

3.2.2 Capabilities

Dam failure inundation areas are included in the CT Alert emergency notification system contact database. The Town has the Emergency Action Plan (EAP) for the Aquarion owned dams on file in the event of a potential failure. The high hazard dams include the Rockwood Lake Dam, the Pemberwick Dam, and the American Can Company Dam.

Most dams in Town are privately owned, and state efforts to ensure dam maintenance address the needs of those structures.

Actions Completed and New Capabilities

The Town is currently performing significant improvements to the Cos Cob dam. Aquarion recently performed significant work on the Rockwood Lake Dam off North Street. The Town also recently performed vegetation maintenance at the dam near the Greenwich High School. Greenwich's dam failure mitigation capabilities have improved since adoption of the previous plan through increased dam monitoring and dam safety enforcement capabilities at the state level, as well as the digitization and inclusion of dam failure inundation areas into the CTAlert system.

3.2.3 Vulnerabilities and Risk Assessment

As of 2013, there were 99 DEEP-inventoried dams within the Town of Greenwich. These dams are shown in Figure 2-4. Six of these dams are a Class C, or high hazard dam, and four others are a Class B, or significant hazard dam. As shown in Table 3-1, the high hazard dams located in the town pose a risk to Greenwich.

Table 3-1: High Hazard Dams with Potential to Affect the Town of Greenwich

#	Name	Location	Class	Owner
5753	Mianus Filter Plant Dam	Mianus Mill Pond	C	Aquarion Water Company of CT
5701	Putnam Reservoir Dam	Putnam Lake	C	Aquarion Water Company of CT
5703	Pemberwick Dam	Pemberwick Pond	C	Fairfield Associates Conservation; Greenwich Hills Association, Inc.

#	Name	Location	Class	Owner
5704	American Felt Dam	American Felt Pond	C	1881 Limited Liability Company
5726	Rockwood Lake Dam	Rockwood Lake Reservoir	C	Aquarion Water Company of CT
5728	American Can Company Dam	North Lake	C	Bush & Greenwich Inc.
5705	Wilcox Pond Dam	Byram River	BB	Private
5706	Ville Pond Dam	Otter Pond	BB	Private
5708	Angulus Pond Dm	Byram River	BB	Upper Cross Road Private Park
5709	Dublin Hill Dam	Brothers Brook Tributary	BB	Private
5701	Wooley Pond Dam	Wooley Pond	BB	Town of Greenwich
5711	East Pond Dam Greenwich Creek	Seabury	BB	The Orchards Property Owners Association
5712	Valley Pond Dam	Converse Pond Brook Tributary	BB	Private
5713	Lake Mead Dam	Converse Pond Brook Tributary	BB	National Audubon Society
5714	Cross Pond Dam	East Branch Byram River	BB	Upper Cross Road Private Park
5715	Street Pond Dam	Horseneck Brook	BB	Private
5716	East Pond Dam	East Pond	BB	Town of Greenwich
5717	Ridgeview Pond Dam	Converse Pond Brook	BB	Private
5718	Dingletown Road Dam	Greenwich Creek	BB	Private
5720	Coat Pond Dam	Coat Pond	BB	Private
5722	Carringtons Pond Dam	Carringtons Pond	BB	Private
5723	Indian Spring Pond Dam	Indian Spring Pond	BB	Indian Spring Land Company
5725	Babcock Pond Dam	Horseneck Brook	BB	Private
5727	F W Perry Dam	Perry Dam	BB	Private
5745	Wilshire Pond Dam	Wilshire Pond	BB	Private
5747	Topping Road Dam	Topping Pond	BB	Private
5751	Alder Pond Dam	Alden Pond	BB	Private
5754	Blind Pond Dam	Blind Pond	BB	Unknown
5762	Spahn Pond Dam	Spahn Pond	BB	Private
5763	West Fork Pond Dam	West Fork Pond	BB	Private
5786	Upper Pond Dam	Greenwich Creek	BB	Private
5798	Hall Pond Dam	Greenwich Creek	BB	Private
57100	Brunswick School Dam		BB	Brunswick School
5707	Converse Lake Dam	Converse Lake	B	Converse Lake Association
5719	Frye Lake Dam	Frye Lake	B	Frye Lake Association
5724	Mianus River Dam	Mianus Pond	B	Town of Greenwich

Failure of a high hazard dam can affect properties downstream of the impoundment both in and outside of town, with potential large inundation zones traveling along each respective waterway.

The Mianus Filter Dam is 130 feet in length, with a maximum height of 28 feet. It is a masonry structure and impounds roughly 118 acres at normal water levels with a contributing watershed of 0.80 square miles. The primary purpose of the dam is for public water supply containment.

The Putnam Reservoir Dam, also owned by Aquarion Water Company, is a 640-foot-long and 35-foot-high earth and concrete dam. This dam impounds roughly 1,775 acres, with a contributing watershed of 2.1 square miles.

The Pemberwick Dam is 115 feet in length, with a maximum height of 44 feet. It is a concrete structure and impounds roughly 25 acres at normal water levels with a contributing watershed of 25.80 square miles.

The American Felt Dam is a 208-foot-long and 33.3-foot-high masonry dam. This dam impounds roughly 36 acres, with a contributing watershed of 25.4 square miles.

The Rockwood Lake Dam, also owned by Aquarion Water Company, is 1,200 feet in length, with a maximum height of 36 feet. It is an earth and concrete structure that impounds roughly 1,534 acres at normal water levels with a contributing watershed of 25.80 square miles. The primary purpose of the dam is for public water supply containment.

The American Can Company Dam is a 543-foot-long and 53-foot-high masonry dam. This dam impounds roughly 18 acres, with a contributing watershed of 0.02 square miles. The primary purpose of the dam is fire protection.

3.3 HURRICANES AND TROPICAL STORMS

3.3.1 Setting

A hurricane striking Greenwich is considered a possible event each year and could cause critical damage to the town and its infrastructure. Wind damage from a hurricane can occur anywhere in town, and heavy rainfall may cause riverine and urban flooding, and storm surge can occur anywhere along the coastline.

3.3.2 Capabilities

Wind loading requirements are addressed through the state building code. The 2018 Connecticut State Building Code was amended in 2009 and adopted with an effective date of October 1, 2018. The code specifies the design wind speed for construction in all the Connecticut municipalities. Effective 2018, the design wind speed for Greenwich is 115 miles per hour for a Category 1, 125 miles per hour for a Category 2 and 135 for Category 3 or greater. Greenwich has adopted the Connecticut Building Code as its building code.

The Parks and Recreation department is responsible for tree maintenance. Additionally, Eversource has been performing a significant amount of tree maintenance along power lines, and CT DOT maintains trees along state roads. The town ran an "at-risk trees program" that was funded for a number of years, and which addressed a number of at-risk trees throughout the

Town's right-of way. During the nor'easter in March of 2018 many trees came down, and so there are fewer problem trees left standing. In all, Greenwich considers its tree maintenance capabilities to be robust.

Actions Completed and New Capabilities

Coordination with the Town's electric utility, Eversource, has improved since the previous HMP (Connecticut Lights & Power was the utility at the time). The State of Connecticut has updated its State Building Code; new construction that adheres to this new code is expected to be more resilient to hurricane winds.

3.3.3 Vulnerabilities and Risk Assessment

Most of the damage to the town from historical tropical cyclones has been due to the effects of flooding and wind. Areas of known and potential flooding problems are discussed in Section 3.1

Most of the housing stock in town predates recent building code changes, and so may be susceptible to roof and window damage from high winds. The primary risk associated with tropical storm winds is the downing of trees and limbs, leading to power outages and blocked roads.

3.4 SUMMER STORMS AND TORNADOES

3.4.1 Setting

Summer storms and tornadoes have the potential to affect any area within the Town of Greenwich. Because these types of storms and the hazards that result (flash flooding, wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the town without harming another.

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

3.4.2 Capabilities

The town's capabilities regarding mitigation of high wind events are described in Section 3.3.2.

Warning is the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. Greenwich's emergency communication capabilities are described in Section 2.5.

Actions Completed and New Capabilities

Greenwich's tree trimming and maintenance capabilities, its coordination with the local electric utility, and its emergency communication capabilities, have all been improved since adoption of the previous HMP.

3.4.3 Vulnerabilities and Risk Assessment

The entire Town of Greenwich is at relatively equal risk for experiencing damage from summer storms and tornadoes. Based on the historic record, a few summer storms have resulted in costly damages to town. Most damages are relatively site specific and occur to private property (and therefore are paid for by private insurance). For municipal property, the city budget for tree removal and minor repairs is generally adequate to handle summer storm damage.

Greenwich experiences many high-intensity, low-duration storms; for example, two or three inches of rain will fall in less than an hour, overwhelming drainage systems and causing flooding of roadways, yards, etc. Town staff observe that the frequency of such events seems to have increased in the last five years.

Changes and Improvements

Brookfield has improved its tree maintenance capabilities, reducing the vulnerability of the town's electric grid and roads system to high wind events.

3.5 WINTER STORMS AND NOR'EASTERS

3.5.1 Setting

The entire Town of Greenwich is susceptible to winter storms and, due to its variable elevation, can have higher amounts of snow in the northern neighborhoods of the town than in the downtown area. In general, winter storms are considered highly likely to occur each year (although major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of town.

3.5.2 Capabilities

Prior to a winter weather event, the Town ensures that all warning/notification and communications systems are ready and ensures that appropriate equipment and supplies, especially snow removal equipment, are in place and in good working order. In some known problem areas, prestorm treatment is applied to roadways to reduce the accumulation of snow. The Town also prepares for the possible evacuation and sheltering of some populations that could be impacted by the upcoming storm (especially the elderly and special needs persons).

The Town has sufficient staff and equipment for snow clearing. CTDOT plows all State roads and Interstates.

Actions Completed and New Capabilities

Greenwich continues to have sufficient capabilities to manage winter storm events.

3.5.3 Vulnerabilities and Risk Assessment

The entire Town of Greenwich is at relatively equal risk for experiencing damage from winter storms although some areas (such as icing trouble spots and neighborhoods with a high concentration of flat roofs) are more susceptible. The public assistance reimbursement from Winter Storm Alfred was $122,326, proving that winter storms can be very costly. However, many damages are relatively site specific and occur to private property (and therefore are paid for by private insurance) while repairs for power outages are often widespread and difficult to quantify to any one municipality.

The structures and utilities in Greenwich are vulnerable to a variety of winter storm damage. Tree limbs and some building structures may not be suited to withstand high wind and snow loads. Ice can damage or collapse power lines, render steep gradients impassable for motorists, undermine foundations, and cause "flood" damage from freezing water pipes in basements. Drifting snow can occur after large storms, but the effects are generally mitigated through municipal plowing efforts.

Snow loads on roofs have not generally been a problem in Greenwich; however, in the winter of 2015 a private garage at the Putnam Park Apartments complex collapsed due to snow; nobody was injured, but cars were damaged.

In general, snow hazards are not a significant concern for the Town. Nevertheless, Town was hit relatively hard by a nor'easter on March 2, 2018. Precipitation saturated the soil, and high winds then downed many trees. According to a Patch article on the event:

- Power was out for over 6,600 customers
- The town set up temporary storm shelters (warming/charging centers at Greenwich Public Safety Complex, Western Greenwich Civic Center, Greenwich Library)
- Several hundred trees were downed
- Downed trees closed the Merritt Parkway, Sound View Drive near Field Point Road, Lake Avenue near Greenwich Hospital

Property damage was not substantial during that event.

3.6 WILDFIRES AND DROUGHT

3.6.1 Setting

The Town of Greenwich is generally considered a moderate risk area for small wildfires but a low risk area for large wildfires. Wildfires are of particular concern in outlying areas without public water service and other areas with poor access for fire-fighting equipment. Hazards associated with wildfires include property damage and loss of habitat.

In addition, Greenwich, and Fairfield County overall, has experienced drought challenges over recent years. The U.S. Drought Monitor (USDM), which has been monitoring nationwide drought conditions since 2000, estimates that over the past two decades Connecticut experienced its longest drought of 46 weeks beginning June 21, 2016 and lasting until May 2, 2017. It was also estimated that the most intense period of this extended drought occurred the week of November 15, 2016, where approximately 44.5% of Connecticut lands were impacted. Figure 3-2: USDM Drought Time Series for Fairfield County depicts the various drought conditions in Fairfield County since 2000, where the warmer colors represent more advanced drought stages.

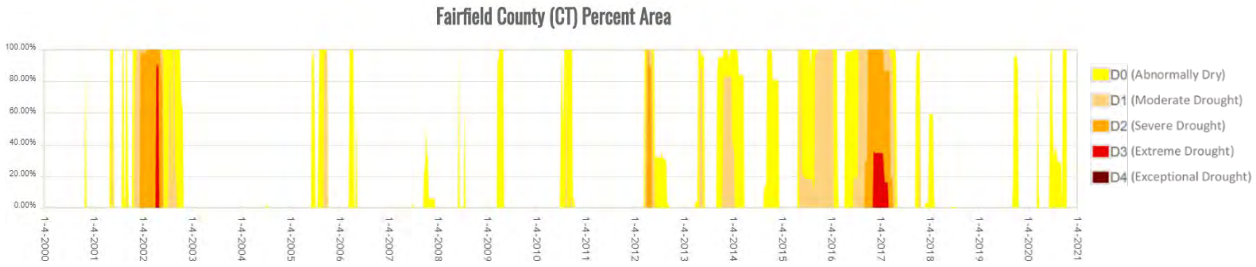

Figure 3-2: USDM Drought Time Series for Fairfield County

The 2019 Connecticut Natural Hazard Mitigation Plan assumes that the State of Connecticut has a medium probably of future drought events. This assumption is based on climate change projections anticipating hotter and wetter conditions in the near future. Climate forecasts often suggest that while precipitation may increase, the overall pattern will generally be higher intensity storms, with longer than average dry periods between events. The State Plan also identifies that Fairfield County accounts for roughly 7.34% of the state's total number of farms, with a market value of over $34 million in product sold from these farms.

3.6.2 Capabilities

The town's Fire Department is a dual level service, with both volunteer and career firefighters staffing the firehouses throughout the community. The GFD is a combination fire department that consists of 106 uniformed career and approximately 85 volunteer firefighters who work together. Fire apparatus consists of 13 Engines, 3 Ladder Trucks, and a Heavy Rescue. The Greenwich Fire Department operates this equipment out of eight fire houses within Greenwich (and Banksville, New York).

Any new development is reviewed for availability of firefighting water. The Town requires the installation of fire protection water in new developments where municipal water service is unavailable, and sprinkler systems where access is limited for fire apparatus.

The Town implements the state Open Burning Program locally. Information on open burning is available on the Town website.

Actions Completed and New Capabilities

Greenwich continues to have sufficient capabilities for mitigating wildfire risks.

The Town is working with NRCS to update the Town's most recent groundwater study conducted around 10 years ago, in order to better inform drought preparations.

3.6.3 Vulnerabilities and Risk Assessment

In the drought year of 1999, the average wildfire in Connecticut burned five acres in comparison to the two most extreme wildfires recorded since 1986 that burned 300 acres each. Given the availability of firefighting water in Greenwich, including the use of nearby water bodies, it is believed that this average value for a drought year and the extreme value are applicable to the town as well.

Wildfire Risk Areas are mapped in Figure 3-3.

A significant drought impacted Greenwich between 2015 and 2017. The drought had the following impacts:

- Aquarion enacted watering restrictions, which are still in force: irrigation has been limited to two days a week for private wells, indefinitely
- The Wastewater Division cut back on sewer cleanings during drought peak so save water
- Town put restrictions on private well withdrawals
- Reservoir levels were low; this affects fire protection abilities

Consideration of the impact of droughts is important to the Town

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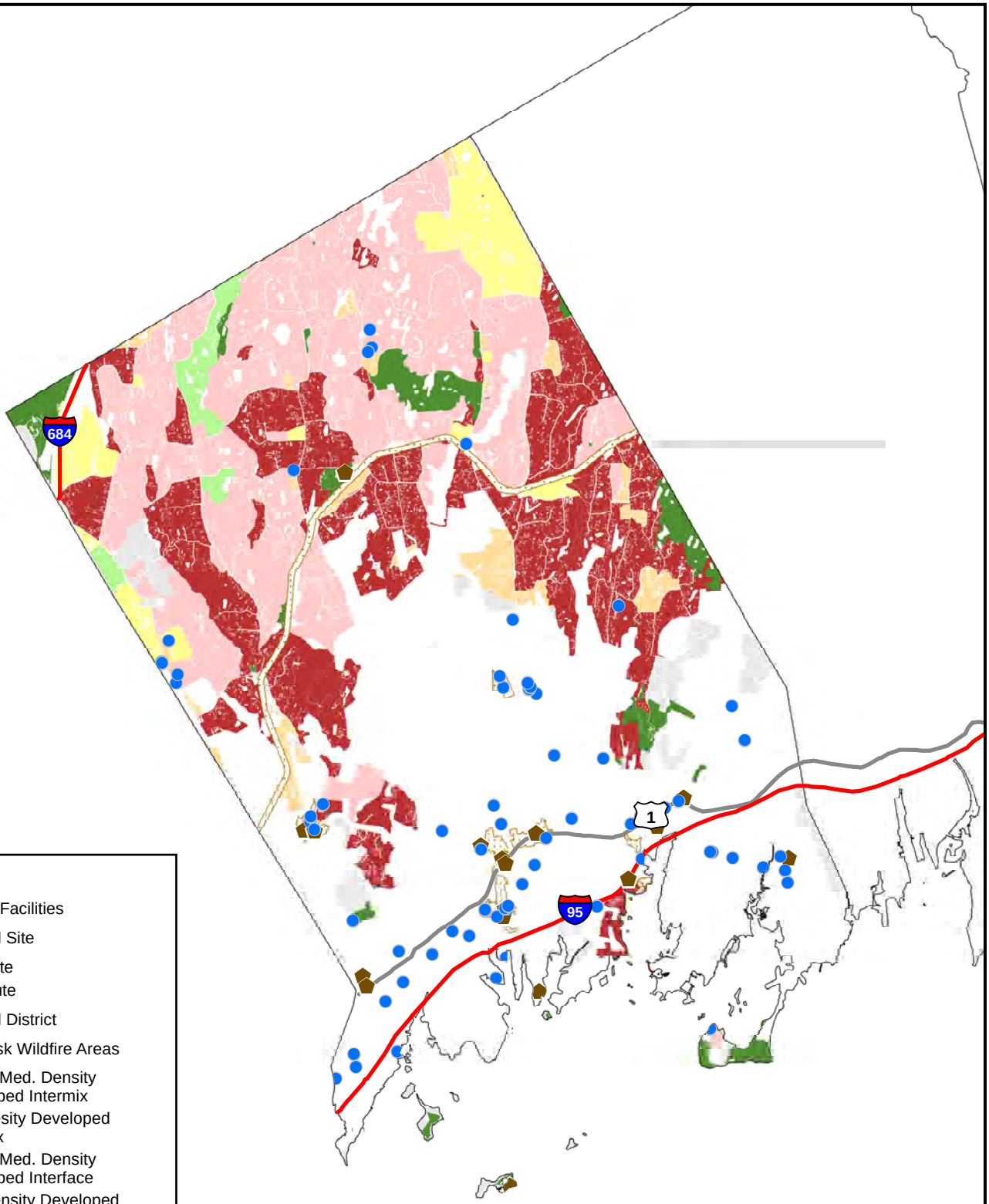

Legend

- Critical Facilities
- Cultural Site
- Interstate
- US Route
- Cultural District
- Low Risk Wildfire Areas
- High & Med. Density Developed Intermix
- Low Desity Developed Intermix
- High & Med. Density Developed Interface
- Low Density Developed Interface
- Very Low Densisty Developed and some Wildfire Prone Vegetated
- Uninhabited and Vegetated

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Wildland-Urban Interface: Wildfire Risk Areas

WestCOG Hazard Mitigation Plan
City of Greenwich

NPS: Cultural Resources
Wildland-Urban Interface:USFA

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Feet

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DATE 11/13/2020
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FIG. 3-3

3.7 EARTHQUAKES AND LANDSLIDES

3.7.1 Setting

The entire Town of Greenwich is susceptible to earthquake damage. However, even though earthquake damage has the potential to occur anywhere both in the town and in the northeastern United States, the effects may be felt differently in some areas based on the type of geology. In general, earthquakes are considered a hazard that may possibly occur but that may cause significant effects to a large area of the town.

3.7.2 Capabilities

The Town has adopted the state building codes for new construction, and they are enforced by the Building Official. Due to the infrequent nature of damaging earthquakes, land use policies in the city do not directly address earthquake hazards. However, various documents do indirectly discuss areas susceptible to earthquake damage and regulations that help to minimize potential earthquake damage.

Actions Completed and New Capabilities

Greenwich continues to have appropriate capabilities for mitigating earthquake events.

3.7.3 Vulnerabilities and Risk Assessment

Some areas in Greenwich are underlain by sand and gravel and artificial fill. Structures in these areas are at increased risk from earthquakes due to amplification of seismic energy and/or collapse. Most of the remaining area is underlain by glacial till and is therefore not at increased risk during an earthquake due to unstable soils.

Changes and Improvements

The town's vulnerability to earthquakes continues to be low.

3.8 SEA LEVEL RISE AND SHORELINE CHANGE

3.8.1 Setting

The coastal areas of Greenwich are susceptible sea level rise and shoreline change. With most of the shoreline being residential, with commercial and water dependent activity in pockets through-out, residential properties are at a greater risk of future inundation. Sea level rise may not be considered a high hazard risk in and of itself, however, rising seas in conjunction with extreme weather may result in inundation farther inland that seen during past events. In addition to extreme weather, nuisance flooding may also become a more frequent issue during extreme high tides.

The State of Connecticut has adopted the recent sea level rise projections developed by the University of Connecticut, Connecticut Institute for Resilience and Climate Adaptation (CIRCA) as the latest planning threshold for coastal municipalities. This projection anticipates a rise of 50 cm by the year 2050.

3.8.2 Capabilities

The town has begun to see an increase in nuisance flooding, and has experience the impacts of extreme storm surge; leaving city officials aware of the potential impacts of an extreme storm with elevated sea levels.

Town staff have begun to identify the areas that are at risk of increased nuisance flooding and solutions and mitigation strategies are being recognized. In an effort to protect municipal infrastructure, projects are also being developed and funded, such as the Greenwich Avenue pump station which is at risk of inundation.

Actions Completed and New Capabilities

Climate Change Risks – Town has a climate change study underway to evaluate the impacts of sea level rise and storm surge. The study explores impacts along the coast and along four town-owned, tidally influenced ponds: Eagle Pond, Mill Pond, Binney Pond, and Bruce Pond. This study is scheduled to be completed in the fall of 2020.

3.8.3 Vulnerabilities and Risk Assessment

The most at-risk areas are those immediately along the shoreline, with risk slightly declining moving inland. Greenwich Point is particularly at risk of increased nuisance flooding under future sea levels. In addition, a 100-year storm event with one foot of sea level rise has the potential to inundate many of the coastal areas including portions of Cos Cob, Indian Harbor, and Greenwich Cove. With much of the infrastructure areas at risk of flooding during a 100-year event with elevated sea levels, there is a large economic factor at risk.

Coastal flooding has been reported to be a concern in the following areas:

- Sound Beach Avenue in Old Greenwich
- Shore Road, near Greenwich Point

The Town has expressed concern about the expected challenge of maintaining roadways in low-lying areas as the properties they serve become elevated; although the properties will be

protected, the roads may continue to experience nuisance flooding. The Town will need to consider its responsibilities is capabilities in this regard as sea levels continue to rise, and private properties continue to adapt.

Changes and Improvements

Town staff have observed that high tides have been getting higher due to sea level rise, and this is causing more nuisance flooding, and increased impacts from high tides. This is especially true during King Tides or Spring Tides.

4.0 MITIGATION STRATEGIES AND ACTIONS

4.1 Goals and Objectives

Municipal goals and objectives have been made consistent regionally and are presented in the Multi-Jurisdictional Plan document.

4.2 Status of Mitigation Strategies and Actions from Previous HMP

The table below lists the mitigation actions developed in the previous HMP and the status of each. Actions to be carried forward are noted as such. Actions that have been institutionalized as capabilities are not carried forward.

#	Description	Status	Notes
1	Focus on implementing public safety projects identified in the town drainage studies.	Completed /Capability	Town has made significant process on this, and will continue to in the future. Strickland Brook drainage improvements were one of the projects identified in these studies that has been completed.
2	Conducting drainage and watershed evaluations for all waterbodies in the town. (Looking at water quality)	Completed	Drainage and watershed evaluations have been completed for most waterbodies in Town, from a flooding standpoint. Most of this work has been with a riverine perspective. Moving forward, the Town will be exploring coastal flooding and the impacts of sea level rise (as part of the climate change study currently underway). The Town recently completed a Binney Pond sediment study that modeled sediment sources. Following the study, the pond was dredged, which may have benefited water quality. The Town does not believe a focus on water quality is necessary at this time. Action is considered complete, and new actions addressing next steps will be added to plan.
3	Work with the Army Corps of Engineers to address the Byram river areas, such as the Route 1 bridge, Byram and Pemberwick.	Carry Forward with Revisions	A feasibility study is scheduled to be completed in 2020. A number of alternatives will be presented in this study. Implementation of projects will depend on funding from federal and state sources as well as the local budget.

#	Description	Status	Notes
4	Work with the state to inventory condition of town owned culverts, bridges and dams and repair and place as needed.	Capability	Greenwich evaluates all bridges and culverts on a 5-year schedule, with some structures evaluated more frequently. This is a capability. Most dams in Town are privately owned, and state efforts to ensure dam maintenance address the needs of those structures. Town is currently performing significant improvements to the Cos Cob dam. Aquarion recently performed significant work on the Rockwood Lake Dam off North Street. The Town also recently performed vegetation maintenance at the dam near the Greenwich High School. Town has sufficient capabilities with regard to culvert, bridge, and dam maintenance. Working with the state on a condition inventory is not believed necessary at this time.
5	Evaluate Binney Park storage shed to determine appropriate flood proofing method, such as raising its elevation.	Partially Completed / Carry Forward	Renovation of the Binney Park Storage Shed is expected in the next several years, and flood proofing will take place at that time. The Town follows floodplain regulations during construction of municipal structures.
6	Implement improvements described in the Old Greenwich Business District and Surrounding Streets- Drainage Study.	Completed	This action has been completed.
7	Request that FEMA and Army Corps of Engineers reevaluate the Flood Insurance Rate studies for riverine sections.	Drop	Town is satisfied with FEMA and USACE activities.
8	Conduct education and outreach regarding Best Management Practices (BMPs) for maintaining and restoring tidal wetlands.	Carry forward with Revisions	The Town work with a conservation nonprofit to provide some outreach about tidal wetlands. A more specific action will be carried forward.
9	Maintain the NFIP. Also promote mitigation of properties in the flood zone, including first floor elevations to account for Sea Level Rise	Capability	This is an ongoing capability
10	Evaluate and implement a strategy for a living shoreline (ex. To protect Greenwich Point and surrounding area).	Carry Forward with Revisions	The Nature Conservancy is currently conducting a study exploring living shoreline potential along the Greenwich coast. A new action to implement recommendations identified in this study will be carried forward.

#	Description	Status	Notes
11	Vulnerability Assessment of town owned infrastructure	Completed	Town has compiled basic information about the first-floor elevations and base flood elevations for all Town facilities. Additionally, a Waste Treatment Plant vulnerability assessment has been completed, and is informing the Capital Improvement Plan moving forward. This action is considered to be completed.
12	Manage roadside forests to reduce storm impacts.	Capability	This is an ongoing capability
13	Conduct a town wide tree management program	Capability	This is an ongoing capability
14	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.	Capability	This is a capability
15	Mitigate flooding in Cos Cob region and Cos Cob Firehouse.	Carry Forward with Revisions	The Town conducted a flood study of Strickland Brook. Some of the actions identified in that study are expected to help mitigate flooding at the Firehouse. Additional mitigation actions will be identified through the Climate Change Study (The Firehouse is coastal, located across road from Mill Pond, which is being evaluated as part of the Climate Change Study). Carry forward, informed by those other studies
16	Improve resiliency of the Waste Water Treatment Plant (e.g. Develop Berm, Raise the plant, Relocation)	Carry Forward with Revisions	A vulnerability and mitigation study has been completed, and is informing projects included in the Capital Improvement Plan. Carry forward, informed by the vulnerability study.
17	As needed procure equipment to sustain critical facilities in the event of a disaster (i.e. obtain additional generators) to enhance EOC capabilities.	Capability	This is a capability
18	Explore improvements to telecommunications systems to minimize disruption and delays during an emergency. Continue to maintain emergency notification system and upgrade as needed.	Capability	This is a capability
19	Evaluate municipalities' sheltering and evacuation needs for a variety of storm scenarios.	Complete	This action has been completed.

#	Description	Status	Notes
20	Improve and enlarge storage of fuel tanks	Drop	Town has sufficient access to fuel.
21	Develop communication & education strategy for at risk populations & disaster preparedness.	Carry Forward with Revisions	Incorporate action below into this action: Develop communication & education strategy for at risk populations & disaster preparedness; include targeted efforts toward households at risk of isolation during hazard events.
22	Provide targeted education and outreach for households in isolated locations (Isolated during hazards).	Drop	Merge with action above
23	Improve Communication channel for residents	Capability	Town has numerous emergency alert capabilities, including: "Report a Problem" link on town website. "Alert Center" on town website - Including RSS feed link, "Notify Me" link Greenwich Community TV Town of Greenwich, Greenwich Police FB groups, other social media
24	Coordination and cooperation with utilities.	Capability	Town has a positive relationship with local utility providers. This is a capability
25	Implement and maintain interactive GIS software which coordinates with all town departments. (Monitors closed roads, downed trees, truck resources location.) Improved IT for live updates	Capability	This is a capability.
26	Improve Power Grid Resiliency	Completed	Eversource has been effective at improving power grid resiliency, and is consistently working to make further improvements.
27	Upgrade and maintain storm drain system.	Capability	This is an ongoing capability
28	Work with Aquarion Water Company to encourage appropriate water line extensions to meet fire protection needs.	Capability	This is an ongoing capability
29	Plan for Fire house in North West Greenwich	Drop	Town has determined that the cost-benefit ratio of this action does not warrant its implementation.
30	Improve communications between the town, state and Aquarion prior to and during drought conditions.	Completed	This action has been completed, and communication with Aquarion is now considered a capability.
31	Work with State to update the Drought Management Plan.	Completed	This action has been completed

#	Description	Status	Notes
32	Review USGS groundwater study and make recommendations for regulations to protect groundwater quality and quantity.	Carry Forward with Revisions	Town is exploring development of an updated groundwater study.
33	Work with Aquarion Water Co. on infrastructure improvements, both in town and inter-town.	Completed	This is a capability.
34	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. Explore the need for underground storage tanks for fire protection should be required for new development	Capability	This is a capability
35	Continue outreach programs encouraging water conservation.	Capability	This is a capability
36	Maintain Emergency Operation Plan and specific information needed to respond to drought conditions.	Capability	This is a capability through the statewide drought plan.

4.3 Prioritization of Strategies and Actions

The STAPLEE method, described in the Multi-Jurisdictional document, was used to score mitigation activities. The STAPLEE matrix in Appendix A provides the total scores. Actions have been further prioritized based on implementation cost, project urgency, and municipal and public input. The strategies below are presented in priority order, with qualitative priority levels listed for each.

4.4 Mitigation Strategies and Actions Implementation Table

The Town proposed to initiate several new mitigation actions for the upcoming five years. The following new actions were identified in meetings with municipal staff:

- Town is working with NRCS to update the Town's most recent groundwater study conducted around 10 years ago
- Completion of Grass Island Waste Treatment Plant mitigation projects
- Completion of Byram River flood mitigation feasibility study, and implementation of recommended projects
- Completion of climate change study, and implementation of recommended projects
- Town may wish to implement a new drought-related action

Additionally, a number of actions from the previous planning period are being carried forward or replaced with revised actions.

The complete suite of actions to be pursued in the next five years are presented below:

Action GCH-01	
Provide information on the Town website about CT DEEP training and information around small business chemical management for hazard resilience.	
Lead	EM, BOS
Cost	$0 - $25,000
Funding	Operating Budget, CT DEEP
Timeframe	2021
Priority	High

Action GCH-02	
Use the CT Toxics Users and Climate Resilience Map to identify toxic users located in hazard zones within your community. Contact those users to inform them about the CT DEEP small business chemical management initiative.	
Lead	EM, BOS
Cost	$0 - $25,000
Funding	Operating Budget, CT DEEP
Timeframe	2021
Priority	High

Action GCH-03	
Host a CT DEEP presentation for municipal staff and local businesses about business chemical management for hazard resilience.	
Lead	EM, BOS
Cost	$0 - $25,000
Funding	Operating Budget, CT DEEP
Timeframe	2021
Priority	High

Action GCH-04	
Take one of the following actions that will mitigate natural hazard risks while also meeting Sustainable CT objectives: **- Disseminate a toolkit for pre-disaster business preparedness.** **- Revise regulations to promote Low Impact Development.** **- Include the goals of this Hazard Mitigation Plan, and at least three other sustainability concepts, in your next POCD update.**	
Lead	BOS
Cost	$0 - $25,000
Funding	Operating Budget, Sustainable CT Community Match Fund
Timeframe	2021
Priority	High

Action GCH-05	
Collaborate with CIRCA on the "Resilient Connecticut" project	
Lead	BOS
Cost	$0 - $25,000
Funding	Operating Budget
Timeframe	2022
Priority	Med

Action GCH-06	
Coordinate with CT SHPO to conduct outreach to owners of historic properties to educate them on methods of retrofitting historic properties to be more hazard-resilient while maintaining historic character.	
Lead	Planning
Cost	$0 - $25,000
Funding	Operating Budget
Timeframe	2022
Priority	Med

Action GCH-07	
Develop communication & education strategy for at risk populations & disaster preparedness; include targeted efforts toward households at risk of isolation during hazard events.	
Lead	EOM
Cost	$0 - $25,000
Funding	Operating Budget
Timeframe	2022
Priority	Low

Action GCH-08	
Compare local floodplain regulations with Revised State Model Flood Regulations to identify any remaining opportunities for improvement	
Lead	Planning
Cost	$0 - $25,000
Funding	Operating Budget
Timeframe	2023
Priority	Low

Action GCH-09	
Contact the owners of Repetitive Loss Properties and nearby properties at risk to inquire about mitigation undertaken and suggest options for mitigating flooding in those areas. This should be accomplished with a letter directly mailed to each property owner.	
Lead	EM, BOS
Cost	$0 - $25,000
Funding	Operating Budget, FEMA Grant
Timeframe	2023
Priority	Low

Action GCH-10	
Distribute the CT DEEP Tidal Wetlands Guidance packet (or a similar pamphlet) to all property-owners abutting tidal wetlands in Greenwich. portal.ct.gov/DEEP/Coastal-Resources/Tidal-Wetlands/Tidal-Wetlands	
Lead	P&Z, CC
Cost	$0 - $25,000
Funding	Operating Budget
Timeframe	2023
Priority	Low

Action GCH-11	
Coordinate with CT SHPO to conduct historic resource surveys, focusing on areas within natural hazard risk zones (flood zones, wildfire hazard zones, steep slopes) to identify historic resources at risk and support the preparation of resiliency plans across the state.	
Lead	Planning
Cost	$25,000 - $50,000
Funding	CT SHPO
Timeframe	2024
Priority	Med

Action GCH-12	
Perform a groundwater study and make recommendations for regulations to protect groundwater quality and quantity in order to improve the reliability of groundwater resources during drought conditions.	
Lead	CC, Health, P&Z
Cost	$25,000 - $50,000
Funding	Operating Budget, Grant
Timeframe	2024
Priority	Low

Action GCH-13	
Work with CT DEEP to validate and/or correct the RL list and update the mitigation status of each listed property.	
Lead	Planning
Cost	$25,000 - $50,000
Funding	FEMA Grant
Timeframe	2024
Priority	Low

Action GCH-14	
Annually conduct an emergency operations exercise for a local terrorism, sabotage, or mass casualty event.	
Lead	EMD
Cost	$25,000 - $50,000
Funding	Operating Budget
Timeframe	2024
Priority	Low

Action GCH-15	
Complete the Greenwich Coastal Resiliency Assessment and Plan and integrate with other municipal planning documents.	
Lead	P&Z
Cost	$50,000 - $100,000
Funding	Operating Budget, Grant
Timeframe	2025
Priority	Low

Action GCH-16	
Mitigate flooding in the Cos Cob area and at the Cos Cob Firehouse, informed by the Strickland Brook study and the planned Greenwich Coastal Resiliency Assessment and Plan.	
Lead	DPW, Fire, Engineering
Cost	$100,000 - $500,000
Funding	Capital Improvement Plan, FEMA Grant, Other Grant
Timeframe	2025
Priority	Med

Action GCH-17	
Pursue actions identified in the Byram River Feasibility Study, completed in cooperation with the US Army Corps of Engineers in 2020.	
Lead	DPW
Cost	$100,000 - $500,000
Funding	Capital Improvement Plan, FEMA Grant, Other Grant
Timeframe	2026
Priority	Low

Action GCH-18	
Implement strategies identified in the Nature Conservancy living shoreline study in Greenwich.	
Lead	CC, P&Z, P&R
Cost	$100,000 - $500,000
Funding	Capital Improvement Plan, FEMA Grant, Other Grant
Timeframe	2026
Priority	Low

Action GCH-19	
Incorporate floodproofing techniques into the renovation of the Binney Park Storage Shed.	
Lead	P&R
Cost	$100,000 - $500,000
Funding	Capital Improvement Plan, FEMA Grant, Other Grant
Timeframe	2026
Priority	Low

Action GCH-20	
Improve resiliency of the Waste Water Treatment Plant, based on the findings of the Waste Water Treatment Plant vulnerability and mitigation study	
Lead	DPW
Cost	More than $1 million
Funding	Capital Improvement Plan, FEMA Grant, Other Grant
Timeframe	2026
Priority	High

APPENDIX A

Appendix A: STAPLEE Matrix

#	Action Description	Regional Theme	Lead Department	Cost Estimate	Potential Funding Sources	Timeframe for Completion	Weighted STAPLEE Criteria														Total STAPLEE Score
							Benefits							Costs							
							Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	
GCH-01	Provide information on the Town website about CT DEEP training and information around small business chemical management for hazard resilience.	CT DEEP Small Business Chem	EM, BOS	$0 - $25,000	Operating Budget, CT DEEP	2021	1	1	1	0	1	1	1	0	0	0	0	0	0	0	8
GCH-02	Use the CT Toxics Users and Climate Resilience Map to identify toxic users located in hazard zones within your community. Contact those users to inform them about the CT DEEP small business chemical management initiative.	CT DEEP Small Business Chem	EM, BOS	$0 - $25,000	Operating Budget, CT DEEP	2021	1	1	1	0	1	1	1	0	0	0	0	0	0	0	8
GCH-03	Host a CT DEEP presentation for municipal staff and local businesses about business chemical management for hazard resilience.	CT DEEP Small Business Chem	EM, BOS	$0 - $25,000	Operating Budget, CT DEEP	2021	1	1	1	0	1	1	1	0	0	0	0	0	0	0	8
GCH-04	Take one of the following actions that will mitigate natural hazard risks while also meeting Sustainable CT objectives: - Disseminate a toolkit for pre-disaster business preparedness. - Revise regulations to promote Low Impact Development. - Include the goals of this Hazard Mitigation Plan, and at least three other sustainability concepts, in your next POCD update.	Sustainable CT	BOS	$0 - $25,000	Operating Budget, Sustainable CT Community Match Fund	2021	1	1	1	1	0	1	1	0	0	0	0	0	0	0	8
GCH-05	Improve resiliency of the Waste Water Treatment Plant, based on the findings of the Waste Water Treatment Plant vulnerability and mitigation study	Critical Facility Mitigation	DPW	More than $1 million	Capital Improvement Plan, FEMA Grant, Other Grant	2026	0	1	1	1	1	1	1	0	0	0	0	0	0	0	8
GCH-06	Collaborate with CIRCA on the "Resilient Connecticut" project	ResilientCT	BOS	$0 - $25,000	Operating Budget	2022	1	1	1	0	0	1	1	0	0	0	0	0	0	0	7
GCH-07	Coordinate with CT SHPO to conduct outreach to owners of historic properties to educate them on methods of retrofitting historic properties to be more hazard-resilient while maintaining historic character.	SHPO	Planning	$0 - $25,000	Operating Budget	2022	1	1	1	1	0	1	0	0	0	0	0	0	0	0	7
GCH-08	Coordinate with CT SHPO to conduct historic resource surveys, focusing on areas within natural hazard risk zones (flood zones, wildfire hazard zones, steep slopes) to identify historic resources at risk and support the preparation of resiliency plans across the state.	SHPO	Planning	$25,000 - $50,000	CT SHPO	2024	1	1	1	1	0	1	0	0	0	0	0	0	0	0	7
GCH-09	Mitigate flooding in the Cos Cob area and at the Cos Cob Firehouse, informed by the Strickland Brook study and the planned Greenwich Coastal Resiliency Assessment and Plan.	Critical Facility Mitigation	DPW, Fire, Engineering	$100,000 - $500,000	Capital Improvement Plan, FEMA Grant, Other Grant	2025	0	1	1	1	1	1	0	0	0	0	0	0	0	0	7
GCH-10	Develop communication & education strategy for at risk populations & disaster preparedness; include targeted efforts toward households at risk of isolation during hazard events.	Outreach and Education	EOM	$0 - $25,000	Operating Budget	2022	1	0	1	1	0	1	1	0	0	0	0	0	0	0	6
GCH-11	Perform a groundwater study and make recommendations for regulations to protect groundwater quality and quantity in order to improve the reliability of groundwater resources during drought conditions.	Drought Mitigation	CC, Health, P&Z	$25,000 - $50,000	Operating Budget, Grant	2024	1	1	1	1	1	1	0	0	-1	0	0	0	0	0	6
GCH-12	Complete the Greenwich Coastal Resiliency Assessment and Plan and integrate with other municipal planning documents.	Flood Study	P&Z	$50,000 - $100,000	Operating Budget, Grant	2025	1	1	1	1	1	1	0	0	-1	0	0	0	0	0	6
GCH-13	Pursue actions identified in the Byram River Feasibility Study, completed in cooperation with the US Army Corps of Engineers in 2020.	Flood Study	DPW	$100,000 - $500,000	Capital Improvement Plan, FEMA Grant, Other Grant	2026	0	1	1	1	1	1	1	0	0	0	0	0	-1	0	6
GCH-14	Implement strategies identified in the Nature Conservancy living shoreline study in Greenwich.	Flood Study	CC, P&Z, P&R	$100,000 - $500,000	Capital Improvement Plan, FEMA Grant, Other Grant	2026	0	1	1	1	1	1	1	0	0	0	0	0	-1	0	6

#	Action Description	Regional Theme	Lead Department	Cost Estimate	Potential Funding Sources	Timeframe for Completion	Weighted STAPLEE Criteria														Total STAPLEE Score
							Benefits							Costs							
							Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	Social	Technical (x2)	Administrative	Political	Legal	Economic (x2)	Environmental	
GCH-15	Incorporate floodproofing techniques into the renovation of the Binney Park Storage Shed.	Floodproofing & Elevation	P&R	$100,000 - $500,000	Capital Improvement Plan, FEMA Grant, Other Grant	2026	1	1	0	1	1	1	1	0	0	0	0	0	-1	0	6
GCH-16	Compare local floodplain regulations with Revised State Model Flood Regulations to identify any remaining opportunities for improvement	Floodplain Management Regulations	Planning	$0 - $25,000	Operating Budget	2023	0	1	1	0	1	1	0	0	0	0	-1	0	0	0	5
GCH-17	Contact the owners of Repetitive Loss Properties and nearby properties at risk to inquire about mitigation undertaken and suggest options for mitigating flooding in those areas. This should be accomplished with a letter directly mailed to each property owner.	RLPs	EM, BOS	$0 - $25,000	Operating Budget, FEMA Grant	2023	0	1	1	0	1	1	0	0	0	-1	0	0	0	0	5
GCH-18	Work with CT DEEP to validate and/or correct the RL list and update the mitigation status of each listed property.	RLPs	Planning	$25,000 - $50,000	FEMA Grant	2024	0	0	1	0	1	1	0	0	0	0	0	0	0	0	4
GCH-19	Annually conduct an emergency operations exercise for a local terrorism, sabotage, or mass casualty event.	Terrorism & Mass Casualty	EMD	$25,000 - $50,000	Operating Budget	2024	1	1	1	1	1	0	0	0	0	-1	0	0	0	0	5
GCH-20	Distribute the CT DEEP Tidal Wetlands Guidance packet (or a similar pamphlet) to all property-owners abutting tidal wetlands in Greenwich. portal.ct.gov/DEEP/Coastal-Resources/Tidal-Wetlands/Tidal-Wetlands	Outreach and Education	P&Z, CC	$0 - $25,000	Operating Budget	2023	1	0	0	1	1	0	1	0	0	0	0	0	0	0	4

APPENDIX B

Appendix B: SVI Summary

Town of Greenwich
Climate Vulnerability Assessment
A Component of Sustainable CT Action 5.4

The Town of Greenwich, for this Climate Vulnerability Assessment (CVA) is considered a suburban coastal town, resulting in various climate change vulnerabilities. Sea level rise, inland flooding, and winter storms may impact the community the most as many issues have been identified.

Hazards

Sea Level Rise

Rising seas have raised concerns in communities throughout the state for various reasons. The Town of Greenwich is currently experiencing increased occurrences of coastal flooding, both nuisance and storm related, with impacts to neighborhoods and critical infrastructure. While many homes have begun to elevate there is still concern regarding the low lying coastal areas that may become isolate during an event. Certain areas are experiencing an increase in flooding, such as Greenwich Point, and are seeing nuisance flooding on a more regular basis than in the past. With sea levels rising, and storm intensity increasing, infrastructure and homes are vulnerable to inundation.

Inland Flooding

With FEMA flood zones along a few rivers in town, such as the Byram River, the town is continuously concern about riverine flooding. There are several areas in town that have had issues in the past, such as the area near Greenwich High School and in the Pemberwick Neighborhood along the Byram River. With precipitation expected to increase due to climate change, flooding events may occur more frequently.

Winter Storms

Greenwich is largely residential, with development relatively evenly distributed throughout town. While snow removal and winter storms have not historically been a primary concern for the town, climate impacts may shift precipitation patterns which can cause issues in the future. It is projected that snow levels will decrease during winter months, however, overall precipitation will increase during winter in the form of rain and freezing rain. This shift may challenge certain municipal capacities such as road salting. Any current drainage concerns may also become exacerbated during a mixed precipitation winter event.

Drought and Extreme Temperatures

The southern half of town is serviced by public water supply, with northern parcels likely serviced by private wells. Therefore, impacts to water supply may be an issue to the town as temperatures rise in the near future, resulting in isolated issues with water scarcity. With increased temperatures, and high pumping levels, private wells may be impacted during times of drought.

When considering these impacts from climate change, the primary vulnerabilities for the town of Greenwich include:

- Coastal municipal infrastructure and neighborhoods

- Private well owners
- Emergency access

Secondary impacts

Economic Impacts

With vulnerable critical infrastructure, the town faces an economic challenge of mitigating or relocating these facilities. There is also a potential economic impact to local businesses during inland flooding events. Poor drainage may reduce site access resulting in loss of business, or businesses may incur expenses related to flood mitigation or clean-up efforts.

Winter storm icing also presents financial responsibility to the town by way of roadway treatment. As precipitation events may increase during winter months, the town may seek to increase sand or salt stockpiles to account for increased icing events.

Private property owners who rely on private drinking water wells may also be impacted economically during droughts or periods of extreme heat. With increasing heat, typically comes increased water demand. This demand would be placed upon local aquifers, potentially resulting in the need for new well construction, or deepening of an existing well.

The many impacts of climate change can result in economic impacts to many citizens, business owners, and municipal budgets as the impacts can be felt on a town level, down to building level.

Social Impacts

To identify social impacts to the town, the Center for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) was used to identify any vulnerable populations within the town. This index was developed to supplement a community's natural hazard preparation actions. To evaluate social vulnerability, the CDC incorporates 15 factors (Fig. 1) into the overall calculation under the categories, or themes, of: socioeconomic status, household composition and disability, minority status and language, and housing type and transportation. These themes and their ranking are based on census statistics. By evaluating these factors and determining a level of social vulnerability, a community can identify specific needs for before, during, and after an event. Such needs may include sheltering capacity, evacuation routes, or to decide how many emergency personnel may be required to respond after an event.

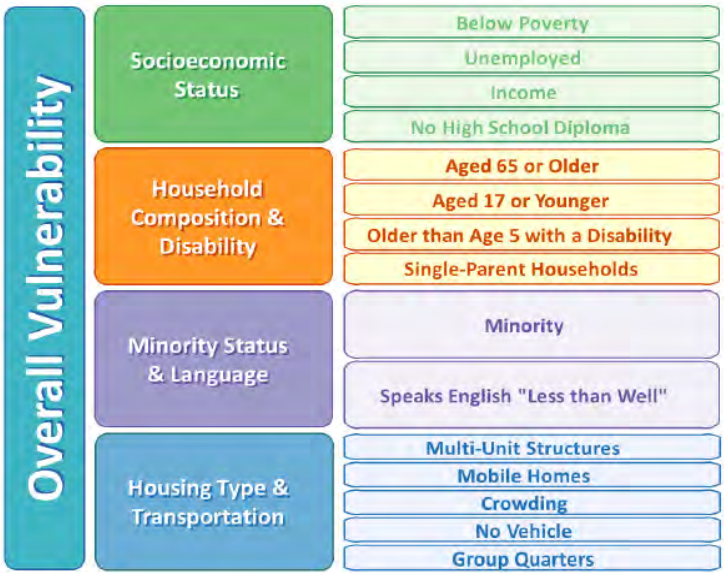

Figure 1: The CDC SVI Index Factors. Graphic: svi.cdc.com

Each municipalities' census tracts were ranked for overall vulnerability, and theme vulnerability, in comparison to other Connecticut municipalities. This rank, 0 to 1, is based on the percentile rank among all tracts within the State of Connecticut. A value closer to 0 indicates a lower vulnerability, while a value closer to 1 indicates a higher vulnerability. Table 1 presents the overall vulnerability and theme rankings for Greenwich.

Table 1: Greenwich SVI Factor Rankings

	Overall SVI	Socioeconomic	Household Composition & Disability	Minority Status & Language	Housing Type & Transportation
GREENWICH	.36	.30	.41	.53	.37

The Town of Greenwich is considered to have a low to moderate overall vulnerability, with their most vulnerable social aspect being minority populations, and populations that speak English "less than well", along with populations with vulnerable household composition. The more vulnerable populations are concentrated in the southwestern tracts.

These populations may be vulnerable to impacts from drought, inland flood and icing events based on the geographic concentrations.

Public Health Considerations

Of the primary vulnerabilities identified, drought and flooding can potentially have public health repercussions. During hot summer months, or drought, if private wells were to be impacted, certain populations may find themselves without adequate drinking water supply, resulting in health problems. Also, when considering the environmental shifts occurring during drought periods, drinking water contamination may become an issue as aquifers become stressed due to excessive pumping.

Flooding, especially poor drainage flooding, presents the concern of pollution into nearby water bodies as these impervious areas drain, they collect pollutants and excess sediment. Depending upon the drainage areas, this runoff can have environmental impacts in associated ecosystems, or public health impacts if water bodies are used for recreational activities.

Vulnerable Populations

The SVI identified the presence of certain populations within the town that may be more vulnerable to climate change hazards. In addition to the SVI, the Connecticut Department of Public Health (DPH)[1] has identified at least five facilities in Greenwich that are a convalescent home.

These populations often need additional time for hazard response, so evacuation or preparation, and may find it more challenging to recover due to financial constraints or health concerns. These populations, in addition to those identified in the SVI, should be considered more vulnerable for the reasons that emergency response and preparation may be more challenging, health issues may be of

[1] https://www.elicense.ct.gov/Lookup/LicenseLookup.aspx

higher concern, and language barriers may exist when working to communicate with the community on risks, response, and recovery efforts.

In addition to the populations, it is important to identify the facilities that can provide different types of assistance to the populations, and others, during or after an event. These facilities, and their proximity to flood zones, can be found in Figure 2-4.