

### 3.5. CONNECTICUT

#### 3.5.1. GREENWICH, CT

<b>Population Density</b>	1285/ sq. mi.
<b>Form of Government</b>	Town
<b>Category</b>	Suburban Soundfront
<b>CRS Rating</b>	Not Participating

Median Household Income	Median Per Capita Income	% Owner Occ	Population	2000-2010				
				Pop Growth Rate	% White	% Hispanic	% Minority Housing	% Seasonal Housing
125266	60076	60.0	61171	0.01	86.7	10%	20.2%	3.0

Adaptations	Status	Incorporates CC	Type	Impact	Standard Costs		Funding Source
Comprehensive Plan - Incorporates Climate Change	Completed	Yes	Procedural	Recommendation	Above Required	Low (< \$10,000)	Town
Freeboard - 1 Ft in A/AE 2 Ft in VZ	Implemented	No	Accommodation	Mandatory	Unique	None	NA
Green Area Ordinance	Implemented	No	Prevention	Mandatory	Unique	Low (< \$10,000)	NA
Evacuation Mapping	Implemented	Yes	Procedural	NA	Unique	Mixed High initial cost for GIS capacity. Minimal staff time with GIS skill.	Town
Flood Zone Home Elevation Database	Implemented	Yes	Procedural	Recommendation	Unique	Town staff time/\$7,700 NOAA Coastal Resilience Grant	Town, NOAA
Cumulative Substantial Improvement Ordinance	Implemented	No	Procedural	Mandatory	Above Required	None	NA
Green Area Ordinance	Implemented	No	Prevention	Mandatory	Unique	None	NA

## CONTACTS

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## POPULATION AND GEOGRAPHY

Evidence of human activity in Greenwich dates back 12,000 years, but the town was formally settled and organized in 1640. It has a current population of 61,171 as of the 2010 Census. It includes areas also known as Cos Cob, Riverside, Byram, Old Greenwich, and Glenville. The town is well-known as an extremely wealthy suburb of New York City; peak-hour express trains take only 38 minutes to reach Grand Central Terminal in Manhattan.

The State of Connecticut has the highest median and per-capita income in the country. In Greenwich, the median household income is \$125,266 and the median home price, according to data cited in the comprehensive plan, is \$1,770,000 (2008).

Like most of New England, the town operates on the town meeting system, although Greenwich uses a “representative” town meeting system with 230 elected representatives. Demographically, the town is 86.7% white, 2.15% African American, 6.6% Asian, and 1.19% Latino.

Greenwich is located in the extreme southwestern corner of the state, bordered on two sides by Westchester County in New York State, the Long Island Sound on its south, and Stamford on the east. It consists of 67.2 square miles—47.8 sq. mi. is land and 19.4 is water. Its southern third is the most heavily developed and contains the major east–west transportation corridor of I-95, U.S. Route 1, the Merritt Parkway, Amtrak, and the Metro-North commuter rail. Its historic downtown and smaller historic commercial areas are also located in the southern part of town. The town has seven National Historic Register Districts, including downtown Greenwich. The northern half of the town, also known as the back-country, is a heavily wooded, lower density area that does not have sewer or municipal water infrastructure. Zoning in much of this area mandates a minimum lot size of four acres. The entirety of the town is located in the New York-Northern NJ-Long Island, NY-NJ-CT-PA consolidated metropolitan statistical area and serves as a commuter suburb to New York City metropolitan center activity centers, including White Plains/Westchester County, Stamford/Hartford, and Manhattan. Commuter rail service runs through the town and provides direct trains to Grand Central Terminal from four separate stations in the town. The town also has a number of major employers itself, including Nestlé Waters North America, United Rentals, Inc., Blythe, Inc., and a number of private equity firms.

COASTAL ISSUES

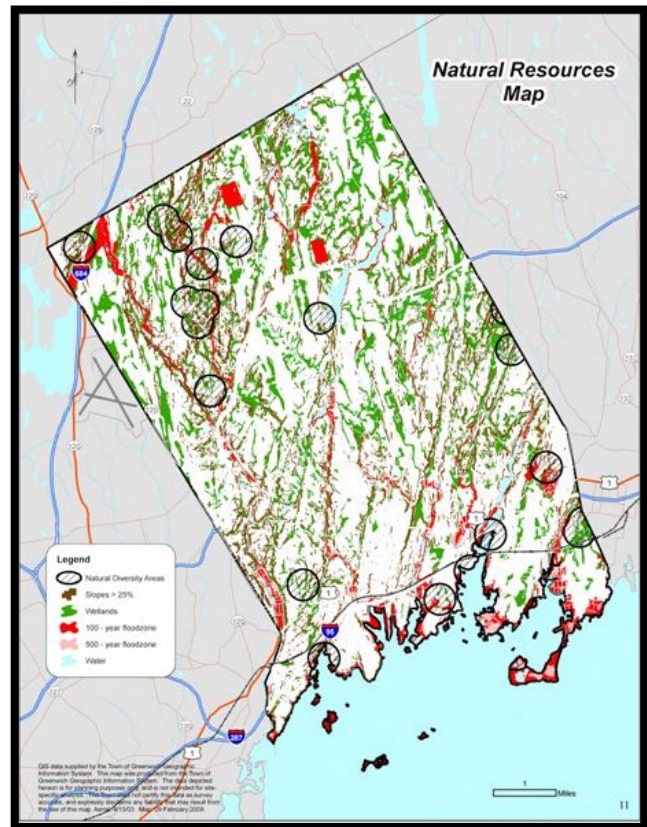
Greenwich recognizes that its economic vitality is tied to the quality of its environment. The Plan of Conservation and Development highlights that "Among the things that make Greenwich so attractive are its numerous open spaces and unspoiled natural features—public parks, beaches, wooded areas, massive rocks, lakes, rivers, fields, and scenic views" (Greenwich, Conn. Plan of Conservation and Development (Plan), p.1)

According to the plan, flooding has been an increasing challenge in town because of both development in the flood plain and increased impervious surfaces. "Floods have caused major damage to residential properties and structures. The Town is very concerned about flooding and drainage and is developing stormwater master plans to address this problem in various areas and watersheds of Town in a cost-effective manner" (p.2)

Sea level rise is seen as a component of this challenge that Denise Savageau, Conservation Director, says is understood by local residents. "...there are more and more people getting that sea level is rising ... but that said, [we are] just letting them know that even in existing conditions how bad it can be..." (Personal Communication, Jul. 9, 2012)

Ms. Savageau identified the challenge of the lack of institutional memory created by a large influx of new residents and a long period without a significant storm. The last major hurricane was in 1965 and a significant amount of construction has taken place since then. "We've had little minor storm events such as in 2007 ... but we don't have a history of people understanding where it is going to flood ... they don't know the elevation of their houses and they have never been in the 100-year storm event," Ms. Savageau said.

Another challenge, however, is that a large percentage of buildings in town are historic structures that were built before provisions for runoff mitigation were enacted. Equally challenging is the multitude of agencies that complicate flood hazard mitigation in Connecticut. The plan states "There are many departments with autonomous authorities and regulatory powers that are involved with stormwater management, drainage and flooding issues ... includ[ing] the Flood and Erosion Control Board (FECB), Inland Wetlands and Watercourses Agency, Department of



**Figure 3.5.1:1 - Greenwich Comprehensive Plan Natural Resource Map, Showing 100- and 500-Year Floodplains**

Public Works, Planning and Zoning Commission, Board of Appeals and the Conservation Commission" (Plan, p.2)

## ADAPTATIONS

### **Comprehensive Plan**

The most recent Greenwich Comprehensive Plan of Conservation and Development, required by state law, was adopted in 2009. To achieve the plan's goals, it includes the following action strategies:

The town's comprehensive plan mentions the need to address climate change. Specifically, it states "Coastal flooding is also an increasingly important issue, as concerns about global warming and sea level rise draw additional attention to this topic. Areas within the Old Greenwich coastal zone are particularly affected" (Plan, p.2)

To deal with these concerns, the plan recommended that Greenwich update the Building Zone Regulations and the Engineering Drainage Manual, which is currently being completed. The plan also recommended that Greenwich require that post-development hydrology of a site use low-impact and best management practices, which was implemented through the Green Area Ordinance.

### **Floodplain Initiatives**

Greenwich recently adopted a new drainage manual that further elaborates the town's commitment to low-impact development, which the town believes helps it prepare for climate change. In March 2012, the town also passed an innovative green area ordinance, which regulates the percentage of a lot that must remain vegetated, and helps reduce stormwater runoff.

The town's flood ordinance was updated in 2010. The town maintains a freeboard requirement of 1 foot in excess of FEMA base flood elevations in the A and AE zones that applies to residential and commercial buildings (Greenwich, Conn. Town Code, Sec. 6-139.1 (11a)).<sup>3</sup> No basements are allowed in the 100-year floodplain.

In the VE zone (Coastal High Hazard Area—areas with special flood hazards associated with high velocity waters, including hurricane wave wash), Greenwich allows two feet of fill. All mechanical equipment, electrical, plumbing, and other utility connections must be elevated 1 foot above Base Flood Elevation (Greenwich, Conn. Town Code, Sec. 6-139.1 (12.b)).

One square inch of flood venting is required for every square foot of enclosed area, which exceeds FEMA requirements. Homeowners can voluntarily elevate their homes above these levels, and the town has recently seen applications for 2 feet and higher above BFE. The town

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<sup>3</sup> Greenwich, Conn. Town Code, Sec. 6-139.1 (11.a) "No new or substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to at least 1 foot above the base flood elevation." Sec. 6-139.1 (11.c) permits non residential structures to be flood-proofed in lieu of freeboard if all utilities and sanitary facilities below required elevation are watertight and use structural components capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.

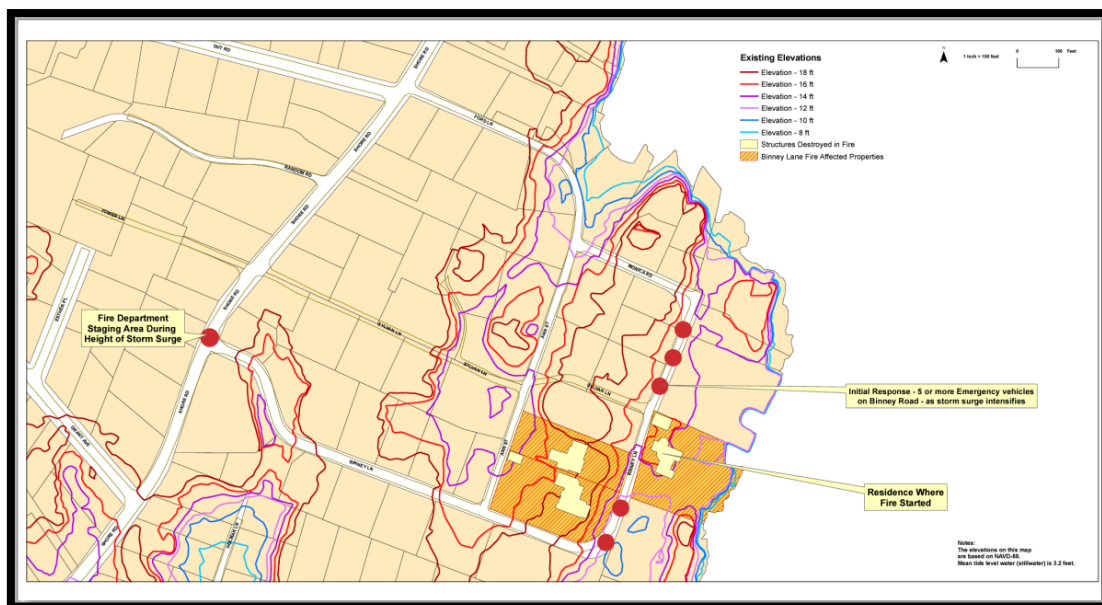
has been encouraging the use of fill instead of structural elevation of homes. The town is also working to educate homeowners about the risks and options for increasing their resilience.

The town also has a cumulative substantial improvement ordinance. Substantial improvement is defined as "any combination of repairs, reconstruction, alteration, or improvements to a structure taking place during the life of a structure." The ordinance defines "substantial improvement" "to occur when the first alteration (after 8/19/86) of any wall, ceiling, floor or other structural part of the building commences ... the term does not ... include any improvement project required to comply with existing health, sanitary or safety code specifications ... necessary to assure safe living conditions..." (Town Code, Sec. 6-139.1(c)(40))

**Evacuation and First Responder Mapping Using GIS**

Greenwich also has several ongoing low-cost adaptation activities involving effective use of Geographic Information Systems (GIS) to plan for extreme coastal flooding. These actions are low-cost for communities equipped with strong GIS capacity, particularly with respect to handling elevation data. However, with increased LiDAR provision throughout the region, the mapping work and methods developed by Greenwich could be scaled up with state and federal support, and extended to towns with inadequate GIS capacity.

The Town of Greenwich Conservation Commission has created detailed flood inundation maps for several extreme coastal flood scenarios using a bathtub model. Using 2-foot elevation contours, the maps show individual homes that would likely be inundated by extreme flood extents. These maps are different from other commonly available inundation maps (e.g., SLOSH) by providing needed detail to plan for individual homes and infrastructure made possible by high-resolution elevation data and a creative GIS application. Next, Greenwich will use 1-foot contours for greater precision. The maps are used for the following:



**Figure 3.5.1:2 - Greenwich Emergency Evacuation Map**

*Education* – Since extreme coastal floods are relatively rare, they are often not in the memory of residents located in the flood zone and, increasingly, they are out of the memory of those who manage the zone. Maps that show possible extreme flood inundation extents help communicate flood risk to provide an experience substitute to increase awareness for events that have not recently occurred.

*Evacuation maps* – Homes exposed to each flood scenario are identified to provide accurate evacuation zones and affected assets.

### TESTING THE GIS SYSTEM IN SANDY

Greenwich used this system for emergency response during Hurricane Sandy. At 6:06 P.M. on the night of the storm, the Greenwich Fire Department received a call about a fire that broke out in a coastal property. According to Ms. Savageau, they "used the detailed elevation map to guide the fire department in terms of staging during the worst part of the storm"\* to look at surge predictions in the area. While low tide was at 6 P.M., the fire department arrived on the scene and "found themselves in 2 ft of water...the storm surge was already creating water levels above flood stage."

With the severity of the wind that night, the fire was spreading and engulfed two other homes and two garages. "Winds were gusting to 80 mph and there were trees and electric lines down on some of the roads. We didn't want our fire crew to get trapped without a way out during the surge," according to Ms. Savageau. In addition, 33 residents had to be evacuated from the combined fire and surge risk.

Using the 2 ft. contour elevation maps and corroborating with the Army Corps of Engineers Stamford Hurricane Barrier Gauge, the town was able to determine the best evacuation route and the location for the optimal staging area, so they could locate fire equipment and personnel as close to the fire as possible but out of the risk of the incoming storm surge.

Using the data from the GIS and observations in the field, the Emergency Operations Center Staff were able to safely direct the fire options and determine when it was safe for fire and EMS personnel to move onto the scene, based on incoming storm surge data correlated to street elevations.

Following the storm, town staff used a GIS unit to document the wrack line and compare it to their topographical lines in the GIS. They determined that the surge was at 10 ft NAVD88 (a 50 year storm event - 100 year is 10.5').

The town is planning to further verify the state's SLOSH maps with data collected during the storm, "so that we can have better evacuation maps...so as not to appear to "cry wolf" with evacuating folks that do not need to be evacuated.

*Emergency response* – Each home is assigned a number indicating under what flood scenarios they would likely be inundated. Emergency responders can use this information to guide first response during a known flood height.

### **Home Elevation GIS Database**

Greenwich is inventorying the elevation of all homes in the coastal flood zone to be added to their GIS database. In addition to increasing the accuracy of the evacuation maps noted above, this GIS layer will help the town assess whether their ongoing practice to use fill dirt to provide freeboard in the AE flood zone is more detrimental than beneficial during extreme floods. The result of this assessment will determine whether this is a best practice.

Not all homes in the flood zone have elevation certificates on town record. While elevation certificates are available for new homes or those that have recently been renovated, other homes are not required to provide an elevation certificate. As part of a \$7,700 NOAA Coastal Resiliency Grant, Greenwich is obtaining elevation information for homes without elevation certificates from other sources, such as mortgage companies, that have this information on record. With accurate elevation information for every home in the flood zone, the emergency response maps with extreme flood exposure designations (see above) will also be more accurate.

Greenwich is also using the home elevation information to study the costs versus the benefits of using fill to raise homes in the AE flood zone. Height limitation variances are usually granted for homes raised by fill, and many homes are built above the FEMA minimum elevation requirement.<sup>4</sup> While this low-cost method for raising homes decreases property exposure to floods, it has the unintended collective effect of creating little islands, which may increase flood vulnerability in other ways. Each dirt mound diverts flood waters adding to a water pooling effect that may worsen floods by preventing water from draining back into the ocean. Some potential consequences of the pooling effect include increased flood exposure of property not raised by fill (e.g., cars and utility infrastructure), increased risk of people being trapped in their homes by flood waters, and decreased accessibility for emergency responders during extreme events. The results of the fill effect study will be used to determine whether Greenwich should change their regulations and not allow fill to be used in the AE flood zone.

### **Green Area Ordinance**

The town enacted a new green area ordinance in March 2012 to achieve the goal of the Comprehensive Plan "to remain a well-maintained residential community who protects and enhances water and land natural resources, pervious surfaces, open space, parklands, recreational facilities and areas in an environmentally sensitive manner" (Town Code, Sec. 6-5 (a)(35)).

The purpose of the law "is to maintain open areas and green spaces," that has the related benefit of "helping with drainage, flooding and water quality problems" (Greenwich, Conn., Planning and Zoning Commission). The law impacts all residentially zoned property except one multi-family zone.

Officially, the law amended Section 6-5 (a)(35) of the Town Code, specifically prescribing "the required percentage of a residentially-zoned property that is naturally occurring, such as rock outcroppings, wooded, grassed, manicured or landscaped areas."

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<sup>4</sup> Note: height limitations are also not an issue in the VE flood zone where Greenwich. However, fill is not allowed in the VE zone, so number of story restrictions tends to limit height in these areas.

The law was not entirely new, since many towns regulate impervious coverage. However, the law expanded Greenwich's previous regulations, which only covered commercial areas to all zones in the town. The new law reverses the typical manner of regulating impervious coverage by instead requiring a certain percentage of green space on the lot.

The law was intended to encourage retention of natural features and existing vegetation instead of relying on engineering solutions to stormwater management such as impervious pavers. The minimum green area coverage varies from up to 84% of the lot in the RA-4 zone to 35% in the R6 zone.

The town requires any landowner making improvements of greater than 500 sq. ft. of impervious surface to complete a drainage analysis. The town engineering department is also conducting an extensive town-wide master drainage study, but this cannot be considered a low-cost adaptation solution.