2023

2023 SCRCOG HAZARD MITIGATION PLAN

City of New Haven

CITY OF NEW HAVEN

2023 SCRCOG HAZARD MITIGATION PLAN UPDATE ANNEX

JANUARY 2023

City of New Haven

165 Church Street

New Haven, Connecticut 06510

https://www.newhavenct.gov

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This municipality Annex includes details regarding New Haven not included in the main body of the 2023 SCRCOG Mitigation Plan Update. The municipality annexes were developed to assist municipalities with the process of implementing and maintaining their portion of the 2023 SCRCOG Mitigation Plan Update. The Annex includes a Municipality Profile, Risk Analysis, Capability Assessment, and Mitigation Actions.

1. Municipality Profile

New Haven, the major City in the South Central Region, was settled by English Puritans in 1638, who bought the land from the Quinnipiac Tribe. The area was viewed as a commercial empire that could control Long Island Sound and that is what New Haven developed into. Yale was founded in the City in 1700 and was the co-capital of Connecticut until 1873.[1] Lying at the heart of the planning region, New Haven is bisected by New Haven Harbor, a major commercial port, and takes the title as the most developed jurisdiction in the region. In the 1850's, the City's manufacturing industry began to flourish, but today over half of the economy is made up of services and trade.[2] New Haven is governed with a Mayor-Board of Alders system and has its own police department and fire department.[3]

1.1 Demographics

As of 2019, New Haven's current population is 130,331 people[4]. There are 55,682 housing units in the City of which only 24.7% are owner-occupied, while 63.6% of its housing is renter-occupied and 11.7% remains vacant. The unemployment rate is at 4.4% which is down from a peak of 12.2% in 2011. Approximately 26.5% of New Haven residents live below the poverty level and 65,190 people are in the annual labor force. New Haven has the highest poverty rate in the South Central Region. As of 2019, 34.9% of residents held a bachelor's degree or higher, which is up by 7.8% since 2000. The median household income in New Haven is $42,222.[4]

As for the community make-up of the City, 43.6% of residents identified as White, 33.6% identified as Black or African American, 0.4% identified as American Indian and Alaska Native, 5.2% identified as Asian, 5.7% identified as Two or More Races, and 30.8% identified as Hispanic or Latino. Of New Haven's population, 17.4% were foreign-born persons.[5]

1.2 Geography and Water

The City of New Haven is bordered to the south by Long Island Sound and is therefore covered under the SCRCOG 2017 Coastal Resilience Plan. Making up a total of 20.1 square miles, the jurisdiction is home to a large deep harbor, the Port of New Haven, two basalt traprock ridges that border the northeast and northwest and contains several water features. The City is bordered to the west by the West River, and the Mill River and Quinnipiac River in the east. There are extensive trail networks in West Rock Ridge

[1] "New Haven's History." (n.d.). City of New Haven.

[2] "New Haven's History." (n.d). City of New Haven.

[3] "Government." (n.d.). City of New Haven.

[4] "South Central Region, CT: Demographic & Socioeconomic Trends." (2021). South Central Regional Council of Governments.

[5] "QuickFacts New Haven City, Connecticut." (2022). United States Census Bureau.

State Park and East Rock Park which lie on the outskirts of the City.[6] Lake Whitney Open Space and West River Memorial Park are additional natural features that entice the residents of New Haven.

1.3 Transportation

New Haven is also the transportation hub of the region, with Interstate 91, Interstate 95, U.S Route 1, and U.S Route 5 all passing through the City. Amtrak serves the City of New Haven, as well as the Metro-North Railroad and Shore Line East, allowing New Haven residents to easily commute. The jurisdiction hosts the New Haven Division of Connecticut Transit as a bus system. New Haven also has the Tweed Airport and the Port of New Haven, two critical transportation facilities for the City and surrounding region.[7]

As of 2019, 58.7% of New Haven residents drove alone, 9.1% carpooled, and 11.9% used public transportation. About 47.8% of the population commutes to a different municipality for work which is a significant decrease from 2000 when 72.6% commuted outside of the City. New Haven has the lowest number of residents who commute to a different municipality for work in the South Central Region and has seen the largest decrease in commuting to a different municipality for work.[8]

The City includes trail and natural areas along the West River, the Mill River and Quinnipiac River. The West River Watershed, Farmington Canal Greenway and Quinnipiac River Watershed are designated state greenways by the Department of Energy and Environmental Protection. Additionally, it has the Farmington Canal Heritage Greenway which is a multi-use trail that goes from New Haven to Suffield and follows the path of the 19th century Farmington Canal. This trail is part of the East Coast Greenway running from Florida to Maine, with the South Central Region having 1.6 miles of it.[9]

1.4 Land Use and Development

The City of New Haven is the most densely populated area in the planning region. The urban environment contains several neighborhoods centered on Downtown New Haven, which provides half the City's jobs and tax base. In the South Central Region Plan of Conservation and Development 2018-2023, New Haven's development goals include, "encouraging affordable and diverse housing, connecting community through a multi-modal transportation network, and adapting to climate change and sea level rise."[10] Alongside these goals, New Haven participated in the Regional Framework for Coastal Resilience in Southern CT, which outlines several projects such as, shoreline enhancement, river bank protection, updating seawalls and bulkheads, green infrastructure, and other mechanisms of flood protection.[11]

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[6] "West Rock Ridge State Park." (2017). Department of Energy & Environmental Protection. 2002-2017, "East Rock Park." Connecticut: Still Revolutionary.

[7] "South Central Region, CT: Demographic & Socioeconomic Trends." (2017). South Central Regional Council of Governments. Pg.24.

[8] "South Central Region, CT: Demographic & Socioeconomic Trends." (2021). South Central Regional Council of Governments.

[9] "South Central CT Region Plan of Conservation & Development." (2018). South Central Regional Council of Governments. Pg. 31.

[10] "South Central Region: Plan of Conservation & Development 2018-2023 DRAFT." (2018). South Central Regional Council of Governments. Pg. 71.

[11] "Southern Connecticut Regional Framework for Coastal Resilience Proposal." (2014). South Central Regional Council of Governments.

2. Hazard Profiles

2.1 Critical Facilities

There are 41 critical facilities in the City, as seen in Table 1, plus several Greater New Haven Water Pollution Control Authority facilities, and Tier 1 and 2 United Illuminating facilities including a substation on Grand Avenue. There are five designated emergency shelters in the City: New Haven Fire Training Academy, Hill Career High School, James Hillhouse High School, Wilbur Cross High School, and the Nathan Hale School.

Table 1. Critical Facilities in the City of New Haven.

Facility	Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	In Surge Zones[12]?
Emergency Services					
Emergency Operations Center	200 Orange Street	N/A	No	No	N/A
City Hall/Government Center	165 Church Street, 200 Orange Street	N/A	No	No	N/A
New Haven Health Department	54 Meadow Street	N/A	No	No	N/A
New Haven School Department	54 Meadow Street	N/A	No	No	N/A
New Haven Fire Training Academy	230 Ella T. Grasso Boulevard	N/A	Yes	Yes	N/A
Hill South Police	410 Howard Avenue	N/A	No	No	N/A
Department of Police Services	1 Union Avenue	N/A	No	Yes	N/A
Dwight-Chapel/West	150 Edgewood	N/A	No	No	N/A

[12] Based on spatial analysis using storm surge results from the Sea, Lake and Overland Surges from Hurricanes (SLOSH) model.

Facility	Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	In Surge Zones[12]?
River	Avenue				
Hill North	90 Hallock Street	N/A	No	No	N/A
Dixwell	28 Charles Street	N/A	No	No	N/A
Newhallville/East Rock	596 Winchester Avenue	N/A	No	No	N/A
Fair Haven	295 Blatchley Avenue	N/A	No	No	N/A
East Shore/Fair Haven Heights/Quinnipiac East	830 Woodward Avenue	N/A	No	No	N/A
Beaver Hills/Whalley Avenue	386 Whalley Avenue	N/A	No	No	N/A
Fire Department Headquarters	952 Grand Avenue	N/A	No	No	N/A
Dixwell Fire Station	125 Goffe Street	N/A	No	No	N/A
East Grand Fire Station	73 East Grand Avenue	N/A	No	No	N/A
Fountain Street Fire Station	105 Fountain Street	N/A	No	No	N/A
Hill Fire Station	525 Howard Avenue	N/A	No	No	N/A
Lighthouse Fire Station	510 Lighthouse Road	N/A	No	Yes	N/A
Whitney Avenue Fire Station	350 Whitney Avenue	N/A	No	No	N/A
Woodward Avenue Fire Station	826 Woodward Avenue	N/A	No	No	N/A
Westside Battalion Chief Fire Station	120 Ellsworth Avenue	N/A	No	No	N/A

Facility	Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	In Surge Zones[12]?
Eastside Battalion Chief Fire Station	412 Lombard Street	N/A	No	No	N/A
Health Care and Senior Living Facilities					
Yale-New Haven Hospital	20 York St	N/A	No	No	N/A
St. Raphael Hospital	1450 Chapel St	N/A	No	No	N/A
Municipal Facilities					
Department of Public Works	34 Middletown Avenue	N/A	No	No	N/A
Department of Parks and Recreation	720 Edgewood Avenue	N/A	No	Yes	N/A
Kathryn Brennan High School Gymnasium	200 Wilmot Road	N/A	No	No	N/A
Hill Career High School	140 Legion Avenue	N/A	Yes	No	N/A
James Hillhouse High School	480 Sherman Parkway	N/A	Yes	No	N/A
Wilbur Cross High School	181 Mitchell Drive	N/A	Yes	Yes	N/A
Nathan Hale School	480 Townsend Avenue	N/A	Yes	No	N/A
Tweed New Haven Airport	155 Burr Street	N/A	No	Yes	N/A
Southern CT State University	501 Crescent Street	N/A	No	No	N/A
East Shore Park	250 Woodward Avenue	N/A	No	Yes	N/A
Sports Haven	600 Long Wharf	N/A	No	Yes	N/A

Facility	Location	Emergency Power Supply?	Shelter?	In Floodplain or Coastal Flood Hazard Area?	In Surge Zones[12]?
	Drive				
Yale University Athletic Fields	76 Yale Avenue	N/A	No	Yes	N/A
New Haven Main Library	133 Elm Street	N/A	No	No	N/A
Water and Wastewater					
GNHWPCA • Plant • 45 Pump Stations • Admin Facilities • Siphon • Tank		N/A	No	N/A	N/A
Regional Water Authority	90 Sargent Drive	N/A	No	Yes	N/A
Regional Transportation					
Union Station (rail, bus)	170 Union Avenue	N/A	No	Yes	N/A
Other Infrastructure and Facilities					
Tier 1 and Tier 2 facilities for United Illuminating		N/A	No		N/A
United Illuminating Grand Avenue sub-station	Grand Avenue	N/A	No	Yes	Yes

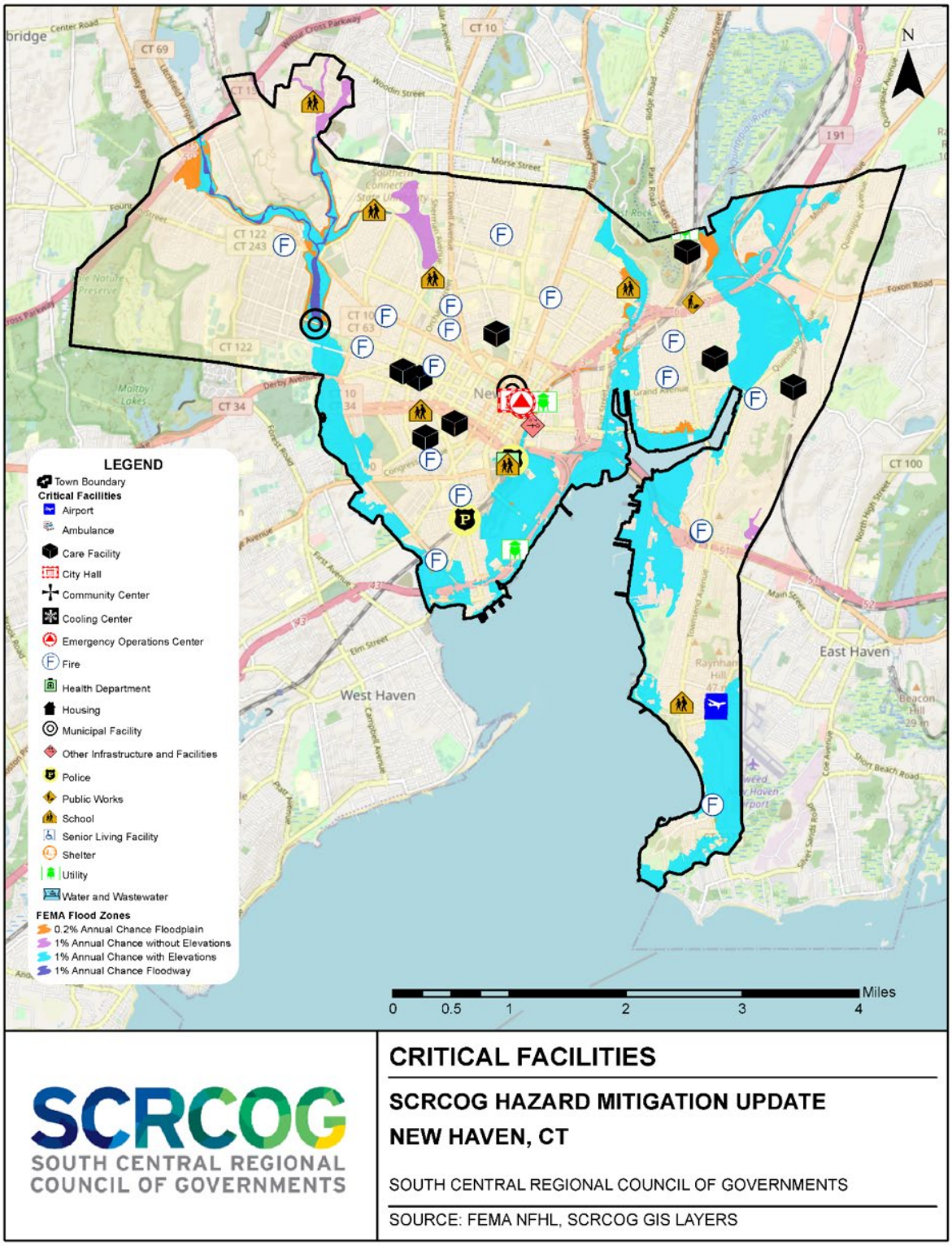

Figure 1. New Haven FEMA Flood Zones and Critical Facilities.

2.2 Vulnerable Assets

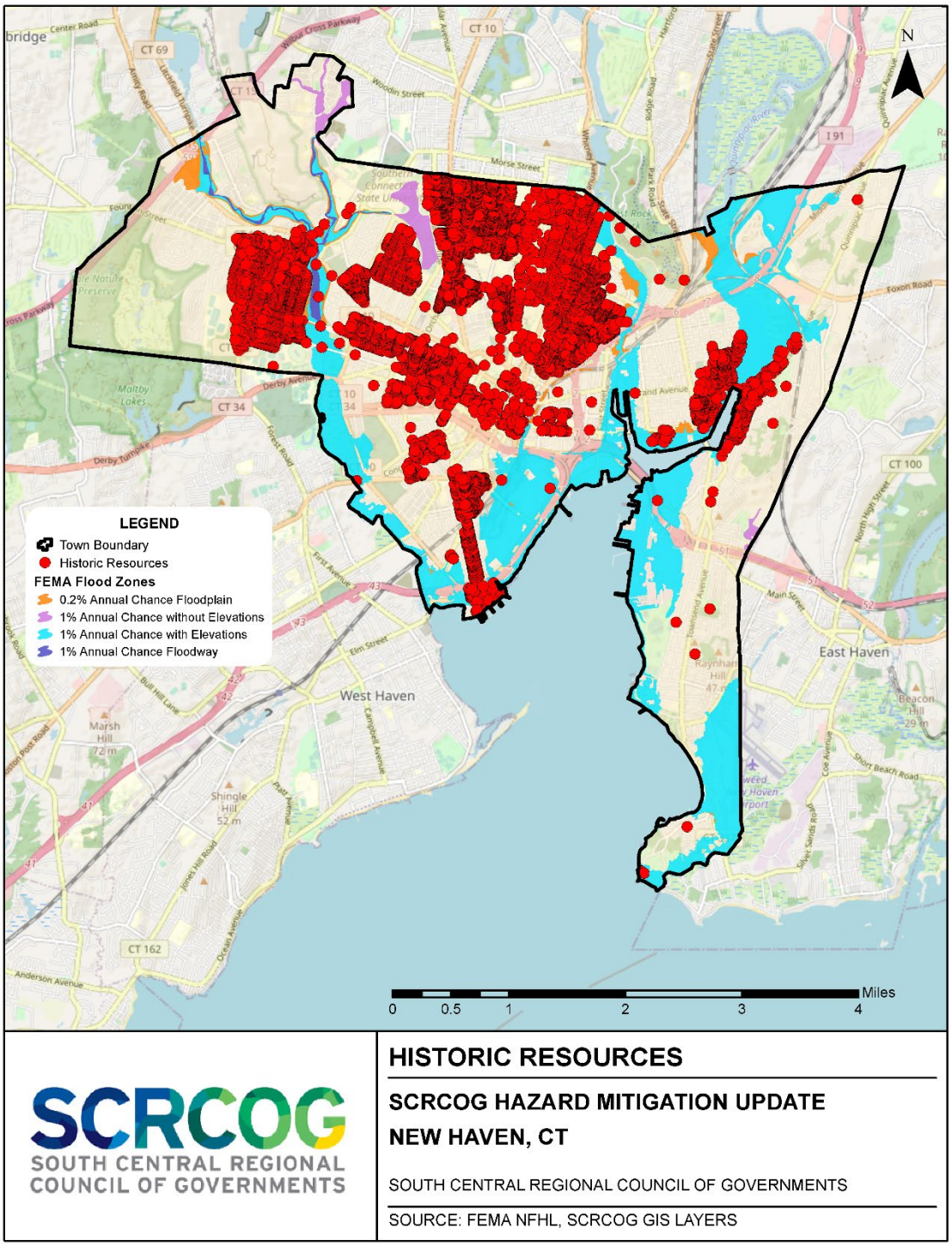

Figure 2. New Haven FEMA Flood Zones and Historic Resources.

Historic Resources

The historic resources shown in Figure 2 are properties in the City of New Haven designated as National Historic Landmarks or properties listed on the National Register of Historic Places, the State Register of Historic Places or local historic districts/local historic properties.

Repetitive Loss and Severe Repetitive Loss Properties

In addition to the spatial analysis conducted above, summary information for repetitive flood loss and severe repetitive flood loss properties within the City of New Haven also provides an indication of vulnerable assets, especially with regard to properties insured under the National Flood Insurance Program that have experienced repeated flooding (Table 2).[13]

Table 2. New Haven Repetitive and Severe Repetitive Flood Loss Summary.

	Number of Losses	Number of Properties	Building Payments	Contents Payments	Total Payments
Repetitive Loss (RL)	95	42	$1,121,224	$543,676	$1,664,901
Severe Repetitive Loss	5	1	$43,199	$2,083	$45,282

The majority of the RL properties are evenly divided among single-family homes, residential condominium units, and multi-family homes. Only seven RL properties are non-residential, and these appear to be commercial and industrial uses.

As of August 31, 2017, the City of New Haven had a total of 422 claims totaling $5,043,909 in losses for all NFIP-insured structures.

Since the City of New Haven's entry to the National Flood Insurance Program to March 31, 2022, the City has had 431 claims totaling $4,719,947 in losses. This is below average compared to coastal towns.

2.3 Historic Disasters

2.3.1 Federally Declared Events

Over the past two decades alone, six historic disaster events have occurred that have shaped how disaster response and recovery is handled across the United States. These events include Hurricanes Katrina, Sandy, Irma, Maria, and Harvey, along with the California wildfires in 2017. While not all of these events directly impacted the SCRCOG region, or the State of Connecticut, hazard mitigation planning has been driven by these catastrophic events.

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

The first federal act of relief occurred in 1803 following a destructive fire in Portsmouth, New Hampshire where Congress provided relief in the form of suspended bond payments. Over a century and a half later in 1979 the Federal Emergency Management Agency (FEMA) was created and tasked with nationwide emergency management. However, emergency and disaster declarations for the State of Connecticut have been made since 1954. These have included hurricanes, blizzards, severe wind and rainstorms, and tornadoes.

Since 2016, specifically for New Haven County, there have been three FEMA Disaster Declarations (DR), and two Emergency Declarations (EM) (Table 3). These are in addition to the COVID-19 disaster and emergency declarations that were declared in March 2020. FEMA declarations are made when it is determined that federal assistance is needed to supplement State and Tribal efforts in the wake of an event.

In addition to the FEMA declarations, the United States Department of Agriculture (USDA) declared eight agriculturally related disasters in the same time frame; two of which were also declared by FEMA. These USDA declarations make emergency loans available to agricultural producers in the designated counties.

Table 3. FEMA and USDA Disaster Declarations for New Haven County.

Event	Disaster	Date of Event	Date Declared
FEMA Disaster Declarations for New Haven County			
Severe Storms, Tornadoes, and Straightline Winds	DR-4385-CT	May 15, 2018	August 20, 2018
Tropical Storm (T.S.) Isaias*	DR-4580-CT EM-3535-CT	August 4, 2020	January 12, 2021
Hurricane Henri	EM-3564-CT	August 21-24, 2021	August 22, 2021
Hurricane Ida*	DR-4629-CT	September 1-2, 2021	October 30, 2021
USDA Declared Disasters for New Haven County			
Frost and Freeze	S4048	February 12, 2016	September 21, 2016
Drought	S4055	August 2, 2016	September 28, 2016
Excessive Rainfall	S4478	August 1, 2018	March 20, 2019
Drought	S4814	September 22, 2020	October 14, 2020
Drought	S4825	September 29, 2020	October 15, 2020
Tropical Storm Elsa	S5069	July 9, 2021	August 30, 2021

Event	Disaster	Date of Event	Date Declared
* Indicates FEMA declaration that was also made by USDA			

In New Haven County, the May 2018 storms (DR-4385) caused $8,187,833 worth of damage, with federal assistance totaling $6,213,312. Tropical Storm Isaias (DR-4580) resulted in $4,656,424 worth of damage and a federal assistance totaling $3,915,143. For reference, Hurricane Sandy resulted in over $14 million of damage. Public assistance (PA) was requested by most communities in the region.

In addition, Individual Assistance (IA) housing assistance for owners and renters was distributed in the wake of Hurricane Ida (DR-4629). Homeowners throughout the region received $570,033 in assistance and renters received $37,112.

2.3.2 National Centers for Environmental Information

The NOAA National Centers for Environmental Information (NCEI) maintains a storm events database that documents significant weather events and their impacts including injuries and loss of life, and economic impacts and property damage. Event types in this database generally include severe storm events such as hurricanes, thunderstorm, or windstorms, hail events, snow and freezing events, and several types of flood events such as flash or coastal floods.

Between 2017 and 2021 the SCRCOG region experienced 70 different events including floods, hail, high windstorms, and tornadoes (Table 4). Property damage throughout the region for these 70 events was estimated to be $1,054,500. Losses specific to the City of New Haven are discussed in Section 3.2.

Table 4. NCEI Events Between 2017 and 2021.

Event Type	Number of Events
Flash Flood	25
Flood	1
Hail	2
Thunderstorm Wind	39
Tornado	3
Total	**70**

2.3.3 Drought Occurrences

The United States Drought Monitor (USDM) is a nation-wide map depicting which areas throughout the U.S are in drought, and the intensity of that drought. The USDM is developed via data synthesis and observations from drought experts and local observers. The chart seen in Figure 3 is a graphical representation of the drought periods in New Haven County from 2015 to the end of 2021. The dark orange and red areas indicate a more severe drought period. Most recently, New Haven County has experienced an extreme drought (D3) in 2016 into 2017, with a severe drought (D2) in 2020.

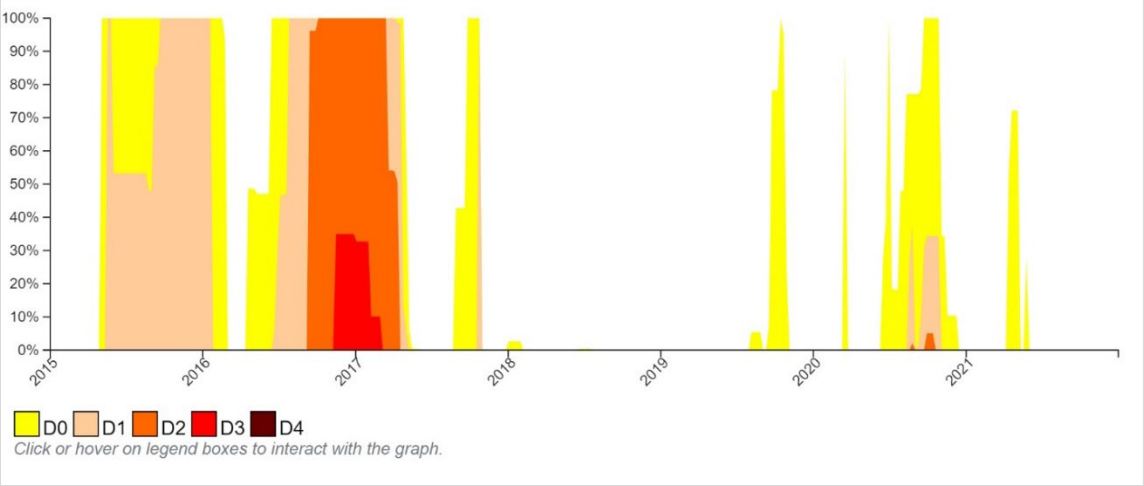

Figure 3. United States Drought Monitor (USDM) Drought Intensity for New Haven County from 2015 through 2021.

Another tool used to characterize drought conditions is the Standardized Precipitation Index (SPI). This index identifies drought areas based on the deviation of recent precipitation levels in comparison to the long-term average. Ultimately, if rainfall levels have been "lower than normal" or "wetter than normal" in a certain timeframe, the SPI represents these highs and lows at a national scale. The chart seen in Figure 4 shows the SPI for New Haven County from 2015 to the end of 2021. In comparison to the USDM, the fluctuations in drought periods are relatively synonymous, however, the SPI indicated a more severe period of drought between 2015 and 2017 than the USDM. This is because the USDM is based on several other factors aside from just precipitation, hence why the USDM is typically used to determine local drought measures and needs. The blue areas on the chart are the periods of time that were wetter than usual with higher precipitation.

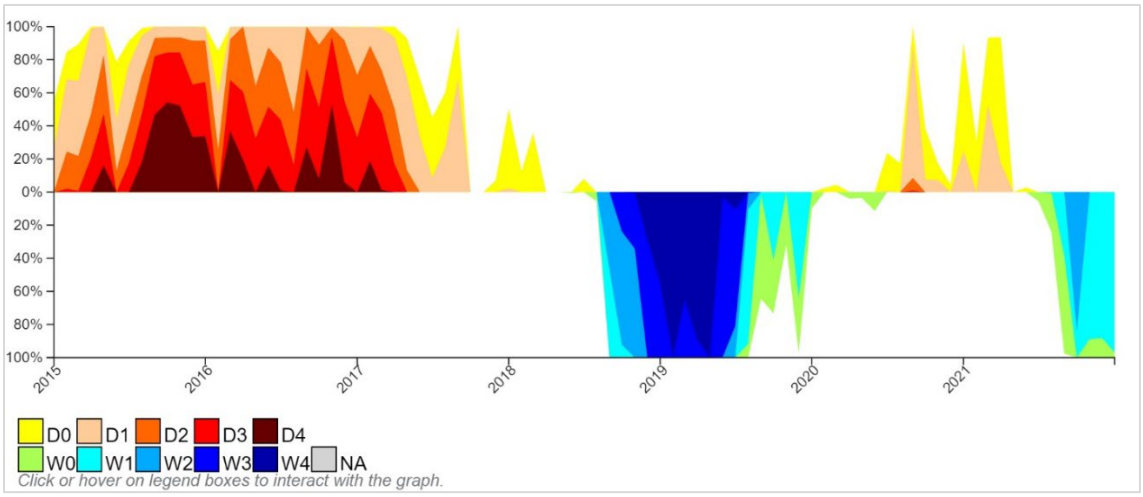

Figure 4. Standardized Precipitation Index (SPI) for New Haven County from 2015 through 2021.

The impacts of drought vary throughout the SCRCOG region and are often felt over a longer period of time and are related to social, ecological, and economic concerns. The 2016 drought, the most extreme in recent years, resulted in mandated water conservation measures, and required some water utilities in the region, to make necessary water management changes. In addition, eight farm operations received assistance from the United States Department of Agriculture in the wake of the event in the amount of $78,590.

The severe drought in 2020 also impacted the region in various ways. At a statewide level, drinking water reservoirs were at 67% of capacity and 83.5% of normal. With decreased precipitation, and drinking water reservoir levels low, the Connecticut Interagency Drought Workgroup placed New Haven County in a Stage 1 drought per the State Drought Plan. Specifically, the Northeast Regional Climate Center identified the City of New Haven as having one of the highest rainfall deficits in the State at -11.09 inches average rainfall. During the 2020 drought, private wells were reportedly drying up, there were reports of livestock farms needing water, and water utilities throughout the region and state were experiencing reduced supply.

On October 15, 2020 the USDA identified New Haven County as a contiguous disaster county, making farm operators eligible to be considered for assistance from Farm Service Agency (FSA). Three farms in the region received assistance as a result of the drought in the amount of $17,982.

2.3.4 Wildland Urban Interface (WUI)

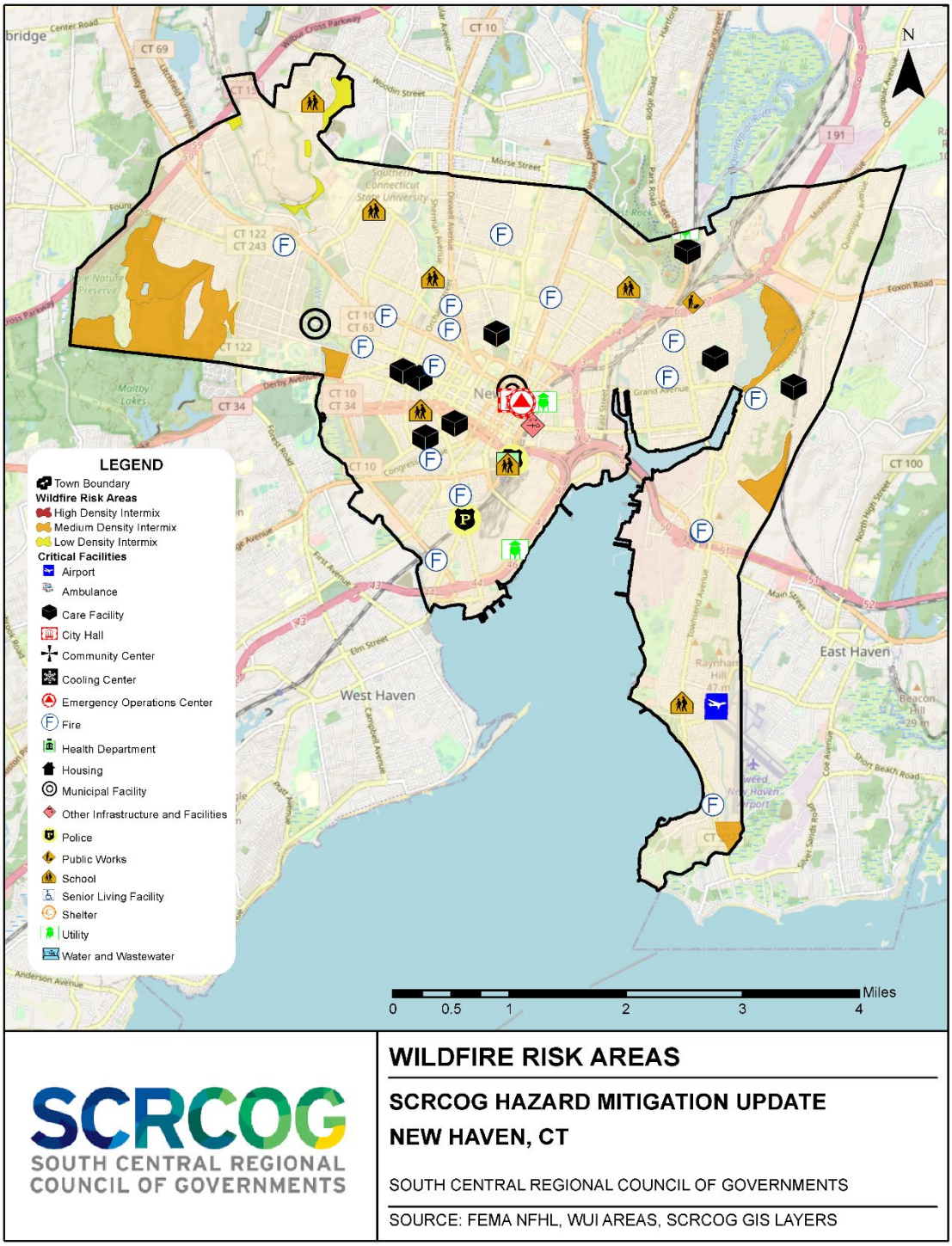

Figure 5. New Haven WUI and Critical Facilities.

3. Risk Analysis

3.1. Vulnerable Assets: Exposure Analysis

Vulnerable assets were identified by intersecting GIS-based asset inventories with known hazard boundaries to determine the numbers of parcels, critical facilities, and historic assets. This results in an estimation of vulnerable assets for the entire region, by hazard as shown in Table 5. Drought exposure was estimated using the Connecticut DPH assumed private well data developed in 2021. The wildfire hazard boundary was defined by those parcels within the wildland-urban interface and intermix *and* that were also assumed to be served by a private well. The assumed presence of a private well indicates a lack of public water supply, and potentially reduced firefighting capacity. The estimated value of at risk assets is based on the City's latest property tax values. Scenarios are cumulative, i.e., the 0.2% annual chance estimates also include the values and numbers of the 1% annual chance event.

Table 5. City of New Haven Vulnerable Assets Exposure Analysis.

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Hurricane/ Tropical Storm	$17,398,314,810	27,745	$624,796,130	41	$4,075,739,440	8,340
Severe Thunderstorm	$17,398,314,810	27,745	$624,796,130	41	$4,075,739,440	8,340
Severe Winter Storm	$17,398,314,810	27,745	$624,796,130	41	$4,075,739,440	8,340
Tornado	$17,398,314,810	27,745	$624,796,130	41	$4,075,739,440	8,340
Drought	-	-	-	-	-	-
Flood						
1% Annual Chance	$2,057,132,795	2,482	$121,648,870	10	$318,435,902	334
0.2% Annual Chance	$2,208,640,663	2,872	$121,648,870	10	$387,428,080	356
VE Zone	$324,008,318	282	$17,292,170	1	$53,977,560	8
Storm Surge						
Category 1	$706,104,724	1,275	$57,682,380	3	$101,032,680	231

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Category 2	$1,899,513,235	2,522	$107,594,410	9	$287,308,932	329
Category 3	$2,551,887,875	3,866	$107,594,410	9	$371,129,132	428
Category 4	$3,255,186,699	4,844	$110,551,560	10	$462,992,302	573
Earthquakes	$17,398,314,810	27,745	$624,796,130	41	$4,075,739,440	8,340
Wildfire	$6,580	2	-	-	-	-

3.2 Hazard Losses

3.2.1 Federal Assistance

Of the five natural hazard emergency and disaster declarations, the City received FEMA Public Assistance funds in the wake of two events: Tropical Storm Isaias and the COVID-19 Pandemic (Table 6).

Table 6. Federal Funds Received from Disaster Declarations.

Event	Disaster	Assistance Type	Federal Funding Received	Total Project Need (Damages)
Tropical Storm (T.S.) Isaias	DR-4580-CT EM-3535-CT	PA	$122,933	$147,353
Covid-19	DR-4500-CT EM-3439-CT	PA	$2,643,907	$2,643,907

Funds received by the City for both events were primarily distributed for protective measures, with just about 2% of the $2,766,841 received going to debris removal and public buildings (Figure 6). Specifically, some of the funds were distributed for debris removal for South Central Connecticut Regional Water Authority during Isaias, emergency repairs for the police station, and COVID-19 protective measures and needs such as sheltering, and vaccination initiatives.

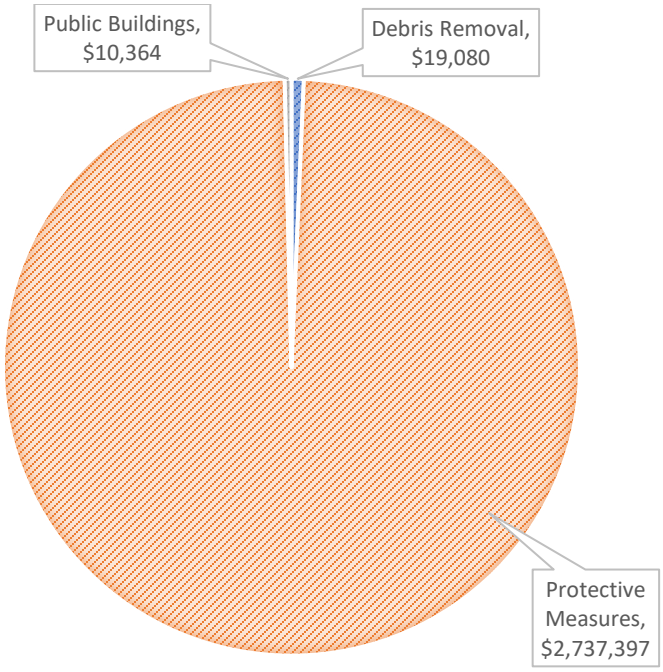

Figure 6. Federal Funds Received by Category.

In addition to PA, City property owners and renters received funds in the wake of Hurricane Ida. Six disbursements were made to owners totaling $56,317, and seven to renters in the amount of $9,468.

3.2.2 National Centers for Environmental Information (NCEI)

The NCEI documentation has identified 14 hazardous weather events for the City of New Haven since 2017. There have been five flash flood events and nine thunderstorm and high wind events. The thunderstorm and wind events resulted in a reported $28,000 in property damage; no damage figures were reported for the flash flood events.

Much of thunderstorm and wind damage reported was attributed to downed trees, limbs, and power line. Wind gusts from some events were reported at 60, 63 and 69 mph. In addition, during flood events, flooding was reported at the Tweed Airport Terminal, Union Avenue near the Police Department and Union Station, in several Yale University dormitories, and along Middletown Avenue.

3.3 Loss Estimates

3.3.1 Sea Level Rise (SLR)

Table 7. Buildings in New Haven affected by the SLR Base Scenario.

New Haven	Buildings Affected	Critical Facilities	Historic Resources
Base Scenario			
Mean Higher High Water (MHHW)	5	0	8
10-year Flood Event	366	2	39
30-year Flood Event	498	2	72
50-year Flood Event	548	2	79
100-year Flood Event	617	2	87
500-year Flood Event	617	2	87

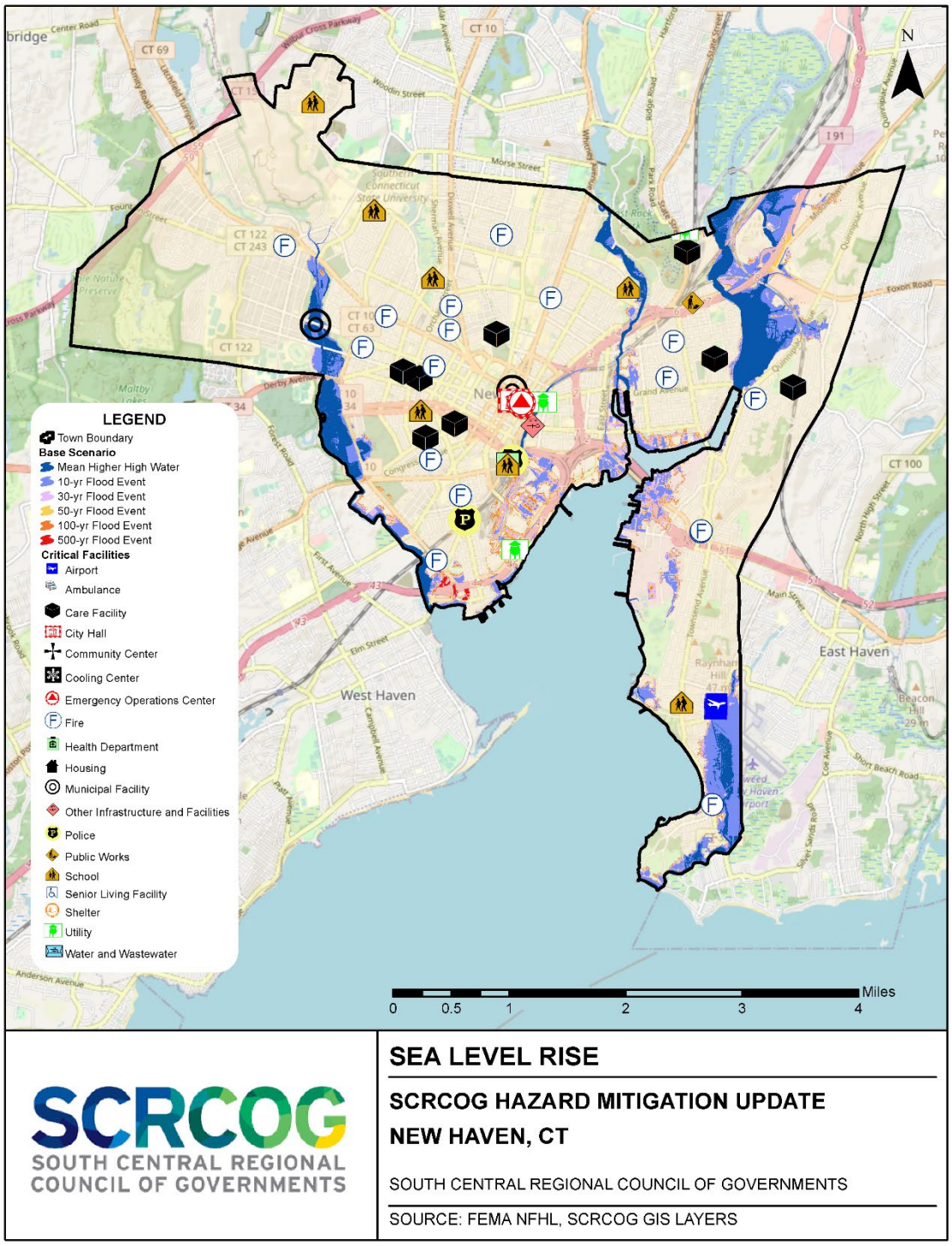

Figure 7. New Haven SLR Base Conditions Scenario.

Table 8. Buildings in New Haven affected by the SLR Future Conditions Scenario.

New Haven	Buildings Affected	Critical Facilities	Historic Resources
Future Conditions Scenario			
Mean Higher High Water (MHHW) +1 foot	27	0	7
Mean Higher High Water (MHHW) +20 inches	54	0	7
10-year Flood Event + 20 inches	614	2	86
30-year Flood Event + 20 inches	792	6	116
50-year Flood Event + 20 inches	844	6	125
100-year Flood Event + 20 inches	906	7	131
500-year Flood Event + 20 inches	925	7	136

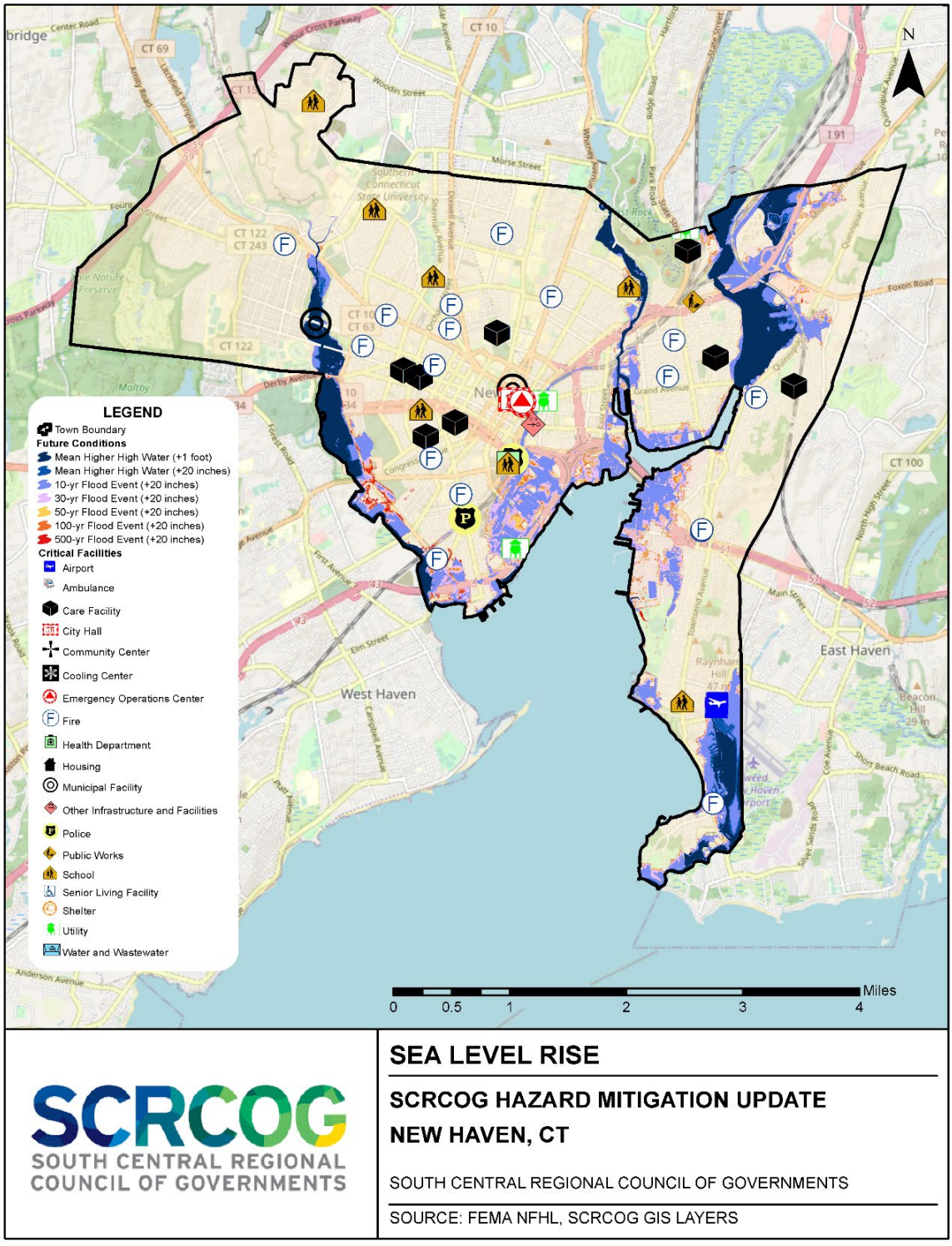

Figure 8. New Haven SLR Future Conditions Scenario.

3.4 HAZUS-MH Analysis

Hazus-MH (Hazus) v5.1 was used to complete the earthquake, hurricane wind, and both riverine and coastal flood analyses for vulnerability and loss estimates for the 2023 plan update. The Hazus software was developed by FEMA and the National Institute of Building Sciences. For the earthquake module, the U.S. Census tracts are the smallest extent in which the model runs; for the hurricane and flood modules, U.S. Census blocks were used. Multi-frequency depth grids were used for the riverine flood analysis, but only the 100-year coastal depth grid was available and used for analysis. Hazus was also used to calculate Storm Surge using the National Hurricane Center's (NHC) Sea, Lake, and Overland Surges from Hurricanes (SLOSH) Maximum of the Maximum Envelope of Waters (MEOWs) (MOM) depth grid.

3.4.1 Earthquake

The earthquake analysis was run based on the largest earthquake in Connecticut history, which occurred in East Haddam on May 16, 1791. Specific parameters include:

- Longitude of epicenter: -72.40
- Latitude of epicenter: 41.50
- Depth: 10.00 km.
- Magnitude: 6.40
- Attenuation function: CEUS 2008

After the earthquake analysis was performed, two tables for each municipality were created based off the tables for the 2018 update: Numbers of Buildings Damaged and anticipated extent of damage (Table 9) and Total Building-Related Economic Loss (Table 10) which includes the total economic loss by general occupancy type. An additional table was also created: Other Earthquake Impacts (Table 11) which includes information related to debris generated, number of displaced households, and the number of individuals who need to seek temporary shelter. Including this table allows these impacts to be compared across different hazards.

Table 9. Number of Buildings Damaged from the East Haddam Earthquake Scenario for the City of New Haven.

New Haven	Slight	Moderate	Extensive	Complete	Total Damaged Buildings	Total Buildings	Percentage of Damaged Buildings
2022 Count	5,031	2,545	732	144	8,452	28,980	29%

Table 10. Total Building Related Economic Loss from the East Haddam Earthquake Scenario for the City of New Haven.

New Haven	Residential	Commercial	Industrial	Others	Total
2022 Losses	$336,013,232	$411,760,152	$44,447,673	$220,998,458	$1,013,219,515

Table 11. Other Earthquake Impacts from the East Haddam Earthquake Scenario for the City of New Haven.

New Haven	Debris Generated (Tons)	Households Displaced	Individuals Seeking Temporary Shelter
2022 Results	351	1,214	983

3.4.2 Hurricane

Hazus uses historical hurricane tracks and computer modeling to identify the probable tracks of a range of hurricane events and then assigns potential wind gusts that result. Widespread extreme thunderstorm wind events, such as those associated with well-developed squall lines, may have wind gusts of a similar magnitude to those of the 50- or 100-year hurricane wind event. A 1000-year event is the rough equivalent of a strong Category 1 or low-end Category 2 hurricane (or weak to mid-strength EF-1 tornado) with 3-second wind gusts of up to around 95 mph. In terms of probability, the 1000-year event has a 0.01% chance of happening in any given year.

For the hurricane hazard, three tables for the City of New Haven were created based off the tables for the 2018 update: Numbers of Buildings Damaged and anticipated level of damage (Table 12), Building-Related Economic Loss (Table 13), and Other Hurricane Impacts (Table 14) which includes information related to debris generated, number of displaced households, and the number of individuals who need to seek temporary shelter. These tables broke down the values for the seven hurricane return periods (10-, 20-, 50-, 100-, 200-, 500-, and 1,000-year).

Table 12. Number of Buildings Damaged from the Probabilistic Hurricane Scenario for the City of New Haven.

New Haven	Return Period	Minor	Moderate	Severe	Destruction	Total
2022 Results	10-year	0	0	0	0	0
	20-year	49	3	0	0	51
	50-year	214	21	2	0	237
	100-year	986	154	7	0	1,148
	200-year	2,583	523	28	2	3,136

New Haven	Return Period	Minor	Moderate	Severe	Destruction	Total
	500-year	5,522	1,685	123	22	7,351
	1,000-year	7,895	3,418	390	84	11,786

Table 13. Total Building Related Economic Loss from the Probabilistic Hurricane Scenario for the City of New Haven.

New Haven	Return Period	Minor	Moderate	Severe	Destruction	Total
2022 Results	10-year	$0	$0	$0	$0	$0
	20-year	$88,040	$4,801	$165	$0	$93,006
	50-year	$394,147	$36,539	$3,485	$0	$434,171
	100-year	$1,909,522	$270,080	$14,150	$381	$2,194,134
	200-year	$5,115,703	$933,135	$53,521	$4,446	$6,106,805
	500-year	$11,086,579	$3,109,863	$240,749	$46,746	$14,483,937
	1,000-year	$15,982,570	$6,430,470	$767,608	$174,459	$23,355,106

Table 14. Other Hurricane Impacts from the Probabilistic Hurricane Scenario for the City of New Haven.

New Haven	Return Period	Debris Generated (Tons)	Households Displaced	Individuals Seeking Temporary Shelter
2022 Results	10-year	0	0	0
	20-year	275	0	0
	50-year	4,471	1	1
	100-year	17,331	108	86
	200-year	37,731	373	299
	500-year	76,756	1,024	823
	1,000-year	124,332	2,022	1,637

3.4.3 Riverine Flood

Floods are often described in terms of annual percentage chance of occurrence. Floodplains have been delineated by FEMA to reflect the 1- and 0.2-percent-annual-chance flood events previously known as 100-year and 500-year floods, respectively. The area that has a 1 percent chance annually to flood each year is delineated as a Special Flood Hazard Area (SFHA) for the purposes of the National Flood Insurance Program (NFIP). The 0.2-percent-annual-chance floodplain indicates areas of moderate flood hazard.

Hazus-MH v5.1 was used to complete the riverine flood analysis for vulnerability and loss estimates for this plan. The Hazus software was developed by FEMA and the National Institute of Building Sciences. A The flood loss estimation methodology consists of two modules that carry out basic analytical processes: flood hazard analysis and flood loss estimation analysis. The flood hazard analysis module uses characteristics, such as frequency, discharge, and ground elevation to estimate flood depth, flood elevation and flow velocity. The flood loss estimation module calculates physical damage an economic loss from the results of the hazard analysis.

A Hazus Level 2 analysis was performed for the City of New Haven with a user-provided depth grid. The flood model was used to run a single-frequency depth grid scenario which included the 1-percent - annual-chance flood (100-year) scenario. The average annualized losses (AAL) were not able to be calculated as a full suite of depth grids run in the multi-frequency scenario is required. The City of New Haven is outside the multi-frequency depth grid footprint. For analysis purposes, the U.S. Census blocks are the smallest extent in which the model runs. Hazus generates economic loss estimates based on direct building damages and business interruption. Table 15 shows the 1-percent-annual-chance losses for the riverine flood scenario.

Table 15. 1-percent-annual-chance Riverine Flood Loss Estimates for the City of New Haven.

New Haven	**2022 Results**				
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Direct					
Building	$8,533,000	$4,156,000	$1,534,000	$351,000	$14,574,000
Contents	$6,487,000	$12,403,000	$2,711,000	$2,835,000	$24,436,000
Inventory	$0	$124,000	$326,000	$5,000	$455,000
Subtotal	$15,020,000	$16,683,000	$4,571,000	$3,191,000	$39,465,000
Business Interruption					
Income	$816,000	$60,552,000	$272,000	$7,964,000	$69,604,000
Relocation	$10,232,000	$15,356,000	$423,000	$3,917,000	$29,928,000

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Rental Income	$10,744,000	$11,323,000	$58,000	$506,000	$22,631,000
Wage	$1,930,000	$52,169,000	$494,000	$40,455,000	$95,048,000
Subtotal	$23,722,000	$139,400,000	$1,247,000	$52,842,000	$217,211,000
Total	**$38,742,000**	**$156,083,000**	**$5,818,000**	**$56,033,000**	**$256,676,000**

3.4.4 Coastal Flood

Hazus-MH v5.1 was used to complete the coastal flood analysis for vulnerability and loss estimates for this plan. The Hazus software was developed by FEMA and the National Institute of Building Sciences. A The flood loss estimation methodology consists of two modules that carry out basic analytical processes: flood hazard analysis and flood loss estimation analysis. The flood hazard analysis module uses characteristics, such as frequency, discharge and ground elevation to estimate flood depth, flood elevation and flow velocity. The flood loss estimation module calculates physical damage an economic loss from the results of the hazard analysis.

A Hazus Level 2 analysis was performed for the City of New Haven with a user-provided coastal depth grid. The flood model was used to run a single-frequency depth grid scenario which only included the 1-percent-annual-chance (100-year) return period. While annualized loss is the preferred manner with which to express potential risk for hazard mitigation planning, as it is useful for creating a common denominator by which different types of hazards can be compared, an annual loss was not able to be generated with only the coastal 100-year depth grid developed for this analysis. Future work to improve this assessment would involve creating a full suite of return periods, either independently or through a Flood Risk Project. For analysis purposes, the U.S. Census blocks are the smallest extent in which the model runs. Hazus generates economic loss estimates based on direct building damages and business interruption.

Table 16 shows the 1-percent-annual-chance losses for the coastal flood scenario.

Table 16. 1-percent-annual-chance Coastal Flood Loss Estimates for the City of New Haven.

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	$47,744,000	$29,702,000	$14,306,000	$2,471,000	$94,223,000

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Contents	$38,266,000	$72,238,000	$33,217,000	$14,598,000	$158,319,000
Inventory	$0	$1,384,000	$4,055,000	$29,000	$5,468,000
Subtotal	$86,010,000	$103,324,000	$51,578,000	$17,098,000	$258,010,000
Business Interruption					
Income	$766,000	$79,740,000	$1,550,000	$7,105,000	$89,161,000
Relocation	$12,162,000	$23,234,000	$2,133,000	$3,339,000	$40,868,000
Rental Income	$9,808,000	$17,105,000	$433,000	$521,000	$27,867,000
Wage	$1,806,000	$76,734,000	$2,644,000	$42,650,000	$123,834,000
Subtotal	$24,542,000	$196,813,000	$6,760,000	$53,615,000	$281,730,000
Total	**$110,552,000**	**$300,137,000**	**$58,338,000**	**$70,713,000**	**$539,740,000**

3.4.5 Storm Surge

Hazus-MH v5.1 was used to complete the storm surge analysis for vulnerability and loss estimates for this plan. The Hazus software was developed by FEMA and the National Institute of Building Sciences. A Hazus Level 2 analysis was performed using user-provided depth grids. Table 17 represents the storm surge inundation for the City of New Haven. The NHC's SLOSH MOM model was used for this analysis. The flood model was utilized to run four separate single-frequency depth grid scenarios for the Category 1 to 4 hurricanes and a loss estimate was determined for each hurricane Category (Table 17 to Table 20). Figure 9 shows the location of the storm surge areas in New Haven and their relation to critical facilities.

Table 17. Category 1 Storm Surge using Maximum of Maximum Envelope of Water (MEOW) for the City of New Haven.

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	$48,721,000	$32,619,000	$14,813,000	$2,554,000	$98,707,000
Contents	$39,861,000	$83,623,000	$35,350,000	$15,764,000	$174,598,000

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Inventory	$0	$1,426,000	$4,573,000	$53,000	$6,052,000
Subtotal	$88,582,000	$117,668,000	$54,736,000	$18,371,000	$279,357,000
Business Interruption					
Income	$816,000	$91,284,000	$1,650,000	$7,096,000	$100,846,000
Relocation	$13,263,000	$27,670,000	$2,336,000	$3,793,000	$47,062,000
Rental Income	$11,251,000	$20,375,000	$479,000	$544,000	$32,649,000
Wage	$1,919,000	$86,068,000	$2,828,000	$46,604,000	$137,419,000
Subtotal	$27,249,000	$225,397,000	$7,293,000	$58,037,000	$317,976,000
Total	**$115,831,000**	**$343,065,000**	**$62,029,000**	**$76,408,000**	**$597,333,000**

Table 18. Category 2 Storm Surge using Maximum of MEOWs for the City of New Haven.

New Haven	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	$184,639,000	$128,682,000	$48,154,000	$9,069,000	$370,544,000
Contents	$134,523,000	$292,266,000	$121,298,000	$52,573,000	$600,660,000
Inventory	$0	$4,801,000	$16,101,000	$240,000	$21,142,000
Subtotal	$319,162,000	$425,749,000	$185,553,000	$61,882,000	$992,346,000
Business Interruption					
Income	$1,163,000	$218,594,000	$2,571,000	$14,536,000	$236,864,000
Relocation	$32,939,000	$61,915,000	$3,508,000	$8,842,000	$107,204,000
Rental Income	$29,003,000	$46,639,000	$739,000	$1,115,000	$77,496,000
Wage	$2,741,000	$176,362,000	$4,403,000	$184,596,000	$368,102,000

Subtotal	$65,846,000	$503,510,000	$11,221,000	$209,089,000	$789,666,000
Total	**$385,008,000**	**$929,259,000**	**$196,774,000**	**$270,971,000**	**$1,782,012,000**

Table 19. Category 3 Storm Surge using Maximum of MEOWs for the City of New Haven.

New Haven	**2022 Results**				
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Direct					
Building	$432,978,000	$553,282,000	$97,683,000	$22,690,000	$1,106,633,000
Contents	$292,883,000	$983,512,000	$227,180,000	$104,592,000	$1,608,167,000
Inventory	$0	$9,209,000	$29,177,000	$376,000	$38,762,000
Subtotal	$725,861,000	$1,546,003,000	$354,040,000	$127,658,000	$2,753,562,000
Business Interruption					
Income	$2,723,000	$748,793,000	$3,643,000	$26,480,000	$781,639,000
Relocation	$64,393,000	$207,123,000	$4,881,000	$15,718,000	$292,115,000
Rental Income	$61,227,000	$157,624,000	$1,028,000	$1,928,000	$221,807,000
Wage	$6,423,000	$465,024,000	$6,239,000	$291,248,000	$768,934,000
Subtotal	$134,766,000	$1,578,564,000	$15,791,000	$335,374,000	$2,064,495,000
Total	**$860,627,000**	**$3,124,567,000**	**$369,831,000**	**$463,032,000**	**$4,818,057,000**

Table 20. Category 4 Storm Surge using Maximum of MEOWs for the City of New Haven.

New Haven	**2022 Results**				
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Direct					
Building	$981,979,000	$1,094,620,000	$161,675,000	$68,475,000	$2,306,749,000
Contents	$627,364,000	$1,751,337,000	$336,695,000	$246,104,000	$2,961,500,000
Inventory	$0	$14,270,000	$40,360,000	$927,000	$55,557,000

New Haven	2022 Results				
	Residential	**Commercial**	**Industrial**	**Other**	**Total**
Subtotal	$1,609,343,000	$2,860,227,000	$538,730,000	$315,506,000	$5,323,806,000
Business Interruption					
Income	$6,300,000	$1,207,906,000	$4,624,000	$64,634,000	$1,283,464,000
Relocation	$122,459,000	$331,636,000	$6,104,000	$38,115,000	$498,314,000
Rental Income	$126,324,000	$248,544,000	$1,235,000	$5,036,000	$381,139,000
Wage	$14,825,000	$795,428,000	$7,916,000	$647,394,000	$1,465,563,000
Subtotal	$269,908,000	$2,583,514,000	$19,879,000	$755,179,000	$3,628,480,000
Total	**$1,879,251,000**	**$5,443,741,000**	**$558,609,000**	**$1,070,685,000**	**$8,952,286,000**

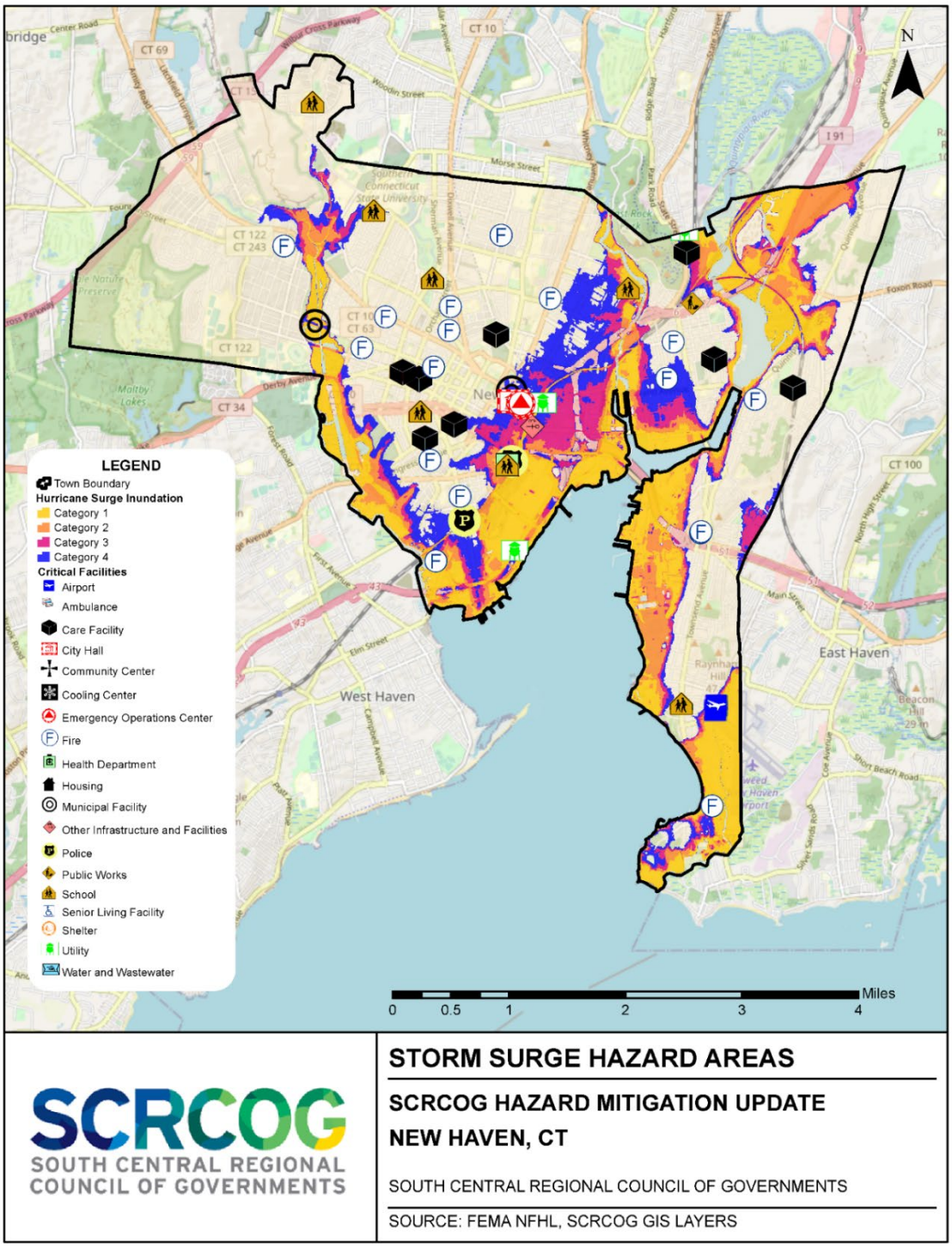

Figure 9. Storm Surge Hazard Areas in the City of New Haven, Connecticut.

3.5 Annualized Losses

Annualized loss estimates (Table 21) have been developed for each hazard discussed in the regional hazard profiles. These estimates have been derived from a number of sources, including:

- Historic FEMA PA funds received by the community
- Historic FEMA IA funds received by property owners and renters
- Historic NFIP claims made within the community
- Connecticut State 2019 Hazard Mitigation Plan estimates
- HAZUS-MH modeling results performed for the region
- HAZUS-MH results from the Connecticut State 2019 Hazard Mitigation Plan

Table 21. Annualized Loss Estimates for the City of New Haven.

Hazard	Source or Method	Losses in New Haven	Years of Record	Annualized or Annual Loss
Coastal Erosion	Refer to Multi-Jurisdiction document	$2,000,000	---	---
Dam Failure	CT HMP NPDP	$5,259	1	$5,259
Drought	USDA	$0	10	$0
	CT HMP NCEI	$2,537	1	$2,537
Earthquake	FEMA P-366	$253,302	1	$253,302
Extreme Heat	None Available	$0	10	$0
Flood	PA	$484,709	10	$48,471
	NFIP	$4,732,466	44	$107,556
	IA (Sandy and Ida)	$143,928	10	$14,393
Hurricanes	FEMA PA	$2,794,203	10	$279,420
Severe Thunderstorm	NCEI direct calculation	$40,000	10	$4,000
	CT HMP NCEI	$8,231	1	$8,231
Severe Winter Storm	FEMA PA	$2,922,147	10	$292,215
	CT HMP NCEI	$27,890	1	$27,890
Tornado	FEMA PA	$0	10	$0
	NCEI direct calculation	$0	10	$0

Hazard	Source or Method	Losses in New Haven	Years of Record	Annualized or Annual Loss
	CT HMP NCEI	$1,320,357	1	$1,320,357
Wildfire	CT HMP NFIC	$18,208	1	$18,208

3.6 Problem Statements

Problem statements were developed upon the completion and review of all risk assessment tasks. These statements are designed to briefly summarize the key hazard risks and vulnerabilities to the municipality based on potential impacts and losses from future events. They are among the issues of greatest concern and were used to assist in the identification and analysis of potential mitigation actions for. These problem statements will be reviewed and revised as needed during future plan updates to reflect the most current information resulting from the risk assessment.

Table 22. New Haven Problem Statements.

Problem Area	Description
Primary Hazards of Concern	
Inland and Coastal Flooding	Inland and coastal flooding (including hurricane storm surge) are the primary hazards of concern, especially given that each is anticipated to get worse under future climate conditions. They are identified as the "most common naturally occurring event that disrupts quality of life for many residents."
High Winds	The City is particularly susceptible to damage from high winds (and heavy snow loads) due to its heavily treed landscape and high residential density.
Severe Winter Storms	Severe winter storms present some specific vulnerabilities, including high propensity for traffic accidents and impassable roads which inhibit the ability of emergency responders to reach trouble spots and/or vulnerable populations.
Geographic Areas of Concern	
East Shore (Morris Cove) and Long Wharf	The East Shore (Morris Cove) neighborhood and the Long Wharf area are at risk to coastal flooding. The Long Wharf area has large concentrations of commercial/industrial properties.
Fair Haven	CIRCA's Resilient Connecticut program identified the entirety of Fair Haven as a climate adaptation and resilience opportunity area due to the potential for flooding, including coastal flooding, and extreme heat

Problem Area	Description
	to increase the risks to people, housing, historic resources, and numerous community assets and critical facilities.
Westville	CIRCA's Resilient Connecticut program identified the West River corridor and Westville (extending down to Blake Street) as a climate adaptation and resilience opportunity area due to the potential for flooding and extreme heat to increase the risks to existing affordable housing, numerous community and regional assets, and critical facilities.
West, Mill, and Quinnipiac Rivers	The areas that are primarily prone to inland flooding include residential properties located adjacent to the West, Mill, and Quinnipiac Rivers. General areas of concern include the following: • Upper Middletown Avenue • Lower Middletown Avenue • Hemingway Creek • Quinnipiac Avenue • Fair Haven • Stiles Street and Port of New Haven • Fort Hale Park and Adjacent Areas • New Haven Flea Market Area (Boulevard at Adeline Street)
Downtown & other Urban Flooding Areas	Frequent flooding events also occur in areas of the City with insufficient drainage; where conditions may cause localized flash floods, and where tidal influences may exacerbate drainage problems. These inland flooding "hot spots" are illustrated in Figure 3-2 on page 3-9 of the plan. The Downtown area is particularly prone to inland flooding due to excess paved surfaces. Downtown and Wooster Square/Mill River neighborhood are at risk to coastal flooding as well.
East Haven Town Line, South End Road, Airport	Other flood prone areas include: the railyard, reduced-capacity of outfalls at the Harbor due to sea-level rise, East Haven Town Line and South End Road (mainly during high tides and coastal storms), and the airport area.
Vulnerable Community Assets	
Historic Assets	140 historic structures are in Special Flood Hazard Areas (SFHAs) and 10 structures are in a 3-foot sea level rise zone. Due to their proximity to a water body, the risk due to flood inundation and damage caused to the structure is high for these properties.
Transportation Infrastructure	Transportation infrastructure in New Haven at risk to adverse effects from sea-level rise includes the regionally significant New Haven Rail Yard, the Tweed-New Haven Airport and parts of Interstate-95. Port facilities on the water's edge are also particularly susceptible to sea

Problem Area	Description
	level rise. There is an electric grid station next to the train station.
Regional Water Authority	The Regional Water Authority's Operations and Administration Building (90 Sargent Drive) is in an identified SFHA. Flood mitigation measures recommended under Mitigation Action 6.
United Illuminating	The United Illuminating Grand Avenue sub-station is within a FEMA flood zone and within surge zones, and has been observed to be vulnerable to flooding. United Illuminating has installed flood barriers, but loss of this station during a flood would mean loss of power to part of the east side of New Haven as well as other parts of the downtown.
Coastal Protective Infrastructure	Many seawalls, bulkheads, and other protective infrastructure assets have been identified for improvement and maintenance for the City, particularly to address flooding and shoreline deterioration in the following areas: Morris Cove; Fort Hale Park and Adjacent Areas; East Shore Park; Port and Terminal Area; Fair Haven and Quinnipiac River Park; Belle Dock Terminal and Long Wharf.
GNHWPCA	GNHWPCA building and infrastructure.

4. Capabilities

The City of New Haven is an urban, growing community with a high degree of capabilities and resources to support the implementation of hazard mitigation actions. This jurisdictional annex provides some additional documentation on the existing local authorities, policies, programs, and resources to support mitigation and the City's ability to enhance or build upon these existing capabilities. This includes more detailed information on the updated capability findings for the community as highlighted in Chapter 6 (Capability Assessment), as well as the identification of some specific opportunities to expand and improve local mitigation capabilities for consideration as potential new actions for Chapter 7 (Mitigation Strategy).

4.1 Summary of Local Findings

4.1.1 Planning and Regulatory Capabilities

Planning and regulatory capabilities include the local plans, policies, codes, and ordinances that are relevant to reducing the potential impacts of hazards. The following planning and regulatory capabilities are currently in place for New Haven:

- Plan of Conservation and Development
- Capital Improvements Plan
- Economic Development Plan
- Local Emergency Operations Plan
- Transportation Plan
- Stormwater Management Plan
- Disaster Recovery Plan
- Coastal Zone Management Plan
- Climate Change Adaptation Plan
- Coastal Resilience Plan
- Building Codes Adequately Enforced
- Zoning Ordinance Adequately Enforced
- Land Use Planning
- Zoning Ordinance
- Natural Hazard Specific Ordinance

Given their direct relevance and significance to long-term hazard risk reduction, all current versions of formally adopted POCDs for participating jurisdictions were reviewed during the plan update process to ensure general consistency and integration as appropriate. Content from the City of New Haven's POCD that is particularly relevant to this hazard mitigation plan is detailed below and hereby incorporated by reference. Additional information on how adequately the POCD and related planning tools are being used for hazard mitigation purposes can be found under the Safe Growth Survey section of this annex (see Section 4.2).

New Haven Vision 2025: A Plan for a Sustainable, Healthy, and Vibrant City (2015)

- As noted in the plan's Executive Summary, "Adapting to emerging sea level rise and reducing the carbon footprint are key environmental priorities of the city." (p. xix)
- The Environment Element includes detailed descriptions of coastal and inland flooding hazards, sea level rise, and climate change. (p. VII-14–VII-16)
- The vision and recommendations within the plan are guided by five planning themes, including "Adapt." Specific recommendations under this theme for various plan elements include the following:
    1. Land Use: "Adapt to sea level rise and other coastal events by flood proofing structures in areas prone to repetitive floods (as discussed within the Environment chapter) and by reviewing, assessing, and revising the floodplain ordinances of the City periodically." (p. III-20)
    2. Transportation: "Adapt to sea level rise and other coastal/inland flooding events by ensuring that the design of complete streets considers the requirements for emergency vehicle access" and "Adapt to sea level rise and other coastal/inland flooding events by working with the Office of Emergency Management to identify, prioritize, and publish evacuation routes within the city on a scenario-based approach." (p. V-28)
    3. Economic Development: "Adapt to sea level rise and other coastal/inland flooding events by identifying and seeking new sources of funding to address and improve the resiliency of properties in V and VE flood zones" and "Adapt to sea level rise and other coastal/inland flooding events by participating in FEMA's Community Rating System so that all property owners in coastal areas, including businesses, can avail a discounted rate on their flood insurance costs." (p. VI-26)
    4. Environment: "Adapt to sea level rise and other coastal/inland flooding events by implementing flood proofing, coastal resiliency, and shoreline stabilization measures along the coast" and "Adapt to sea level rise and other coastal/inland flooding events by continuing to strictly enforce the City's floodplain ordinances to limit developments in SFHAs and by updating and adopting the City of New Haven Natural Hazard Mitigation Plan and Climate Action Plan, in addition to identifying and seeking funding opportunities to correct coastal, as well as inland, flooding issues within the city." (p. VII-30)

Fortunately, as evidenced above, the City of New Haven has some other important mitigation capabilities in place that work in conjunction with the POCD to reduce hazard risk. This includes the adoption and enforcement of building codes and land use and development ordinances/regulations that support mitigation by ensuring new or substantially improved development projects meet specific standards for public safety and protection from natural hazards. Many of these standards are codified in the City's Zoning Ordinance, Flood Damage Prevention Ordinances, and Inland Wetlands and Watercourses Regulations. The City's planning department (City Plan) also routinely engages with

residents, community leaders, and elected officials to guide the development of physical spaces and develop frameworks for the long-term sustainable growth and development of the City. These services in combination with the administration and enforcement of the City's zoning and development regulations are considered among the most effective and cost-beneficial measures to protect people and future development from the impact of natural hazard events. Some additional information on how effectively these regulatory tools and methods are being used for hazard mitigation purposes can be found in the Safe Growth Survey and NFIP Participation and Compliance sections of this annex. Some specific opportunities to enhance these tools are identified at the end of this Capabilities annex.

4.1.2 Administrative and Technical Capabilities

Administrative and technical capabilities include the local human resources and their skills/tools that can be used to support mitigation activities. The following administrative and technical capabilities are in place for New Haven:

- Planning Commission
- Maintenance Programs to Reduce Risk
- Mutual Aid Agreements
- Chief Building Official
- Floodplain Manager
- Emergency Manager
- Community Planner
- Civil Engineer
- GIS Coordinator
- Warning Systems
- Hazard Data
- Hazus Analysis

The City of New Haven has strong administrative and technical capabilities spanning across many departments under the general supervision of the Mayor and the Chief Administrative Officer. Key departments as it relates to hazard mitigation and long-term risk reduction to natural hazards include City Plan, the Office of Emergency Management, Engineering, the Office of Building Inspection and Enforcement, and the Parks and Public Works Department. City staff are supported by other community members who are appointed to local boards and commissions which goes a long way in supporting local administrative capabilities and technical expertise. The City of New Haven currently has 45 different boards and commissions with over 300 New Haven residents, representing every neighborhood and all walks of life, volunteering countless hours to serving the community. Relevant examples include the Capital Projects Committee, City Plan Commission, City Wide Building Committee, Development Commission, and the Redevelopment Agency. In addition, the City is fortunate to have Yale University as an active community partner across many citywide initiatives and activities.

New Haven's participation as a Class 7 community in FEMA's Community Rating System (CRS) is an example of how the City's administrative and technical capabilities have helped it implement a range of

hazard mitigation measures. Although the City has experienced some staff turnover, continued participation and advancement in the CRS program remains a high priority for the City.

4.1.3 Financial Capabilities

Financial capabilities include the fiscal resources the community has access to for helping to fund the implementation of hazard mitigation projects and related risk reduction activities. The following financial capabilities are in place for New Haven:

- Capital improvement project funding
- Authority to levy taxes for specific purposes
- Community Development Block Grant
- Federal Funding
- State Funding

The City of New Haven remains highly committed to investing in building resilience to natural hazards and climate change. Through the support of the Mayor, who is responsible for developing the General Fund budget, the City has utilized local funding to support the implementation of hazard mitigation projects in the past. The Capital Projects Committee also plays a big role by preparing and proposing to the Mayor a program of capital projects which include the acquisition of permanent property; equipment for any public betterments or improvement when first erected or acquired; major alterations and repairs to existing buildings or structures; and major pieces of equipment. The City of New Haven is also fortunate to have other non-traditional sources of funding that can be leveraged to assist with related project implementation efforts. For example, the Greater New Haven Green Fund promotes environmental quality, public health, and equity in the community by providing grants and other incentives to support initiatives that contribute to a more environmentally sustainable future. Other owners of the City's key infrastructure are also quite active in terms of funding and implementing their own hazard mitigation measures. For example, the Greater New Haven Water Pollution Control Authority (GNHWPCA) continues to make numerous resiliency upgrades to its assets throughout the City, including flood protection and wind retrofit projects.

4.1.4 Education and Outreach Capabilities

Education and outreach capabilities include the local programs and methods already in place that can be used to support mitigation activities. The following education and outreach capabilities are in place for New Haven:

- Community Emergency Response Team (CERT)
- Public Education Program
- Citizen Group or Nonprofit Focused on Emergency Preparedness
- Public-Private Partnership for Disaster Issues
- Website
- New Haven Alerts (Emergency Notification System through Everbridge)

As part of the City's participation in FEMA's Community Rating System (CRS), New Haven has also developed and implements a creditable Program for Public Information (PPI) that significantly bolsters their capabilities for education and outreach activities related to flood risk awareness and risk reduction across the community.

4.2 Safe Growth Survey

As introduced and described in Chapter 6 (Capability Assessment), the Safe Growth Survey was used again during the plan update process to help evaluate the extent to which the City of New Haven is positioned to grow safely relative to its natural hazards. The survey covered six topic areas including the following:

- Land Use
- Transportation
- Environmental Management
- Public Safety
- Zoning Ordinance
- Subdivision Regulations
- Capital Improvement Program and Infrastructure Policies

The results of the Safe Growth Survey are summarized in Table 23. This includes describing how strongly current City staff agrees or disagrees with 25 statements as they relate to existing plans, policies, and programs for guiding future community growth and development, according to the following scale:

1=Strongly Disagree 2=Somewhat Disagree 3=Neutral 4=Somewhat Agree 5=Strongly Agree

Survey results provide some helpful information on how effective existing planning mechanisms are currently being used to address hazard mitigation and long-term risk reduction. The results were also incorporated into the analysis of possible new mitigation actions for the City of New Haven to consider in terms improving or expanding upon its planning and regulatory capabilities to reduce the effects of natural hazards, including but not limited to the vulnerabilities identified in the risk assessment.

Table 23. Safe Growth Survey Results, City of New Haven.

COMPREHENSIVE/MASTER PLAN *(i.e., Plan of Conservation and Development)*						
Land Use						
1.	The comprehensive/master plan includes a future land use map that clearly identifies natural hazard areas.	1	**2**	3	4	5
2.	Current land use policies discourage development and/or redevelopment within natural hazard areas.	1	2	**3**	4	5

COMPREHENSIVE/MASTER PLAN *(i.e., Plan of Conservation and Development)*						
3.	The comprehensive/master plan provides adequate space for expected future growth in areas located outside of natural hazard areas.	1	2	**3**	4	5
Transportation						
4.	The transportation element limits access to natural hazard areas.	1	**2**	3	4	5
5.	Transportation policy is used to guide future growth and development to safe locations.	1	2	3	**4**	5
6.	Transportation systems are designed to function under disaster conditions (e.g., evacuation, mobility for fire/rescue apparatus, etc.).	1	2	**3**	4	5
Environmental Management						
7.	Environmental features that serve to protect development from hazards (e.g., wetlands, riparian buffers, etc.) are identified and mapped.	1	**2**	3	4	5
8.	Environmental policies encourage the preservation and restoration of protective ecosystems.	1	2	**3**	4	5
9.	Environmental policies provide incentives to development that is located outside of protective ecosystems.	**1**	2	3	4	5
Public Safety						
10.	The goals and policies of the comprehensive/master plan are related to and consistent with those in the hazard mitigation plan.	1	2	**3**	4	5

COMPREHENSIVE/MASTER PLAN *(i.e., Plan of Conservation and Development)*						
11.	Public safety is explicitly included in the comprehensive/master plan's growth and development policies.	1	**2**	3	4	5
12.	The monitoring and implementation section of the comprehensive/master plan covers safe growth objectives.	1	2	3	**4**	5
ZONING BYLAWS						
13.	The zoning bylaws conform to the comprehensive/master plan in terms of discouraging development and/or redevelopment within natural hazard areas.	1	**2**	3	4	5
14.	The bylaws contain natural hazard overlay zones that set conditions for land use within such zones.	1	**2**	3	4	5
15.	Rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density of use.	1	2	**3**	4	5
16.	The bylaws prohibit development within, or filling of, wetlands, floodways, and floodplains.	**1**	2	3	4	5
SUBDIVISION REGULATIONS						
17.	The subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas.	**1**	2	3	4	5
18.	The regulations provide for conservation subdivisions or cluster subdivisions to conserve environmental resources.	**1**	2	3	4	5
19.	The regulations allow density transfers where hazard areas exist.	**1**	2	3	4	5
CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE POLICIES						

COMPREHENSIVE/MASTER PLAN *(i.e., Plan of Conservation and Development)*						
20.	The capital improvement program limits expenditures on projects that would encourage development and/or redevelopment in areas vulnerable to natural hazards.	**1**	2	3	4	5
21.	Infrastructure policies limit the extension of existing facilities and services that would encourage development in areas vulnerable to natural hazards.	**1**	2	3	4	5
22.	The capital improvements program provides funding for hazard mitigation projects identified in the hazard mitigation plan.	1	2	3	**4**	5
OTHER						
23.	Small area or corridor plans recognize the need to avoid or mitigate natural hazards.	1	**2**	3	4	5
24.	The building code contains provisions to strengthen or elevate new or substantially improved construction to withstand hazard forces.	1	2	3	**4**	5
25.	Economic development and/or redevelopment strategies include provisions for mitigating natural hazards or otherwise enhancing social and economic resiliency to hazards.	1	**2**	3	4	5

4.3 NFIP Participation and Compliance

The City of New Haven has actively participated in the National Flood Insurance Program (NFIP) since 1980. The current effective Flood Insurance Rate Map (FIRM) is dated May 16, 2017. As of August 31, 2022, there are a total of 716 NFIP policies in force. The total annual premium is $1,178,370 for a total of $193,243,600 in coverage. A total of 432 claims amounting to approximately $4,732,466 have been paid to NFIP policyholders in New Haven since joining the program.[14] More information on NFIP-insured structures, including those that have been repetitively damaged by floods, is provided in Chapter 5 (Risk Analysis).

[14] FEMA NFIP, HUDEX Report, Policy and Loss Data by Community: https://nfipservices.floodsmart.gov//reports-flood-insurance-data

Table 243 describes the City of New Haven's participation and continued compliance in accordance with NFIP requirements and as specified in FEMA's 2022 Local Mitigation Planning Policy Guide.[15]

Table 24. NFIP Participation and Compliance, City of New Haven.

REQUIRED INFORMATION	RESPONSE
Adoption of NFIP minimum floodplain management criteria via local regulation.	Flood Damage Prevention Ordinance (Title IV - Flood Damage Prevention, NHZO), last amended July 8, 2013.
Adoption of the latest effective Flood Insurance Rate Map (FIRM), if applicable.	Adopted via the above Flood Damage Prevention Ordinance (Section 3.2: Basis for Establishing the Areas of special flood hazards). Latest effective FIRM is dated 7/8/2013.
Implementation and enforcement of local floodplain management regulations to regulate and permit development in SFHAs.	Permitting for developments in the floodplain is jointly regulated via both the City Plan Department (via the New Haven Zoning Ordinance [NHZO]) and the Building Department (via the State Building Code). All applicants in a SFHA are required to include a Floodplain Development Permit (FDP) with their Building Permits. The FDP confirms flood elevations and requirements which meet the FEMA NFIP standards for elevation certificates. Additionally, all sites within the SFHA also require a Coastal Site Plan Review in compliance with the CCMA and local NHZO regulations.
Appointment of a designee or agency to implement the addressed commitments and requirements of the NFIP.	Anne Hartjen, Assistant Director of Comprehensive Planning
Description of how participants implement the substantial improvement/substantial damage provisions of their floodplain management regulations after an event.	Developments of substantial size and/or involving coastal structures are referred to DEEP for comment prior to approval. Substantial improvement/substantial damage are calculated based upon the last ten years of improvements on any given property. This is determined by the Building Department.

New Haven's local floodplain management regulations and building code enforcement procedures include the following requirements that exceed minimum NFIP standards:

[15] Local Mitigation Planning Policy Guide. FEMA. April 2022. P. 26.

- Require freeboard (elevation requirements higher than the base flood)
- Require soil tests or engineered foundations
- Require compensatory storage for new developments
- Prohibit or minimize new development in floodplain areas
- Prohibit or enforce higher standards for critical facilities subject to flood hazards
- Provision for cumulative substantial damage/improvement requirements
- Provisions that protect natural and beneficial functions of floodplains

The City of New Haven joined the CRS Program in 2017 and currently participates as a Class 7 community, among the highest class communities in the state. The City receives significant credit for running an effective floodplain management program that exceeds minimum NFIP standards in numerous areas, including higher finished floor elevation requirements ("freeboard"), foundation protection, more stringent building improvement rules, protection of critical facilities, low density zoning for floodplain development, preservation of floodplain storage, and higher mapping and regulatory standards. This also includes activities such as drainage system maintenance, flood warning systems, or any public education or outreach activities related to promoting flood risk awareness, risk reduction, and the availability of flood insurance. As mentioned earlier in this chapter, New Haven has also developed and implements a creditable Program for Public Information (PPI) that significantly bolsters their capabilities for education and outreach activities related to flood risk awareness and risk reduction across the community.

In terms of barriers to running an effective floodplain management program, City staff explained that any current impediments are related mainly to staffing issues. The City has had excessive staff turnover in the last four years, which has necessitated a continual staff hand-off to new and untrained internal coordinators. In addition, staff time and availability are limited due to the demands of the City Plan department on a daily, weekly, and monthly basis. The NFIP and CRS require specialized training that has been difficult to access, especially during Covid. Additionally, outreach via digital platforms is not always the most effective way to reach the most vulnerable populations, but it has been what has been available in the last 30 months.

Despite these current staff-related impediments, the City has robust compliance procedures in effect: building permit procedures, site plan reviews, inspections, retention of records, and all other NFIP minimum requirements are currently being met and exceeded as described above to help maintain the City's Class 7 CRS rating. The City's last Community Assistance Visit with FEMA was in 2021 and resulted in no compliance issues.

Additional information on each jurisdiction's floodplain management program and participation in the NFIP is provided in Chapter 6 (Capability Assessment).

4.3.1 Improvement Opportunities

Although the City of New Haven has relatively high capabilities and is well-positioned to mitigate the natural hazard risks faced by the community, it can expand and improve on the capabilities described in Chapter 6 (Capability Assessment) and this annex. The City is aware of each it's strengths and

weaknesses in terms of mitigating risk. Specific opportunities to address existing gaps or limitations in local capabilities to reduce risk have been identified for each capability type and are further described below. Each of these opportunities were then considered by the City during the plan update process as potential new mitigation actions to be included in the updated Mitigation Strategy.

Planning and Regulatory Capabilities

- Conduct a detailed assessment of all relevant zoning bylaws, land use regulations, and the City's permit review process to identify the amendments/improvements needed to better address natural hazards, climate change, and projected future conditions (including coastal vulnerability but also extreme heat, heavy downpour events, etc.). This includes the incorporation of nature-based solutions such as living shorelines, low impact development, and other green infrastructure techniques into existing rules and regulations where most appropriate.
- Increase the integration of hazard mitigation and climate resiliency into the City's existing CIP planning and project lists. Examples include (1) making resilience a key objective/priority for the City's strategic, operational, and fiscal policies for municipal infrastructure and asset management; and (2) developing methods to help ensure the City limits expenditures on projects or infrastructure improvements that would encourage development and/or redevelopment in areas at high risk to natural hazards.
- Be opportunistic with further incorporating hazard mitigation and resilience into the City's updated POCD (draft plan update underway in 2023), especially as it relates to hazards beyond coastal flooding and sea level rise. This includes land use policies that will discourage development and/or redevelopment within other natural hazard areas as well as updated environmental management policies that can reduce risk or provide incentives to infrastructure and development that is located outside of high risk areas and/or protective ecosystems.
- Coordinate between to align the City's economic development plans, goals and strategies with long-term community resilience and this hazard mitigation plan.
- Coordinate closely with Yale University on the alignment and cross-integration of this hazard mitigation plan with its own Resiliency Plan that is still under development.

Administrative and Technical Capabilities

- Develop central tracking system to decrease staff burdens and facilitate improved coordination between departments on floodplain management activities, pre-disaster mitigation/resiliency-themed projects, or other routine maintenance activities as well as emergency preparedness and response operations. This includes improving and streamlining the documentation and record-keeping practices for compliance with the City's CRS program as required by FEMA and ISO.
- Develop systems or practices that can help the City to better cope with staff turnover or other disruptions to routine government functions and duties that support risk reduction.

- Increase current staff capacity to pursue and implement floodplain management, hazard mitigation, climate adaptation, and other community resilience building activities through professional development opportunities and making additional staff hires as determined necessary. Specialized training for staff assigned to overseeing and maintain credit for CRS-related floodplain management activities should be considered a high priority for the City to support.
- Build internal staff capacity to identify and pursue external sources of grant funding for mitigation projects through increased opportunities for training/professional development and the ability to invest more time on grant writing, grants management, and related administrative tasks. Consider the designation or hiring of a dedicated resource development / grants administrator for the City.

Financial Capabilities

- Through the City's Capital Projects Committee, continue to leverage and maximize opportunities through the City's budgeting and CIP process to help fund priority hazard mitigation and climate adaptation projects, especially when a local cost-share increases the City's chances for a grant award.
- Continue to pursue additional funding for risk reduction activities through external funding sources, including those that may not be directly focused on hazard mitigation but can support long-term risk reduction or climate adaptation through co-benefits (i.e., land acquisition, open space preservation, infrastructure upgrades, sustainability improvements, etc.).
- Continue to coordinate with SCRCOG, neighboring communities, Yale University, and other private or non-profit entities in the region as it relates to positioning the City to pursue and capture future grant funding for regional hazard risk reduction projects.

Education and Outreach Capabilities

- Increase use of the City's website to support low-cost public education and outreach initiatives on building community resilience to hazards as well as individual mitigation actions for homeowners, business owners, etc.
- Expand opportunities for public/private partnerships to support public education and community outreach initiatives related to hazard awareness and risk reduction efforts.
- Identify and seek to address any unmet needs related to targeted outreach and education for the community's more vulnerable populations (i.e., environmental justice communities, residents with special needs, property owners in high risk hazard areas, new residents who are unfamiliar with New Haven's coastal hazards, etc.).
- Continue to implement and enhance the City's Program for Public Information (PPI) in support of the City's ongoing education and outreach activities for the CRS program under Activity 330.

Possible New Actions Related to NFIP Participation and Compliance

- Coordinate with the State NFIP Coordinator on possible updates or revisions to local floodplain management regulations based on CT DEEP's most current Model Floodplain Management Regulations (which are routinely being updated as needed).
- Establish a goal to have each plan reviewer and building inspector attend a related training periodically (for example, ASFPM's Annual National Conference, chapter conferences, webinars, etc.).
- Hold informative work sessions for newly elected officials and new appointees to planning commissions and appeals/variance boards, to provide an overview of floodplain management, the importance of participating in the NFIP, and the implications of failing to enforce the requirements of the program or failing to properly handle variance requests.
- Conduct a review of other regulatory programs and planning tools, such as the comprehensive plan and zoning ordinance, and report on opportunities to improve consistency with the objectives of floodplain management.

5. Mitigation Actions

Mitigation actions are projects or activities identified to reduce current and future vulnerabilities identified through the process of developing this 2023 SCRCOG Mitigation Plan Update. The first table in this section identifies the status of the mitigation actions included in the 2016 version of this plan. Besides current status, actions brought forward to this 2023 plan are identified in the Keep for Plan Update? column. The second table includes all the actions, and their essential details, for this 2023 SCRCOG Mitigation Plan Update. The actions are also listed in the Mitigation Action Tracker (a Google Sheet spreadsheet) maintained by SCRCOG. These actions were prioritized by the Municipality according to the criteria detailed in the main body of the plan.

Table 25. Status of Previous Mitigation Actions – City of New Haven.

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
1	Long Wharf Flood Protection	Implement flood protection recommendations from Long Wharf Flood Protection study including living shoreline, deployable flood dams at I-95 underpasses, and planning and design of permanent flood wall.	Partially Completed / In Progress	A recommended alternative from the Long Wharf Flood Protection Study is now being implemented in various new projects including Long Wharf Park Living Shoreline and ACOE Long Wharf Project which includes a flood wall, pump station, and deployable gates. These two projects are funded through construction and have been identified as new mitigation actions for the 2023 plan.	YES (see Actions # 1, 19, and 22)
2	Downtown Green Infrastructure	Installation of green infrastructure within the downtown drainage area to alleviate pressure on the storm sewer system. Roughly 200 locations have been identified throughout the Downtown drainage area. This is considered Phase 2 of the Tranche 2	Completed	Construction is complete on bioswales.	NO (see explanation at left)

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
		funding. Phase I is the implementation of the proposed alternative recommended in the Downtown Stormwater Modeling study. Of the $4 million received in Tranche 2 funding, roughly $2.5 million will be used for installation of green infrastructure and the remaining for the implementation of the stormwater modeling study's recommended alternative.			
3	Quinnipiac River riprap repairs	Repair of existing riprap and seawall.	Partially Completed / In Progress	Preliminary design is complete; currently identifying funding sources for implementation upon completion of the Grand Avenue Bridge rehabilitation project.	YES (see Action #2)
4	Lighthouse Point Park Carousel Building Floodproofing.	Floodproof existing Carousel Building to higher elevation in park to eliminate any future flooding of building.	Delayed	Will be planned after the Lighthouse Point Park Carousel Building Floodproofing Study is completed.	YES (see Action #3)
5	City Point Flood Mitigation Measures Implementation.	Implement recommendations of City Point flood mitigation study.	Delayed	Will be planned after the study (see action #20 below).	YES (see Action #4)
6	CSO Clean Water Fund projects	Several projects proposed: 1. Installation of approximately 75 bioswales for CSO reduction within the West River Watershed 2. CSO Closure and Regulator Improvements at Quinnipiac/Clifton Street, George/Temple Street, and Mitchell Drive	Partially Completed / In Progress	Projects #1, #2, #5, and #6 are completed. Projects #3 & #4 are in final design and moving toward implementation in 2022/23	YES (see Action #5)

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
		3. Union Street and East Street Pump Station Upgrades 4. Yale Campus Trumbull Street Area Sewer Separation Phase 2A 5. West River CSO Improvements at Orange Street, Ella T. Grasso Boulevard, and Whalley Avenue 6. Union Street Downtown Crossing CSO Improvements 2018			
7	Mill River	Implement recommendations of the Mill River planning study that forecast storm surge and sea level rise within the Mill River Industrial District and then to assess three coastal zone management approaches: natural attenuation, intensive infrastructure investment and a balance of new infrastructure with attenuation.	Delayed	Evaluating recommendations and seeking funding	YES (see Action #6)
8	Dam failure drill with Regional Water Authority	Work with Regional Water Authority to complete a drill of potential failures of the West River, Whitney, and Maltby Dams which are all located upstream of the City.	Partially Completed / In Progress	Planned for 2020.	YES (see Action #7)
9	Implementation of CRS Program for Public Information	The City Plan Department must ensure that the City makes progress in the many action items in the PPI. Emergency Management will coordinate and lead Public Information Meetings at public libraries within Quinnipiac, East	Partially Completed / In Progress	Underway	YES (see Action #8)

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
		Shore and City Point neighborhoods to review the CRS rating system, the City's flood mitigation strategies, and flood preparedness.			
10	Beach Nourishment South of Pardee Seawall	Beach nourishment in front of private homes on Townsend Avenue for flood prevention.	Completed	This project was completed in winter 2020	NO (see explanation at left)
11	River Street Bulkhead	Shoreline stabilization along city property to prevent further erosion along the Quinnipiac River including sections of steel bulkhead and revetments with public access.	Delayed	Design complete; seeking funding for this extensive undertaking.	YES (see Action #9)
12	Downtown Stormwater Modeling and Drainage System Improvements Project	Hydraulic study of the Downtown area including Union Avenue and the Route 34 underpasses. The result of this study will inform the sewer system improvements will be implemented. The recommended alternative will be designed to construction-level documents using a portion of a CDBG-DR Tranche 2 grant (roughly $1.5 million).	Completed + To Be Continued	This project was completed in June 2020. Portions of the recommended alternative from the study will be constructed under new FEMA BRIC and ACOE Long Wharf projects.	NO (see explanation at left)
13	Church Street South Residential Planning and Demand Analysis	During Hurricane and other storm surges, excessive flooding occurs along Church Street South making it an extremely vulnerable community for residents and visitors. The scope of the Residential Planning and Demand analysis will determine the most sustainable residential and mixed-use structure(s) to be	Cancelled	This project is being helped through the FEMA BRIC Grant, but the area remains a high risk flood zone.	NO (see explanation at left)

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
		developed based on the area's need and will leverage existing planning initiatives included in the storm water and flood mitigation studies as well as the Community Plan to determine a viable mix of housing and commercial developments for the redeveloped property.			
14	Morris Cove Drainage Improvement Project	Redirection of existing drainage to improve conveyance of stormwater flow.	Partially Completed / In Progress	Design is underway	YES (see Action #10)
15	Fort Hale Park drainage outlet rehabilitation	Restoration and silt removal from an existing drainage channel. Requires access to the Armed Forces Reserve Center but would solve a drainage problem for residents near the USCG facility.	Delayed	Need identified and feasibility assessed. Design and implementation schedule contingent on funding source (to be determined).	YES (see Action #11)
16	East Shore Park shoreline stabilization	Living Shoreline solutions are being studied, including: segmented sills with marsh fringe, regrading and vegetating waterfront slopes with armored toe, and improving public access to the waterfront.	Partially Completed / In Progress	Design underway. Funding secured for construction.	YES (see Action #18)
17	Criscuolo Park seawall	Install wall along shoreline of park to prevent flooding of park.	Cancelled		NO (see explanation at left)
18	Lighthouse Point Park Carousel Building Floodproofing Study.	Conduct feasibility study to floodproof Carousel building to higher elevation in park to eliminate any future flooding of building.	Delayed	In the process of developing scope of work.	YES (see Action #12)

Action #	Action Title	Action Description	Current Status	Status Description/Explanation	Keep for Plan Update?
19	Fort Hale Park shoreline stabilization	Install riprap and other shoreline stabilization measures.	Delayed	In the process of determining project manager to conduct site assessment and develop scope of work (see action #15).	YES (see Action #13)
20	City Point Flood Mitigation Study	A study to prepare storm surge and sea level rise model for the City Point area to assess risk and propose protection and resilience strategies.	Delayed	City Plan and Engineering are collaborating on community engagement and outreach to determine scope of the study.	YES (see Action #14)

Table 26. Updated Mitigation Actions (2023-2028) – City of New Haven.

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
1	Long Wharf Flood Protection	A structural coastal storm risk management system along the seaward embankment of I-95 including approximately 5,800 linear feet of flood wall with a top elevation of 15 feet NAVD, deployable flood gates at the on/off ramps and underpasses, and a pump station.	$130-160M	ACOE funds; state and local bond funds	Engineering Department, Parks Department	Design for next 2 years (2023-2024) Construction to follow (2025-2029)	High
2	Quinnipiac River Riprap Repairs	Repair of existing riprap and seawall.	$300,000	Municipal CIP Budget	Parks Department	To be implemented upon completion of the Grand Avenue Bridge	Very High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
						Rehabilitation Project	
3	Lighthouse Point Park Carousel Building Floodproofing	Floodproof existing Carousel Building to higher elevation in park to eliminate any future flooding of building.	$1- $2 million	FEMA HMA (BRIC, HMGP, FMA); HUD CDBG-DR	Parks Department	TBD. Will be planned after the Lighthouse Point Park Carousel Building Floodproofing Study is completed (see Action #12).	Low
4	City Point Flood Mitigation Measures Implementation	Implement recommendations of City Point flood mitigation study.	>$5,000,000	FEMA HMA (BRIC, HMGP, FMA); HUD CDBG-DR	TBD	TBD. Will be planned after the study (see action #14).	Low
5	CSO Clean Water Fund Projects	Several projects as identified in the 2018 plan are still to be completed, including: 3. Union Street and East Street Pump Station Upgrades 4. Yale Campus Trumbull Street Area Sewer Separation Phase 2A	$145,200,000 (total)	Multiple: CWF/Blended Grant Loans/ Sewer Lining Loans	GNHWPCA	2022-2023	Very High
6	Mill River	Implement recommendations of the Mill River planning study that forecast storm surge and sea level rise within the Mill River Industrial District and	>$5,000,000	FEMA HMA (BRIC, HMGP, FMA); HUD CDBG-DR; USACE	Board of Alders with Engineering, Public Works, City Plan, and	2023-2028	Very High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
		then to assess three coastal zone management approaches: natural attenuation, intensive infrastructure investment and a balance of new infrastructure with attenuation. English Station and John Murphy Drive are highest priorities.			Economic Development		
7	Dam failure Drill with Regional Water Authority	Work with Regional Water Authority to complete a drill of potential failures of the West River, Whitney, and Maltby Dams which are all located upstream of the City.	Less than $5,000 per year	Municipal Operating Budget	Emergency Management	2023-2028	Very High
8	Implementation of CRS Program for Public Information (PPI)	The City Plan Department must ensure that the City makes progress in the many action items in the PPI. Emergency Management will coordinate and lead Public Information Meetings at public libraries within Quinnipiac, East Shore and City Point neighborhoods to review the CRS rating system, the City's flood mitigation strategies, and flood preparedness.	Less than $5,000 per year	Municipal Operating Budget	City Plan and Emergency Management	2023-2028	Very High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
9	River Street Bulkhead	Shoreline stabilization along city property to prevent further erosion along the Quinnipiac River including sections of steel bulkhead and revetments with public access.	Analysis and design budget is $342,000; Construction budget is $3 million (preliminary)	HUD CDBG-DR for analysis and design; TBD for construction	Economic Development Administration	TBD – still seeking funding. stalled the project.	High
10	Morris Cove Drainage Improvement Project	Redirection of existing drainage to improve conveyance of stormwater flow.	$400,000	Municipal CIP Budget	Engineering Department	2023-2024	High
11	Fort Hale Park Drainage Outlet Rehabilitation	Restoration and silt removal from an existing drainage channel. Requires access to the Armed Forces Reserve Center but would solve a drainage problem for residents near the USCG facility.	In kind from DEEP to dredge outlets as part of mosquito control.	Municipal CIP Budget	Parks Department	Design and implementation schedule contingent on funding source (to be determined).	High
12	Lighthouse Point Park Carousel Building Floodproofing Study	Conduct feasibility study to floodproof Carousel building to higher elevation in park to eliminate any future flooding of building.	$50,000	Municipal Operating Budget	Parks Department	TBD. In the process of developing scope of work.	High
13	Fort Hale Park Shoreline Stabilization	Install riprap and other shoreline stabilization measures.	$225,000	Municipal CIP Budget	Parks Department	TBD. In the process of determining project manager to conduct site assessment and develop scope	High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
						of work (see Action #10).	
14	City Point Flood Mitigation Study	A study to prepare storm surge and sea level rise model for the City Point area to assess risk and propose protection and resilience strategies.	$425,000	FEMA HMA (BRIC, HMGP, FMA); HUD CDBG-DR; USACE	City Plan	TBD. City Plan and Engineering are collaborating on community engagement and outreach to determine scope of the study.	High
15	Fair Haven Resiliency Study and Concept Design	Assist CIRCA with execution of the study and concept design.	$300,000	CIRCA MRG; CT DEEP Climate Resilience Fund; Municipal Operating Budget	City Plan and Engineering	2022-2023	High
16	Fair Haven Resiliency Study - Implementation	Pursue federal funding to implement the results of the Resilient Connecticut project for Fair Haven.	TBD	FEMA HMA (BRIC, HMGP, FMA); CT DEEP	City Plan and Engineering	2024-2025	High
17	Port Resilience Project	Work with CIRCA to determine whether the Port resilience opportunity area identified by Resilient Connecticut should be scoped for project development.	TBD	CIRCA MRG; CT DEEP Climate Resilience Fund; Municipal Operating Budget	City Plan, CIRCA	2023-2028	High
18	East Shore Park Living Shoreline	Living Shoreline solutions are being studied, including segmented sills with low	Approximately $4,000,000	Municipal Operating Budget; CIRCA MRG; CT	Engineering Department,	09/2020-12/2025	High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
		marsh fill and plantings, reducing slope at existing shoreline, removal of phragmites and improving public access to the waterfront. Construction to follow.		DEEP Climate Resilience Fund; Municipal Operating Budget	Parks Department		
19	Long Wharf Park Living Shoreline	Living Shoreline solutions including segmented sills with low marsh fill and plantings and improving public access to the waterfront. Construction to follow.	Approximately $4,000,000	Municipal Operating Budget; CT DEEP	Engineering Department, Parks Department	09/2020-12/2025	High
20	Coastal Resilience Plan	Update the City's 2006 Municipal Coastal Plan; Investigate best practices in addressing and mitigating the impacts of sea level rise and climate change; Develop list of adaptation and resilience methods (i.e. infrastructure improvements; shoreline protection; adaptive reuse; flood damage prevention modifications; zoning regulations modifications; allow inland migration; improve ordinance enforcement and inspection; strengthen and consolidate	TBD	CIRCA MRG; CT DEEP Climate Resilience Fund; Municipal Operating Budget	City Plan, Engineering, Emergency Management, Building Department	2023-2024	High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
		flood plan coordinator role, etc.).					
21	Green Ordinance Update	In order to more effectively implement the goals set forth in the New Haven Climate and Sustainability Framework, the City Plan Department is prioritizing updating the standards of existing "green ordinances" in the New Haven Zoning Ordinance (i.e. flood development permit, stormwater management, reflective heat impact, coastal site plan regulations, bike parking criteria, etc.) and incorporating new ordinances to encourage environmentally mindful development (LEED certification incentives; transit-oriented development districts; permitted encroachments for rain barrels; compost piles; alternative energy systems; solar power, etc.). Anticipated updates to the existing ordinance include increasing stormwater	TBD	CIRCA MRG; CT DEEP Climate Resilience Fund; Municipal Operating Budget	City Plan, Engineering, Food System Policy	2022-2023	High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
		retention requirements for site plan applications.					
22	New Haven Inland and Coastal Flood Resiliency Project	Advance preliminary design of new 10-foot diameter outfall pipe, outfall structure, and local drainage connections to final design and construct these improvements. Long Wharf Living Shoreline is part of this project as well (see Action #19).	$32.5M	FEMA HMA (BRIC, HMGP), CTDOT LOTCIP, Local capital funds	City Engineering	2023-2026	Very High
23	Harbor District Dry Egress	Building off of the Long Wharf Responsible Growth Plan, making improvements to the public ROW to provide dry egress above the 100-year base flood elevation for this planned district.	$8-$10M (est)	TBD	City Engineering	2023	High
24	Westville Flooding	Flooding of sanitary sewer system through manholes at West Rock Ave and Whalley. Project in initial engineering study stages to understand inflows and develop mitigation strategies. Short term capacity improvements at intersection are needed.	TBD	CIRCA MRG (proposed); CT DEEP Climate Resilience Fund	City Engineering, GNHWPCA	2023-2028	Very High
25	Westville Resilience Project	Work with CIRCA to determine whether of the Westville affordable housing	TBD	CIRCA MRG; CT DEEP Climate Resilience Fund	City Plan	2023-2028	High

Action #	Action Title	Action Description	Estimated Cost	Potential Funding Source	Lead Department	Implementation Schedule	Priority
		resilience opportunity area identified by Resilient Connecticut should be scoped for project development.					
26	Quinnipiac Ave Culvert	Existing culvert that frequently overtopped and flooding road during storm events. Needs maintenance and repair/increase size.	TBD	FEMA HMA (BRIC, HMGP, FMA); IIJA / AOP; CT DEEP; Municipal CIP Budget	City Engineering	2023-2028	Very High
27	2022 Long Term Control Plan (LTCP) Update	Implementation of additional Resiliency Projects identified/recommended in the 2022 LTCP Update.	Study/Update: $600,000, implementation costs to be determined	Multiple: CWF/Blended Grant Loans/ FEMA	GNHWPCA	Plan to be completed in 2022; Projects to be undertaken within 5 years	Very High
28	WW Pump Station Forcemain Resiliency	Build forcemain resiliency for wastewater pumping stations discharges to assure continued services during emergencies.	$30,000,000 (est.)	Multiple: FEMA / CWF/Blended Grant Loans	GNHWPCA	2024 pending funding and investigations	High
29	Wind Borne Debris Region Wind Retrofits	Retrofit critical wastewater facilities located in the Wind Borne Debris Region to meet latest recommendations and building codes.	$1,200,000 (est.)	Multiple: FEMA / CWF/Infrastructure Renewal Fund	GNHWPCA	2022 - 2024	High
30	Floodplain Ordinance Update	Update floodplain ordinance to align with building code.	N/A - Staff Time	Municipal Operating Budget	City Plan	2022-2024	High