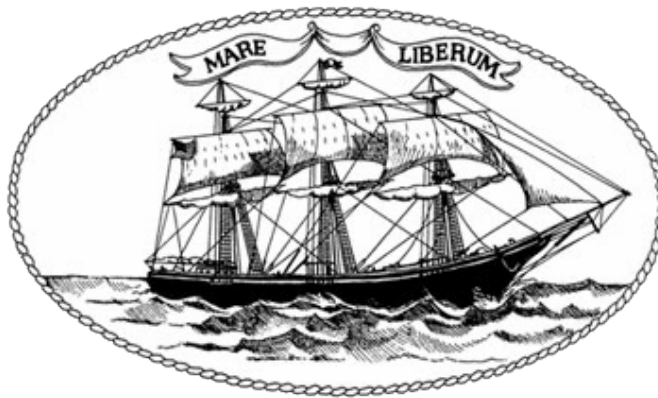

CITY OF NEW LONDON ANNEX DOCUMENT

Southeastern Connecticut Council of Governments
Multi-Jurisdictional Hazard Mitigation and Climate Adaptation Plan Update

March 2023



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1. Introduction

1.1. Purpose of Annex

The planning process for the multi-jurisdiction hazard mitigation plan update commenced in April 2022 and ended in December 2022, spanning a period of nine months. The planning process included 24 jurisdictions (22 municipalities and two tribal governments) with two participating together (Griswold and Jewett City) for a net total of 23 local planning teams represented. For this 4th edition of the plan, SCCOG elected to link the planning process to a parallel planning process administered by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) that is known as “Resilient Connecticut 2.0” (stylized as *Resilient Connecticut*). The *Resilient Connecticut* program is described on CIRCA’s web site at <https://resilientconnecticut.uconn.edu/> and the expansion of the program into southeastern Connecticut is described at <https://circa.uconn.edu/2022/02/23/resilient-connecticut-expands-statewide/>.

The linkage of the two planning processes was advantageous for the following reasons:

- Incorporation of climate change into the hazard mitigation plan update
- Increased interest from the local communities, especially for those interested in developing climate adaptation strategies.
- Direct incorporation of climate change vulnerability products developed by CIRCA including the Climate Change Vulnerability Index (CCVI) for flood and extreme heat vulnerabilities.
- Direct incorporation of combined sea level rise and coastal flood inundation simulations from CIRCA
- Positioning of the SCCOG jurisdictions for new funding sources in Connecticut such as the new Department of Energy and Environmental Protection (DEEP) Climate Resilience Fund (DCRF)
- Consistency with the Governor’s Council for Climate Change (GC3) outcomes from the 2020-2021 planning process
- Positioning of the actions for incorporation on the State’s “resilience project pipeline” per Executive Order (EO) 21-3 issued at the end of 2021.

The planning process commenced for the local communities on April 20, 2022, with a presentation to the SCCOG Board. During this presentation, the consultant and CIRCA described the planning process and the approach for incorporating the *Resilient Connecticut* program into the hazard mitigation plan update, and notified the chief elected officials that invitations to local planning meetings would follow at the end of April. Local planning team meetings commenced on May 23, 2022, and ended on July 8, 2022. Workshops with local coordinators were conducted in July and September 2022, and supplemental meetings with water utilities in the region and specific stakeholders continued through November 2022.

The purpose of this HMP annex is to provide an update to the hazard risk assessment and capability assessment provided in the previous HMP, and to evaluate potential hazard mitigation measures and prioritize hazard mitigation projects specific to mitigating the effects of hazards on the City of New London. Background information and the regional effects of pertinent hazards are discussed in the main body of the Southeastern Connecticut Council of Governments (SCCOG) Multi-Jurisdictional Hazard

Mitigation and Climate Adaptation Plan. Thus, this annex is designed to supplement the information presented in the Multi-Jurisdictional HMCAP with more specific detail for New London and is not to be considered a standalone document.

1.2. Hazard Mitigation and Climate Adaptation Goals

The primary goal of the previous hazard mitigation plans adopted in 2013 and 2018 was to identify risks to hazards and potential mitigation measures for such hazards in order to **reduce the loss of or damage to life, property, infrastructure, and natural, cultural, and economic resources**. This included the reduction of public and private damage costs. Limiting losses of and damage to life and property was also meant to reduce the social, emotional, and economic disruption associated with a natural disaster.

Coinciding with the incorporation of climate adaptation and the alignment of this HMCAP with the *Resilient Connecticut* planning process administered by CIRCA, five new goals were developed for this HMCAP:

- Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.
- Address risks associated with extreme heat events, especially as they interact with other hazards.
- Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.
- Reduce losses from other hazards.
- Invest in resilient corridors to ensure that people and services are accessible during floods and that development along corridors is resilient over the long term.

2. Community Profile

The City of New London is an urbanized municipality incorporated as a city in 1784. It is approximately six square miles in area and had a population of 27,367 as of the 2020 census. It is located in the south-central portion of the southeastern Connecticut shoreline. It is bordered by the City of Groton and Town of Groton to the east across the Thames River, the Town of Waterford to the north and west, and Fishers Island Sound to the south. The City of New London can be accessed by Interstate 95.

2.1. Physical Setting

The City of New London is a coastal community located on the Connecticut shoreline. Elevations range from sea level along the Thames River and Fishers Island Sound to just over 200 feet in the northwest corner of the City.

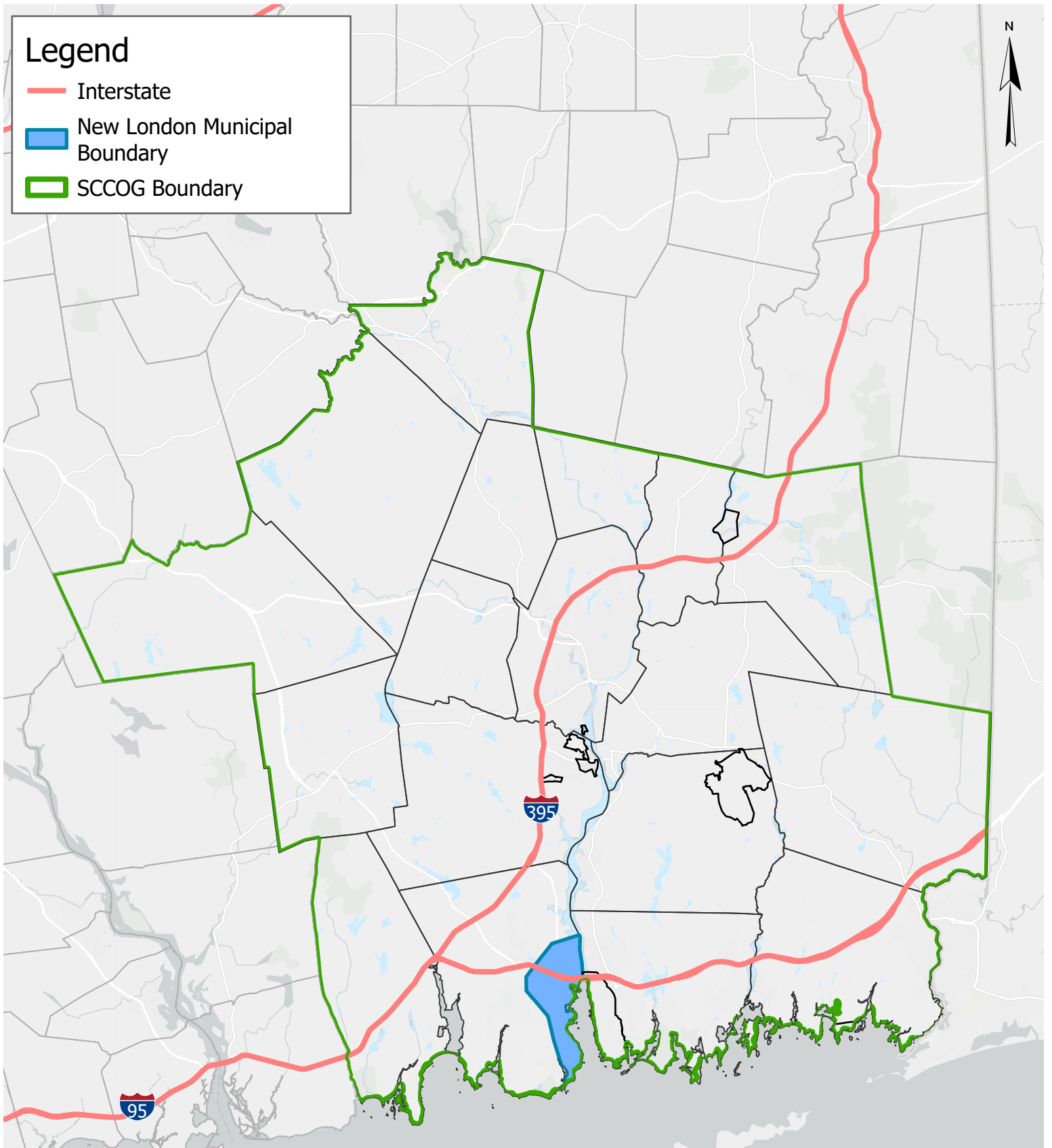
Geology is important to the occurrence and relative effects of natural hazards such as earthquakes. Thus, it is important to understand the geologic setting and variation of bedrock and surficial formations in lands underlying the City of New London. The City of New London lies above six metamorphic bedrock types which trend northwest to southeast across the area. From north to south these are the Potter Hill Granite Gneiss, the Plainfield Formation, the Hope Valley Gneiss, the Mamacoke Formation, the New London Gneiss, and the Rope Ferry Gneiss. Each of these formations consists primarily of gneiss, a relatively hard metamorphic rock. There are no faults mapped within or near the City of New London boundary.

The City's surficial geologic formations include glacial till, stratified drift, and coastal formations. Refer to the Multi-Jurisdictional HMCAP for a generalized view of surficial materials. Much of the City is underlain by glacial till. The exceptions are coastal areas along the Thames River and Alewife Cove which are underlain by stratified drift, and the Shaw's Cove area which is underlain by fill material.

The amount of stratified drift present is important as areas of stratified materials are generally coincident with floodplains. These materials were deposited at lower elevations by glacial streams, and these valleys were later inherited by the larger of our present day streams and rivers. The amount of stratified drift also has bearing on the relative intensity of earthquakes as described later in this annex.

Legend

- Interstate
- New London Municipal Boundary
- SCCOG Boundary

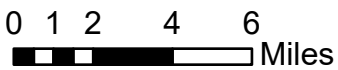


Regional Location of New London

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of New London

Date: 7/22/2022



Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

2.2. Drainage Basins and Hydrology

The City of New London is divided among two sub-regional watersheds as delineated by the Connecticut DEEP. The eastern side of the City drains directly to the Thames River, whereas the remainder of the City drains to the Southeast Shoreline basin (Long Island Sound). The western perimeter of the city drains to the Southeast Shoreline via Fenger Brook, which outlets to Alewife Cove. The northern section of the city along I-95 drains to the Thames River via Green Swamp Brook. There are few significant water bodies within city limits.

2.3. Land Cover

According to the 2016 1-meter resolution land cover developed by the NOAA Office of Coastal Management, New London is predominantly comprised of developed impervious, with approximately 40.70% of the city classified as such. The second largest land cover type is mixed forest, which covers about 24.37%, and next is developed open space which is about 17.35% of land cover. All land covers and their percent coverage can be found in Table 2-1.

Table 2-1 City of New London Land Cover

Land Cover Type (2016)	% Coverage
Barren Land	2.24
Developed, Impervious	40.70
Developed, Open Space	17.35
Estuarine Emergent Wetland	0.02
Grassland/Herbaceous	0.74
Mixed Forest	24.37
Open Water	11.15
Palustrine Aquatic Bed	0.08
Palustrine Emergent Wetland	0.04
Palustrine Forested Wetland	1.36
Palustrine Scrub/Shrub Wetland	0.10
Scrub/Shrub	1.53
Unconsolidated Shore	0.33

2.4. Population, Demographics, and Development Trends

The Thames River has played an important part in the development of the City of New London. The city is well known as the home of the State Pier, Fort Trumbull, Connecticut College, and Coast Guard Academy. Amtrak's busy rail line traverses the City as well.

New London's State Pier is Connecticut's only major deep water seaport within a multi-use Foreign Trade Zone. The Thames River directly accesses the major transatlantic and coastal sea lanes, which allows companies to utilize freight shipping and receiving from around the world. Immediately south of the State pier is Cross Sound Ferry Services, which provides ferry service to Orient Point, New York and Block Island, Rhode Island. Other ferry services provide service to Fishers Island, New York and Montauk Point, New York. Ferry service to Orient Point on Long Island and Fishers Island is year round while

service to other locations is seasonal. This terminal has become increasingly important to the transport of visitors to the New London area from Long Island, NY.

A mix of residential, commercial, and industrial development is found along the City's shoreline, with predominantly residential development occupying the central and southern areas of the City. Much of the northern portion of the City is institutional land associated with Connecticut College and the Coast Guard Academy. Open space properties of significance include Bates Woods and portions of the college campus.

Several major employers in New London have helped boost the City's economic development. These employers include Yale Lawrence & Memorial Hospital, The Day Publishing Co., General Dynamics Electric Boat, Connecticut College, the United States Coast Guard Academy, and Cross Sound Ferry Services.

Most development in New London entails the redevelopment of existing properties. Several developments have been recently completed, are underway, or are likely to be completed in the future; additionally, at least one property is slated for demolition.

Development projects listed in the previous plan include:

- Oaktree Development has completed Phase I of a project to build 127 condominiums at Shaw's Landing / Bank Street.
- Nine two-bedroom residential and four commercial rental spaces have been completed at 147-153 Bank Street by Academy Group Properties.
- A post-fire reconstruction project was completed in May 2017 by Bill Cornish at the Bacon Building on State Street. This included 21 one-bedroom efficiency rental apartments.
- Twenty two-bedroom townhouse condominiums have been constructed by Ken Boyer on Crystal Avenue and Williams Street.
- 84 rental apartments at Crocker House have been completed by AME Development.
- New England Developers have gained approval for a project to build 31 three-bedroom townhouse condominiums on Georgetown Road. They have not yet broken ground. The approval expires in 2019.
- On September 3, 2015, the Planning and Zoning Commission approved The Connection Fund's plans for construction of 12 studio and nine one-bedroom apartments at 10 Huntington Street and 42-52 Jay Street.
- 104 rental units are under construction on Mansfield Road by AR Building Company
- 73 Washington Street has been completed with 28 studio, artist studio, and one-to-two bedroom rental apartments.
- Foti & Foley Developers are in the construction planning stage of apartments and commercial space at 253 State Street.
- Caruso has completed six studio and one one-bedroom rental apartments on State Street.
- AME Development has completed four one-bedroom rental apartments on State Street.
- Anthony Silvestri has completed work on 6,000 square-feet of office space, 3,000 square-feet of retail space, and 39 condominiums in the New London Harbour Towers at 429-461 Bank Street.

- 25 apartments and two commercial spaces have been completed by Peter Levine at 13 Washington Street.
- Newly O'reilly Auto Shop
- Upswing of mixed use in Downtown

Current development projects include:

- Fort Trumbull is being heavily focused on for resilient redevelopment.
- Plans to increase usage and upgrade the State Pier have spurred some smaller development projects in the surrounding area.
- There are plans for improvements in the area adjacent to Briggs Brook. Projects include the creation of a city park between Crystal Avenue and State Pier Road near Old Town Mill, and some flood management along the brook itself.

Redevelopment and infill in New London are anticipated to continue. The City must strive to ensure that these projects are resilient to the hazards discussed in this plan. Generally, however, new development and redevelopment is not increasing risks to natural hazards. Redevelopment throughout the city offers significant opportunities for flood mitigation to be incorporated into buildings and stormwater management to be addressed on-site; and new development is constructed per the flood damage prevention, wind loading, and snow loading requirements in the State Building Code.

As of the 2020 Decennial Census, the population for the city is 27,367, which equates to about 4,940 people per square mile. The 2020 American Community Survey 5-year estimates identified the annual average median income for New London to be \$47,706, with an average of 25.4% of the population holding a Bachelor's Degree or higher, and an average unemployment rate of 7.3% throughout the city.

2.5. Governmental Structure

The City of New London is governed by a Mayor-City Council government. The Mayor is the chief executive officer of the City and is directly responsible for the administration of all departments, agencies, and offices. The City Council is the City's legislative body, consisting of seven members. The Councilors are elected at large and serve for two-year terms. A majority of all the members elected to the Council shall constitute a quorum to do business. The President and the President Pro Tempore are selected by vote of the members of the Council. The President presides over the meetings of the Council.

The City of New London has several departments that provide municipal services. Departments pertinent to hazard mitigation include the Fire Department, Office of Development & Planning, Police, and Public Works. In addition, there are several boards and commissions that can take an active role in hazard mitigation, including the Planning & Zoning Commission. The general roles of most of these departments and commissions are common to most municipalities in SCCOG and were described in Section 2.9 of the Multi-Jurisdictional HMCAP. More specific information for certain departments and commissions of the City of New London is noted below:

- It is the primary mission of the New London Fire Department to provide a range of programs and services designed to protect the lives and property of inhabitants and visitors in the City of New London from the adverse effects of "Fires, Sudden Medical Emergencies, Exposure to Hazardous Materials or Exposure to any other dangerous conditions, either natural or man-

made." The New London Fire Department provides 24 hour, 365-day emergency and non-emergency services in the City. In addition to providing traditional fire suppression activities, the Fire Department provides Emergency Medical Services at the R-2 level (ambulance transport) as well as a full range of Fire Prevention services from Code Enforcement to Public Education. The Fire Department also has specific emergency and non-emergency responsibilities in the event of Radiological, Hazardous Materials and extreme weather emergencies.

- The Office of Development & Planning (ODP) administers and is responsible for a broad and complex array of planning, regulatory, economic and community development programs designed to improve the quality of life in New London. The office is divided into four separate divisions: Planning, Zoning & Wetlands; Economic Development; Community Development; and Building Division. The programs administered by the ODP staff include the Community Development Block Grant Program, the Housing Conservation Program, the Neighborhood Improvement Program, the Enterprise Zone, and a variety of other federal, state and locally funded special programs. The ODP personnel implement the objectives within the City's community and special area plans such as the Plan of Conservation and Development, the Downtown Action Agenda, Comprehensive Economic Development Strategy and the Consolidated Housing and Community Development Strategy. ODP personnel also provide technical assistance and expertise to other city departments and a wide range of boards, commissions and agencies.
- The Building Division of the ODP is the City's regulatory authority for the Connecticut Building Code, the City's Demolition Ordinance, the City's Housing and Property Maintenance Code and the City's Flood Plain Management Ordinance. The Building Official has a unique responsibility when it comes to hazard mitigation as he is responsible for overseeing a number of codes such as those related to wind damage prevention as well as those related to inland and coastal flood damage prevention. Although other departments and commissions may review development plans and develop or revise regulations, many important types of pre-disaster mitigation are funneled through and enforced by the Building Department. For example, the Building Department enforces A- and V-zone standards for construction and building elevations, maintains elevation certificates, and enforces building codes that protect against wind and fire damage.
- The Planning & Zoning Commission oversees orderly and appropriate use and development of residential, commercial, and industrial land and the conservation of natural resources. It reviews and approves a wide range of land use applications, zoning regulation amendments, planning and development projects, and grant opportunities to ensure that development and growth in the City is consistent with existing land use, environmental policy, and the objectives of the Plan of Conservation and Development.
- The Inland Wetlands/Conservation Commission reviews plans for compliance with the Inland Wetland Regulations.
- The Department of Public works is responsible for the maintenance of all City owned buildings, streets, parks and equipment. The Public Works Department's operational divisions are Administration, Building Maintenance, Highway Maintenance, Parks Maintenance, Solid Waste & Recycling and Mechanical Maintenance.

As is common throughout Connecticut, the Public Works Department is charged with implementing numerous projects that are related to hazard mitigation. Specifically, roadway/infrastructure maintenance and complaint logging/tracking are the two primary duties of the Public Work Department. For example, the Public Works Department tracks, plans, prepares for, and responds to flooding, inundation, and/or erosion of roads and infrastructure such as the sewer pumping station and the wastewater treatment plants. The Public Works Department also conducts snow removal and deicing on roads; tree and tree limb removal in rights-of-way; and maintains and upgrades storm drainage systems to prevent flooding caused by rainfall. Because of these duties, the Public Works Department is often the de facto first responder during emergencies.

- The Police Department provides law enforcement services. The Department also provides important press release services such as the notification of snow emergency operations in 2015 and the availability of FEMA disaster assistance as appropriate.

In addition to the departments described above, the City of New London has several other departments similar to surrounding municipalities, including Finance, Health and Social Services, etc. The roles of City departments have not changed since the time of the previous HMP. Thus, the City of New London is technically, financially, and legally capable of implementing mitigation projects for natural hazards. As discussed in the next section and the historic record throughout this annex, the City of New London is densely developed and thus has particular vulnerability to certain types of natural hazards.

2.6. Review of Existing Plans and Regulations

The City has several Plans and regulations that suggest or create policies related to natural hazard mitigation. These policies and regulations are outlined in the Emergency Operations Plan, *Plan of Conservation and Development*, *Harbor Management Plan* and Ordinance, Zoning Regulations, Subdivision Regulations, and Inland Wetland Regulations.

Emergency Operations Plan

The City has an Emergency Operations Plan (EOP) that is updated and certified by the Mayor annually. This document provides general procedures to be instituted by the Mayor and/or designee, Police Department, and Fire Department in case of an emergency. Emergencies can include but are not limited to natural hazard events such as hurricanes and nor'easters. The EOP is directly related to providing emergency services prior to, during, and following a natural hazard event. The New London EOP provides current, detailed instructions regarding the timing of evacuations.

Plan of Conservation and Development

The most recent version of the New London POCD was adopted in 2017. It was developed with contributions from local boards, commissions, committees, citizens, and citizen groups. The Plan seeks to be a statement of policies, goals and standards for the physical and economic development of the City and recommends the most desirable use types and population densities in various parts of the municipality.

The 2017 New London POCD includes the following actions, among others:

- Create an inventory of infrastructure improvements prioritized by condition and replacement timetable.
- Remove or relocate from the waterfront uses inconsistent with effective coastal or water dependent resource utilization.
- Implement strategies to conserve water and educate the public about water conservation.
- Seek opportunities to implement developmentally appropriate “low impact development” (LID) techniques that promote infiltration into the ground as opposed to using drainage pipes, especially in outlying areas.
- Expand the public water supply system.
- Maintain and improve existing open space and parks.
- Create a municipal land acquisition fund to support future purchase, enhancement, or expansion of open space.
- Adopt a standardized maintenance program for catch basins and street sweeping.
- Update zoning regulations to include Best Management Practices and State of Connecticut Stormwater Management requirements.
- Encourage the use of LID policies and practices.
- Implement Best Management Practices for snow and ice removal to mitigate potential impacts to water quality.
- Evaluate the long term implications of sea level rise.

The 2017 POCD incorporates several hazard mitigation relation themes, goals, and strategies. In general the plan aims to plan for waterfront areas, protect coastal and natural resources, and continues to support policies that also increase mitigation and resilience. Therefore, this update is considered to be consistent with the goals of this HMCAP.

Fort Trumbull Vision

This Concept Plan for Fort Trumbull, prepared by the Yale Urban Design Workshop in 2011 in collaboration with the City of New London, the New London Development Corporation and a diverse group of New London citizens and stakeholders, aims to build upon, update and add concrete detail to the previous plans for the area. The plan seeks to help position Fort Trumbull as a unique regional destination, development opportunity and mixed-use neighborhood linking to and complementing, but not directly competing with, Downtown New London and the Bank Street corridor.

Most of the Fort Trumbull area is within coastal flood zones and hurricane surge zones. The plan notes that "Parcel 4B" could be developed as a marina-related waterfront residential mid-rise tower. Because of the low elevation, the ground floor would be in the floodplain, so residential units could not be constructed unless on the second or third floor. The City must take care to develop resilient structures at Fort Trumbull.

Code of Ordinances

Chapter 6 (Buildings and Structural Appurtenances) Article III (Construction in Floodprone Areas) is the City's basic articulation of the NFIP Regulations. The code focuses on the A8 and V8 zones that were in place as of 1976.

Zoning Regulations

The Zoning Regulations of the City of New London, Connecticut are amended to July 10, 2018. The section dealing with flood damage prevention (Section 830: Flood Plain Management) was last updated in June 2011. They include a variety of preventative regulations pertinent to mitigating flooding hazards. An amendment in July 2013 redefined Flood Hazard Areas according to the most recent Flood Insurance Rate Maps (FIRMS) and Flood Insurance Study (FIS), either August 5, 2013, or July 18, 2011, depending on the location.

New London requires that new construction or substantial improvement be elevated or floodproofed to more than two feet above the Base Flood Elevation. Substantial improvement is defined cumulatively over a ten year period.

These regulations are applied during the permitting process for new construction and during substantial improvement of existing structures. Section 830 essentially contains additional provisions from the NFIP regulations that are not listed in the code of ordinances.

Section 840 of the Zoning Regulations and, to a lesser extent, Section 560 of the Subdivision Regulations, details the Coastal Area Management regulations, outlining measures to protect the coastal area of the City in a matter consistent with the Connecticut Coastal Management Act.

The Zoning Regulations also contain a number of provisions for ensuring safety and the ability of the Fire Department to access sites and new developments.

Subdivision Regulations

The City of New London Subdivision Regulations were last amended in June 2011. Section 550 of the Subdivision Regulations addresses drainage system design and consistency with the NFIP regulations articulated in the municipal code and the Zoning Regulations. The amendment date of the Subdivision Regulations coincides with the adoption of the DFIRM for the City in 2011. Section 540.2 of the Subdivision Regulations discusses stormwater system adequacy. The regulations also contain numerous provisions regarding road lengths and widths, restrictions for developing dead-end streets, and the like. These help ensure public safety and egress.

Inland Wetland and Watercourses Regulations

The Regulations for the Preservation of Inland Wetlands and Watercourses in the City of New London were last amended on January 23, 2012. The regulations require a permit for certain regulated activities which take place within 100 feet of a wetland or watercourse. These regulations build on the preventative flood mitigation provided by the Zoning and Subdivision regulations by preventing fill and sedimentation that could lead to increased flood stages.

Arboricultural Specifications and Standards of Practice

This document guides maintenance of municipal trees (specifically street trees) in New London.

2.7. Critical Facilities, Sheltering Capacity, and Evacuation

The City of New London considers several facilities to be critical to ensure that emergencies are addressed while day-to-day management of the City continues. In addition, locations with populations

that may be at additional risk during an emergency are also considered to be critical. Critical facilities are summarized in Table 2-2.

Table 2-2 City of New London Critical Facilities

Facility	Address or Location	Emergency Power	Shelter	Cooling Center	In SFHA	In Surge Zone
Emergency Services						
Fire Headquarters (EOC)	289 Bank Street	✓			*	✓
North Fire Station	Broad Street	✓				
South Fire Station	Lower Boulevard	✓				
Police Department Headquarters	5 Gov. Winthrop Blvd.	✓				✓
Municipal Facilities						
City Hall	181 State Street					
Stanton Building	111 Union Street	✓				
Public Works Complex	189 Crystal Avenue					
Water Pollution Control Facility	Trumbull Street	✓			✓	✓
Senior Center	120 Broad Street	✓	✓	✓		
New London High School	490 Jefferson Avenue					
Bernie Dover Jackson Middle School	36 Waller Street					
Jennings Elementary School	50 Mercer Street					
Nathan Hale Elementary School	37 Beech Drive					
Harbor Elementary School	432 Montauk Avenue					
Winthrop School	74 Grove Street	✓		✓		
Public Library of New London	63 Huntington Street			✓		
Health Care/Senior Living						
Lawrence and Memorial Hospital	365 Montauk Avenue					
Community Health Center	1 Shaws Cove				✓	✓
Beechwood Manor	31 Vauxhall Street					
Harbor Village Rehabilitation & Nursing Center South	89 Viets Street					
Harbor Village Rehabilitation & Nursing Center South	78 Viets Street					
Bacon and Hinkley Home	581 Pequot Avenue					
Briarcliff Manor	179 Colman Street					
Sunny Lodge (Cedar Grove Manor)	47 Cedar Grove Avenue					

*Zone X/Protected by Levee

City Hall and the Stanton Building

The City Hall at 181 State Street has no standby power supply. It is undergoing a Historic Renovation Project in 2017. The City considers the City Hall to be a critical facility due to its many functions such as City Clerk, Probate Judge, the Office of Planning and Development, and other offices.

The Stanton Building (City Hall Annex) at 111 Union Street is partially powered by a generator during outages and houses the City's radio transmission capabilities. It is therefore a critical facility and is located outside of any flood or hurricane surge zones.

Public Works Complex

The Public Works Department and sub-departments operate mainly out of the Public Works complex at 189 Crystal Avenue. This complex includes a garage, fueling station, dry sand or salt storage, a transfer station, and offices. It is located near but outside of an AE zone of the Thames River.

Shelters

The Connecticut Hurricane Evacuation Study and Technical Data Report reports that three shelters were available as of 1994: the Martin Center (capacity 750), New London High School (capacity 1,500), and New London Junior High School (now the Middle School with a capacity 1,500). The ARC had agreed to operate all three shelters. The Martin Center (120 Broad Street) was most recently used as a shelter during Hurricane Irene, and up to 60 people took advantage of shelter services at that location. The Martin Center has since been sold and is no longer a shelter for the city. The New London High School and Middle School (Bernie Dover Jackson Middle School) are no longer emergency shelters.

The city has also identified the Senior Center, Winthrop School, and the Public Library of New London as the primary cooling centers for residential use during an extreme heat event or heat wave.

Fire and Police Department Facilities

There are a total of three fire stations, and all are critical facilities. The Emergency Operations Center (EOC) is the Fire Headquarters. The fire headquarters is located at 289 Bank Street. It is in a Category Two surge zone and is protected by a levee from the 1% annual chance flood event. Since the previous HMP the Fire Headquarters has updated its conference room capabilities.

In the long term, the City desires a new Fire Headquarters that is located in a more flood-resilient location. SCCOG completed an assessment of critical facilities in the region in 2017, fulfilling an action listed in the 2012 edition of the multi-jurisdiction hazard mitigation plan. The Fire Headquarters was addressed in this study. The assessment determined that the City should undertake stormwater improvements and backflow prevention in the short term and pursue dry floodproofing of the utility room and wet floodproofing of remaining lower areas in the long term. These recommendations are incorporated into the list of actions in Section 8 of this annex. The assessment did not recommend that the Fire Headquarters should be relocated in the short-term, but this hazard mitigation plan absolutely supports relocation of the Fire Headquarters outside the SFHA if the opportunity arises for some other reason such as the availability of land.

Outlying fire stations are located at 240 Broad Street (North Station) and 25 Lower Boulevard (South Station-Station 3). Neither fire station is located in hurricane surge zones or flood zones.

The police department headquarters is a separate building and is a critical facility. The northeast portion of the building is located within a Category Four hurricane surge zone. The police department headquarters has emergency power.

Wastewater Utilities

The Water Pollution Control Facility (WPCF) located along the Thames River is a critical facility, along with the sewer pumping stations located throughout the City. These facilities are a high priority for power restoration following any outage to prevent sewer backups. Since the previous HMP, the WPCF has made improvements to its reservoir and removed fuel tanks.

Health Care Facilities

The 1994 hurricane study report notes seven medical and institutional facilities in New London (one hospital and six nursing homes): Lawrence & Memorial Hospital, Beechwood Manor, Camelot Nursing Home, Nutmeg Pavilion Health Care, Bacon and Hinkley Home, Briarcliff Manor, and Cedar Grove Manor. In particular, Lawrence & Memorial Hospital is a major provider of advanced healthcare services in the SCCOG region. Lawrence & Memorial Hospital is now an affiliate of Yale New Haven Health System. None of the facilities are located in either a flood zone or a hurricane surge zone.

Communication Capabilities

New London has upgraded its emergency radio communication system to operate on an ultra-high frequency (800 megahertz) digital system.

Evacuation Routes

The Police Chief has an evacuation plan on file that considers an evacuation required because of an emergency at the Millstone Nuclear Power Plant in Waterford, a coastal flooding emergency, or a hurricane. Evacuation routes should not include roads that can become submerged during coastal storms and riverine flooding (See Section 4). Any changes in shelter status or shelter locations will necessarily require modifications to the evacuation map. In addition, any changes in routing will necessarily require modifications to the evacuation map.

2.8. Repetitive Loss Properties

A repetitive loss (RL) property is defined as any insurable building that has had two or more claims exceeding \$1,000 that were paid by the National Flood Insurance Program (NFIP) within a ten-year period. As of June 2022, the City of New London has 17 RL properties with losses associated with inland flooding; all but one is residential. A total of \$1,270,461.41 has been paid in claims for these properties. There is one more residential RL property since the 2017 HMP. There are also 17 RL properties affected by coastal flooding; 16 are residential and 1 is commercial. These properties are impacted by the Thames River and Long Island Sound.

2.9. Exposure to Climate-Affected Natural Hazards

Properties, people, historic resources, and critical facilities in the City are exposed to natural hazards affected by climate change (i.e., severe storms, coastal flooding, droughts) as well as hazards that are not affected by climate change (i.e., earthquakes). As an initial screening of exposure to hazards, areas of risk have been overlaid onto parcel and point data in a GIS to understand the maximum potential exposure to hazards. The results of this analysis are found in Table 2-3.

Table 2-3 City of New London Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Hurricane/Tropical Storm	\$2,071,264,631	6,277	\$216,160,560	18	\$233,666,275	989
Severe Thunderstorm	\$2,071,264,631	6,277	\$216,160,560	18	\$233,666,275	989
Severe Winter Storm	\$2,071,264,631	6,277	\$216,160,560	18	\$233,666,275	989
Tornado	\$2,071,264,631	6,277	\$216,160,560	18	\$233,666,275	989
Drought	\$153,030,430	45	\$9,377,210	1	\$61,670	1
Flood						
1% Annual Chance	\$548,922,141	460	-	1	\$32,737,455	32
Coastal (VE)	\$387,543,056	169	-	-	\$22,182,540	5
0.2% Annual Chance	\$687,724,671	836	\$1,722,210	2	\$57,235,965	123
Reduced Risk Due to Levee	\$33,294,900	107	-	-	\$13,375,900	47
Storm Surge						
Category 1	\$333,356,536	249	-	1	\$29,338,570	15
Category 2	\$574,493,161	546	-	1	\$46,478,265	80
Category 3	\$607,470,941	664	\$1,722,210	2	\$48,635,345	97
Category 4	\$652,164,681	754	\$1,722,210	2	\$54,825,375	122
Earthquakes	\$2,071,264,631	6,277	\$216,160,560	18	\$233,666,275	989
Wildfire	\$1,235,110	12	\$9,377,210	1	\$61,670	1

2.10. Community Climate Change Challenges

As is with all of the SCCOG communities, the City of New London has several concerns regarding climate change challenges. Most communities in the region are typically most concerned with the impacts of increased flooding and extreme heat events, however, there are often concerns about other climate driven hazards. The following summary sheet identifies the top flooding, heat, and other climate change concerns for the city, along with the hazard mitigation and climate adaptation actions that will work to address these concerns.

Climate Change Summary Sheet for City of New London

What are the City's Top Climate Change Concerns?

Flooding: The City is challenged by stormwater collection, conveyance, and discharge systems that may not be adequate for rising sea levels. The City is also concerned about potential future flooding along Briggs Brook.

Extreme Heat: Developed and urban areas with impervious surfaces will contribute to heat island effects, and more vegetative coverage is desired to help provide shade and cooler surfaces.

Others: Extreme wind events occurring during high tide events may increase flooding, such as the storm of 12/23/22. The City is also somewhat concerned about Fort Trumbull redevelopment, given its location among coastal flood zones.

Which Hazard Mitigation and Climate Adaptation Actions Will Address Climate Change Concerns?

Flooding: Pursue Briggs Brook improvements including grading, flood management, and development of a flood resilient city park. The short-term focus should be development of feasibility studies and concept designs.

Extreme Heat: In collaboration with the Urban Tree Initiative, prioritize green space and urban tree plantings in new development projects and high heat or highly impervious areas.

Others: Ensure that development at Fort Trumbull is resilient to flooding, storm surges, and sea level rise; coordinate with DEEP to develop a site-specific resilience plan if needed. Undertake a study to identify flood risk reduction options for the underpasses used to access Fort Trumbull.

3. Extreme and Severe Storms

3.1. Climate Change Impacts

Climate change projections indicate varying changes in the frequency and intensity of severe storms and their relative hazards like precipitation and wind. It is expected that as global mean temperatures continue to rise, storms like hurricanes, tropical storms, and severe thunderstorms, may become more frequent and more intense. The degree to which these events might change, and the confidence levels in the models, vary by event type.

Hurricanes and tropical storms are likely to be accompanied by higher wind speeds and an overall increase in intensity. Warm water and air temperatures are essentially the fuel source for the storm, therefore warmer temperatures mean an increase in fuel which can produce more intense winds and high precipitation levels.

While the future behavior of tornado and high wind events is a little more challenging to predict in comparison to hurricanes, it has been noted that the number of days of tornadic activity has decreased in recent decades, though the number of tornadoes in a single day has increased.¹ There is a similar lack in confidence when projecting severe thunderstorm and wind events. Because these events are short-lived and relatively small-scale, monitoring and modeling are more challenging. Overall, however, future climate conditions are likely to become more conducive to the development of such events, therefore increasing the potential for occurrence.

Severe winter storm events, similar to hurricanes, are expected to become more intense under future climate conditions, however they are expected to become less frequent. These storms will continue to be capable of producing large amounts of precipitation, though in future decades this precipitation will consist of less snow and more wintry mix or rain.

These changes in storms could mean an increase in risk throughout the city or for specific populations, more severe storm damage and impacts, or an increase in flooding occurrences.

3.2. Hurricanes and Tropical Storms

3.2.1 Setting and Recent Occurrences

Several types of hazards may be associated with tropical storms and hurricanes including heavy or tornado winds, heavy rains, and flooding. Flooding and storm surge hazards are discussed in Section 0 and Section 4.2 of this annex. Wind hazards are widespread and can affect any part of the City. However, some buildings in the City are more susceptible to wind damage than others.

- Hurricane Irene impacted the city in August 2011. The storm surge was only moderate, but the waves broke over the seawalls and a number of coastal streets were flooded. Trees fell throughout the City and power outages ranged from one day to one week.
- In 2012, Super Storm Sandy, a hybrid storm with both tropical and extra-tropical characteristics, brought high winds and coastal flooding to southern New England. Record breaking high tides

¹ <https://nca2018.globalchange.gov/chapter/2/>

and wave action combined with sustained winds of 40 to 60 mph and wind gusts of 80 to 90 mph. Widespread significant statewide power outages of 667,598 lasted up to 8 days.

On August 2, 2020 Tropical Storm Isaias swept through the State bringing severe winds which resulted in the highest number of outage events Connecticut has ever experienced. With over 620,000 outages reported by Eversource alone, the state's largest electric supplier, residents across the SCCOG region were without power, cable, and internet for extended periods of time. While this storm did not generate typical amounts of rainfall experienced during a tropical storm event, the wind damage exceeded expectations bringing down trees and power lines across the state.

In 2021, there were four tropical storm events that passed through, or within 50 miles of, the state. Some of these events, which are described in more detail below, resulted in flooding along several brooks and stream crossings, including roadway washouts.

The 2021 events included Elsa, Fred, Henri, and Ida.

- July 9, 2021 (T.S. Elsa) – Elsa made landfall as a tropical storm in Florida and traveled along the eastern seaboard. It passed through Southeastern New England bringing high winds and rainfall. Gusts were reported over 40 mph, and residents throughout the region and state were left without power.
- August 19, 2021 (Extratropical Storm Fred) – This tropical event passed north of the state bringing heavy rain to some areas in Connecticut; there was a reported 5.14 inches in West Hartford. Fred also produced an EF-0 tornado in Windham County.
- August 22, 2021 (T.D. Henri) – Hurricane Henri made landfall in Rhode Island as a tropical storm and then traveled northwest across the State of Connecticut. While the impacts for Henri were projected to be more severe than they actually were, the storm did result in heavy rainfall and thousands of power outages.
- September 1, 2021 (Extratropical Storm Ida) – Though Hurricane Ida made landfall in Louisiana as a category 1, the storm moved south of Long Island as an extratropical storm and is reported to be costliest storm even since Hurricane Sandy a decade earlier. Ida caused major flooding across Connecticut and the Southeastern Region. For the first time, a statewide flash flood warning was issued. Several communities in the state, including the City of Norwich, warned residents to have minimal contact with surface waters due to the discharge of untreated sewage. There were reports of 7 to 8 inches of rainfall in the Southeastern Region, and as high as 8.58 inches in Uncasville.

In general, the city did not report significant impacts from the 2021 events.

3.2.2 Existing Capabilities

Wind loading requirements are addressed through the state building code. The Connecticut State Building Code was most recently adopted with an effective date of October 1, 2016. The code specifies the design wind speed for construction in all the Connecticut municipalities. The basic design wind speed for New London ranges from 120 to 140 miles per hour, the ultimate design wind speed is 127 miles per hours; final speeds used vary depending on the building use (for example, hospitals must be designed to the higher wind speed). Note that changes in design wind speed figures since the previous HMP are largely the result of a shift from "nominal" to "ultimate" wind speeds, for compatibility

purposes; see the Connecticut Building Code or the American Society of Civil Engineers website for more information. New London has adopted the Connecticut Building Code as its building code.

Parts of trees (limbs) or entire tall and older trees may fall during heavy wind events, potentially damaging structures, utility lines, and vehicles. Utility lines are located underground in a few areas of the City such as State Street and Bank Street, both located downtown. The City has a tree warden who can post notifications and schedule tree removal. The Public Works staff also monitor trees as part of their normal rounds and includes a budget for minor tree maintenance.

In response to the major power-outages caused by Tropical Storm Irene and Hurricane Sandy, as well as significant winter storm events, Eversource has taken an aggressive approach to tree maintenance and has improved communication and coordination with municipalities. Municipal staff report that Eversource has improved its tree clearing efforts by implementing "Enhanced Tree Trimming," has updated its facilities, and has been working to strengthen the power grid and build in redundancies. Communication and coordination have improved due to Eversource's liaison program. The utility maintains a tree pruning program.

Warning is one of the best ways to prevent damage from hurricanes and tropical storms, as these storms often are tracked well in advance of reaching Connecticut. The City can access National Weather Service forecasts via the internet as well as listen to local media outlets (television, radio) to receive information about the relative strength of the approaching storm. This information allows the City to activate its EOP and encourage residents to take protective or evacuation measures if appropriate.

Prior to severe storm events, the City ensures that warning/notification systems and communication equipment are working properly and prepares for the possible evacuation of impacted areas. The statewide CT "Everbridge" Reverse 9-1-1 system can be utilized to warn coastal residents of an impending evacuation. Although hurricanes that have impacted New London have historically passed in a day's time, additional shelters could be outfitted following a storm with the assistance of the American Red Cross on an as-need basis for long-term evacuees.

Other municipal capabilities related to tropical storm mitigation include:

- A protocol for removing personal watercraft from marinas prior to a storm event
- Providing information on wind-resistant construction techniques to building permit applicants upon request
- A location has been identified for brush-disposal to help manage debris following a storm
- Agreements with landowners and companies to chop/chip to assist with debris removal have been developed
- Evacuation routes have been marked with street signs

Summary

In general, municipal capabilities to mitigate hurricane damage have not increased significantly since the 2017 edition of the hazard mitigation plan was adopted. This is likely because the City increased its capabilities slightly in response to the damage from Tropical Storm Irene in 2011 and Hurricane Sandy in 2012, and has continued to operate at this level.

3.2.3 Vulnerabilities and Risk Assessment

The entire City is vulnerable to hurricane and tropical storm wind damage and from any tornadoes (Section 3.3) accompanying the storm, as well as inland flooding (Section 0) and coastal flooding and storm surge (Section 4.2). Of particular concern are the blockage of roads and the damage to the electrical power supply from falling trees and tree limbs. The City experienced a range of outages during and after Hurricane Irene.

Direct wind damage to newer buildings from hurricane or tropical storm-level winds is rare in the City since the new buildings were constructed to meet or exceed current building codes. Many buildings in the City were built under prior codes and do not meet current building codes. Older buildings in the City are particularly susceptible to roof and window damage from high wind events, although this risk will be reduced with time as these buildings are remodeled or replaced with buildings that meet current codes.

The strength of a large hurricane could cause a significant economic impact to the City. The potential economic effect of wind damage to SCSOG was evaluated in the Multi-Jurisdictional HMP. A separate analysis was not performed specifically for the City of New London.

3.2.3.1 Hazard Losses

The City of New London did not receive FEMA PA funds in the wake of Tropical Storm Isaias. Since 2012, the city has received \$764,340 in FEMA PA funds for project costs of \$1,019,120. This was all received for Hurricane Sandy. These funds were received for debris removal, protective measures, public buildings, water control facilities, and recreational or other needs.

FEMA also provides Individual Assistance (IA) for property owners and renters in the wake of a declared disaster. After Hurricane Ida, two property renters received IA funds totaling \$10,647.

FEMA HAZUS-MH 6.0 was used to develop losses associated with seven probabilistic hurricane scenarios from the 10 year to 1,000 year return period. Losses include economic loss, building damages, debris, and sheltering needs. Table 3-1 through Table 3-3 presents hurricane related damages for the City of New London. Additional HAZUS-generated losses for the city and region can be found in the Multi-Jurisdictional document.

Downscaled tropical storm losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

Table 3-1 HAZUS-MH Hurricane Related Economic Impacts

New London	Return Period	Residential	Commercial	Industrial	Others	Total
	10-year	\$362,010	\$9,300	\$5,750	\$2,190	\$379,250
	20-year	\$6,134,420	\$323,800	\$58,660	\$154,040	\$6,670,920
	50-year	\$36,216,550	\$5,519,030	\$1,662,100	\$2,719,700	\$46,117,380
	100-year	\$7,360,510	\$4,873,520	\$246,640	\$456,760	\$12,937,430
	200-year	\$145,587,690	\$48,086,320	\$13,855,540	\$26,103,780	\$233,633,330
	500-year	\$265,078,860	\$111,284,420	\$25,608,440	\$58,206,620	\$460,178,340
	1,000-year	\$374,003,450	\$184,956,980	\$39,166,580	\$85,285,230	\$683,412,240

Table 3-2 HAZUS-MH Hurricane Related Building Damage

New London	Return Period	Minor	Moderate	Severe	Destruction	Total
	10-year	9	1	0	0	10
	20-year	65	6	0	0	71
	50-year	558	99	7	1	665
	100-year	1,171	311	34	7	1,523
	200-year	1,722	633	97	25	2,477
	500-year	2,108	1,078	249	73	3,508
	1,000-year	2,194	1,359	407	124	4,084

Table 3-3 HAZUS-MH Hurricane Related Debris and Sheltering Needs

New London	Return Period	Debris Generated (Tons)	Households Displaced	Individuals Seeking Temporary Shelter
	10-year	26	0	0
	20-year	933	0	0
	50-year	5,896	5	3
	100-year	12,143	29	15
	200-year	20,285	101	66
	500-year	33,246	346	250
	1,000-year	43,900	640	495

3.3. Tornadoes and High Wind Events

3.3.1 Setting and Recent Occurrences

Similar to hurricanes and winter storms, wind damage associated with severe thunder or summer storms and tornadoes has the potential to affect any area of the City. Furthermore, because these types of storms and the hazards that result (flash flooding, wind, hail, and lightning) might have limited geographic extent, it is possible for a summer storm to harm one area within the City without harming another. Such storms occur in the City each year, although hail and direct lightning strikes to the City are rarer.

A funnel cloud was spotted on August 5, 2010, in the Thames River closer to Groton, as reported to the NCDC. No tornadoes have occurred in the City since the last HMP.

Other recent severe storm events include:

- On September 6, 2017, a cold front triggered severe storms in the county and caused tree damage in multiple communities in the region. Nearby Colchester reported trees and wires down, and the Groton-New London Airport measured sustained winds at 44 mph and gusts of 56 mph.
- On April 13, 2020, a low pressure system resulted in high winds throughout New London County.
- On November 13, 2021, a tornado touched down in Pawcatuck, and another in Plainfield. There were reports of uplifted trampolines, downed trees and powerlines, and an uplifted metal shed. This same storm also caused damage in other surrounding communities.

3.3.2 Existing Capabilities

Warning is the most viable and therefore the primary method of existing mitigation for tornadoes and thunderstorm-related hazards. The NOAA National Weather Service issues watches and warnings when severe weather is likely to develop or has developed, respectively. The City can access National Weather Service forecasts via the internet as well as listen to local media outlets (television, radio) to receive information about the relative strength of the approaching storm. This information allows the City to activate its EOP and encourage residents to take protective measures if appropriate.

Aside from warnings, several other methods of mitigation for wind damage are employed by the City as explained in Section 3.2.2 within the context of hurricanes and tropical storms. In addition, the Connecticut Building Code includes guidelines for the proper grounding of buildings and electrical boxes to protect against lightning damage.

Summary

In general, municipal capabilities to mitigate thunderstorm and tornado damage have not increased significantly since the 2017 edition of the hazard mitigation plan was adopted.

3.3.3 Vulnerabilities and Risk Assessment

Summer storms are expected to occur each year and are expected to at times produce heavy winds, heavy rainfall, lightning, and hail. All areas of the City are equally likely to experience the effects of

summer storms. The density of damage is expected to be greater near the more densely populated area of the City.

Most thunderstorm damage is caused by straight-line winds exceeding 100 mph. Experience has generally shown that wind in excess of 50 miles per hour (mph) will cause significant tree damage during the summer season as the effects of wind on trees are exacerbated when the trees are in full leaf. The damage to buildings and overhead utilities due to downed trees has historically been the biggest problem associated with wind storms. Heavy winds can take down trees near power lines, leading to the start and spread of fires. Such fires can be extremely dangerous during the summer months during dry and drought conditions. Fortunately, most fires are quickly extinguished due to the City's strong fire response.

Lightning and hail are generally associated with severe thunderstorms and can produce damaging effects. All areas of the City are equally susceptible to damage from lightning and hail, although lightning damage is typically mitigated by warnings and proper grounding of buildings and equipment. Hail is primarily mitigated by warning, although vehicles and watercraft can often not be secured prior to the relatively sudden onset of a hailstorm. Lightning and hail are considered likely events each year, but typically cause limited damage in the City. Older buildings are most susceptible to lightning and hail damage since many are renter occupied and they were constructed prior to current building codes.

Although tornadoes pose a threat to all areas of Connecticut, their occurrence is least frequent in New London County as compared with the rest of the State. Thus, while the possibility of a tornado striking the City exists, it is considered to be an event with a very low probability of occurrence.

3.3.3.1 Hazard Losses

Since 2017, there has been zero NOAA reported events associated with severe thunderstorm and wind events. Since 2012 there was one report of hail in the city; no damage was reported for this storm. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

3.4. Severe Winter Storms

3.4.1 Setting and Recent Occurrences

Similar to hurricanes and summer storms, winter storms have the potential to affect any area of the City. However, unlike summer storms, winter storms and the hazards that result (wind, snow, and ice) have more widespread geographic extent. In general, winter storms are considered highly likely to occur each year (major storms are less frequent), and the hazards that result (nor'easter winds, snow, and blizzard conditions) can potentially have a significant effect over a large area of the City.

Some of the most significant events from the 2017 HMP include:

- The storms during the winter of 2010-2011 had a significant impact on the region. The roof of the building at 575 Bank Street collapsed in early 2011. It was a mixed-use commercial/residential building. A total of 17 people had to be relocated. Other buildings in the city were checked, and the roof of City Hall was cleared.
- Winter Storm Alfred struck later in 2011, but damage was minimal as compared to much of Connecticut.

- 2013 featured exceptional snow events that severely taxed snow removal abilities of towns in the region. The blizzard of 2013 in early February dumped one to two feet of snow on the region. Another snowstorm struck the region in mid-March 2013 dumping upwards of one to two feet of snow in some parts of the county. Although New London country escaped the 3 feet + totals of some areas in the mid-Atlantic, the vast quantity of snow was still a major disruption to the city. New London received over \$60,000 in federal aid from FEMA to cover storm cleanup costs.
- A nor'easter in December 2014 caused significant damage and disruption in New London.
- In January 2015 winter storm Juno created blizzard conditions across southeastern Connecticut. The region received 20 to 28 inches of snow, or more.
- In February 2017 a blizzard brought snow and high winds to New London.

Some of the more recent significant winter events include:

- A heavy storm came through the region on February 9, 2017, bringing blizzard conditions and heavy snowfall. The Town of Colchester reported 14.5 inches of snow, and 13 inches were reported along the coast in Groton.
- A late winter storm on March 12, 2018, resulted in 23 inches of snowfall in Oakdale, with reports of one to two feet in other parts of Northern New London County. The southern part of the region experienced 10 to 18 inches of snow, and strong wind gusts. There were also reports of downed trees throughout the region as a result of this storm.
- On January 28, 2022 the region was hit with a heavy snowstorm and blizzard like conditions. Parts of the region reported up to 22 inches of snowfall, and gusts up to 65 mph. There were also several hours of less than ¼ mile visibility. Snow drifts were also reported to be a challenge, with some areas experiencing drifts up to three and a half feet deep.

3.4.2 Existing Capabilities

Existing programs applicable to winter storm winds are the same as those discussed in Sections 3.2.2 and 3.3.2. Programs that are specific to winter storms are generally those related to preparing plows and sand and salt trucks; tree trimming and maintenance to protect power lines, roads, and structures; and other associated snow removal and response preparations.

As it is almost guaranteed that winter storms will occur annually in Connecticut, it is important to locally budget fiscal resources toward snow management. Snow is the most common natural hazard requiring additional overtime effort from City staff, as parking lots and roadways need constant maintenance during storms. The Public Works Department oversees snow removal in the City. The City has established plowing routes that prioritize access to and from critical facilities. These routes have been updated since the previous HMP based on lessons learned from the exceptionally snowy winters in 2013 and 2015. The DPW also pretreats roads when winter storms are predicted. The Connecticut Department of Transportation plows Interstate 95 and other State roads.

The Connecticut Building Code specifies that a pressure of 30 pounds per square foot be used as the base "ground snow load" for computing snow loading for roofs. As noted above, snow loads were problematic in early 2011 and a roof collapsed downtown. The DPW has updated its snow removal

protocols and equipment and maintains a plan for inspecting and prioritizing removal of snow from City owned structures.

Information for protecting residents during cold weather, including mitigating icing and insulating pipes at residences, is available seasonally through the City website.

Summary

In general, municipal capabilities to mitigate snowstorm damage have increased slightly since the 2017 edition of the hazard mitigation plan was adopted. This is because the City continues to experience heavy snow each winter.

3.4.3 Vulnerabilities and Risk Assessment

Severe winter storms can produce an array of hazardous weather conditions, including heavy snow, blizzards, freezing rain and ice pellets, flooding, heavy winds, and extreme cold. Further "flood" damage could be caused by flooding from frozen water pipes. Often, tree limbs on roadways are not suited to withstand high wind and snow or ice loads.

This section focuses on those effects commonly associated with winter storms, including those from blizzards, ice storms, heavy snow, freezing rain, and extreme cold. Warning and education can prevent most injuries from winter storms. Most deaths from winter storms are indirectly related to the storm, such as from traffic accidents on icy roads and hypothermia from prolonged exposure to cold. Damage to trees and tree limbs and the resultant downing of utility cables are a common effect of these types of events. Secondary effects can include loss of power and heat.

Many City buildings are of older construction and are therefore susceptible to damage from heavy snow. While some City buildings could be susceptible to heavy snow loads, they will be cleared quickly if safety is a concern. Many buildings in the City have flat roofs which are more susceptible to damage from heavy snow than sloped roofs.

Icing is not a common issue in the City. In general, there are few steep slopes such that extra sanding and salting of the roadways in necessary locations alleviates any trouble spots.

3.4.3.1 Hazard Losses

There have been no reported winter storm losses for the City of New London since 2017. In the past decade, the city has received FEMA PA funds in the amount of \$307,775 for winter storms. Downscaled losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

4. Sea Level Rise

4.1. Climate Change Impacts

Sea levels are rising at an increased rate across the globe. These rising waters are attributed to melting glaciers and ice sheets, as well as thermal expansion from warming ocean waters. Global sea level rise takes into account the major causes of rise, and the averages of rise around the world. Local sea level rise estimates consider the global changes, but also characterizes what is happening more locally such as changes in currents or land subsidence.

The University of Connecticut, Connecticut Institute for Resilience and Climate Adaptation (CIRCA) has, in accordance with state statute, developed local sea level rise projections for communities to use as a planning threshold (Figure 4-1). CIRCA recommends that communities plan for 0.5 (1.64 feet) of sea level rise above 2001 levels by 2050. CIRCA intends to revisit this estimate and update the planning thresholds in the lifespan of this plan (2023-2028).

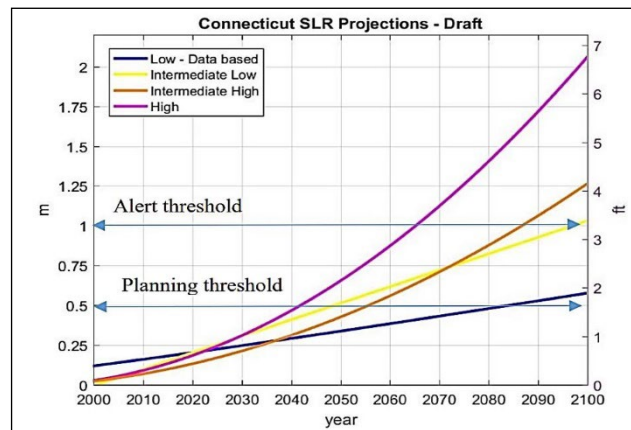


Figure 4-1 Four Localized Sea Level Rise Scenarios for

Even though sea level rise occurs over a longer time period than other hazards, coastal communities are becoming increasingly concerned with the cascading impacts. Increased sea levels can also cause a greater geographic reach for coastal flooding events, an increase in frequency or extent of “sunny day” flooding, an increase in storm surge extent, and saltwater inundation along the shoreline. All of these impacts can damage properties, deteriorate infrastructure, cause access and egress challenges, and exacerbate coastal erosion processes.

4.2. Coastal Flooding

4.2.1 Setting and Recent Occurrences

The shorefront of the City of New London contains a developed shorefront along the Thames River. Areas of rocky shorefront, coastal bluffs and escarpments, modified bluffs and escarpments, beaches and dunes, and intertidal flats are found along New London Harbor and Long Island Sound. The coastal resources found in Connecticut and described by DEEP can be found in the Multi-Jurisdictional HMP.

Homes, businesses, and industry are located in close proximity to the coastline along the Thames River and Long Island Sound. Structures and infrastructure along the Thames River, the harbor, and Long Island Sound are closer to sea level than in northern areas and are therefore more susceptible to coastal flooding. Hurricanes and tropical storms have the potential to induce coastal flooding and storm surge that can impact structures.

Floodwater due to Super Storm Sandy in October 2012 damaged a relatively small number of coastal properties in New London, with the main damage caused by coastal flooding being beached boats and debris piled along the shoreline. The New London Harbor Lighthouse sustained serious damage, and the city received nearly \$700,000 in federal public assistance funds.

In general, with recent drainage and flood mitigation projects having occurred in the city, such as the Bank Street pumps and the upgrade of the downtown flood protection system, flooding has not been as impactful as in years past.

New London is also concerned with the potential long-term effects of sea level rise and its potential to exacerbate flooding conditions in the future.

4.2.2 Existing Capabilities

The City primarily attempts to mitigate coastal flood damage and flood hazards by controlling and restricting activities in floodprone areas, encouraging the elevation of homes and roadways, maintaining hard structures in good condition, and providing signage and warning systems. Many of the Existing Capabilities utilized in the City for inland flood mitigation (Section 3.2) are also applicable to coastal flood mitigation.

As noted in Section 0 and Section 2.6, the City utilizes the 1% annual chance floodplains delineated by FEMA. These consist of the 1% annual chance floodplain with elevations (Zone AE), and the 1% annual chance floodplain subject to wave velocity (Zone VE) as presented on Figure 5-1. As noted by the Zoning Regulations and the Subdivision Regulations, building activities in these areas are restricted and new construction or substantial redevelopment must prove that the lowest horizontal member of the new construction will be above the base flood elevation. The Planning and Zoning Commission and OPD are required to review and approve portions of applications that involve structures within FEMA Special Flood Hazard Areas.

The City has conducted outreach to residents about flood mitigation and a number of residents are interested in structure elevations. The recommendations from the Plan of Conservation and Development described in Section 2 and regarding flood damage prevention are pertinent to coastal flood mitigation.

Although New London lacks inland flood control structures such as dams and channelized sections of rivers, the shoreline of New London contains many coastal flood control structures. Seawalls and bulkheads can be found in many of the residentially developed coastal neighborhoods. Additionally, the City conducts beach nourishment and vegetation replacement along any affected beaches to keep up with erosion.

To address tidal flooding and hurricane surge damage in the Shaw's Cove and downtown area, the United States Army Corps of Engineers constructed a hurricane barrier as described in Section 5.2.2. The barrier protects the downtown area from tidal flooding. The U.S. Army Corps of Engineers' Connecticut Hurricane Evacuation Study and Technical Data Report from 1994 noted that this hurricane barrier was designed to protect against flooding events up to the 100-year frequency flood. Study results indicated that worst case surges generated by Categories 3 and 4 hurricanes in combination with astronomical tides were higher than the design height of the barrier. Potentially vulnerable land areas located behind this barrier should be evacuated for hurricanes of these intensities.

The hurricane barrier system is classified as a levee and as such, it requires continued accreditation. The appropriate paperwork was submitted to FEMA on December 22, 2011. Minor recommendations related to clearing sediment were returned to the City, and compliance is anticipated.

As explained elsewhere in this HMP, the National Weather Service issues a flood watch or a flash flood watch for an area when conditions in or near the area are favorable for a flood or flash flood, respectively. A flash flood watch or flood watch does not necessarily mean that flooding will occur. The National Weather Service issues a flood warning or a flash flood warning for an area when parts of the area are either currently flooding, highly likely to flood, or when flooding is imminent. The City of New London utilizes these warnings and forecasts to prepare emergency responders for flooding events.

Like many communities, the City lacks existing policies and mitigation measures that are specifically designed to address sea level rise. The City participated in a resiliency planning initiative with SCCOG and TNC in 2016-2017². However, the City has not yet embarked on detailed coastal hazard planning to the degree that nearby communities like Waterford and the Town of Groton have done. Although the City of New London does not currently have a specific plan to address sea level rise, important pieces are in place in the form of the codes and regulations cited in this HMP that have been enacted to minimize storm, erosion, and flood damage. Together, the policies of the POCD (2017) and the existing regulations and codes will build a foundation for addressing coastal resilience and adaptation.

As explained in Section 2 of the regional part of this multi-jurisdiction hazard mitigation plan, the State Historic Preservation Office (SHPO) embarked on a resiliency planning study for historic and cultural resources beginning in 2016. During winter 2016-2017, individual meetings were held with the shoreline SCCOG communities. Reports were issued to these communities in December 2017. The City of New London report outlines eight strategies that can be employed to make historic and cultural resources more resilient:

- Identify Historic Resources
- Revisit Historic District Zoning Regulations
- Strengthen Recovery Planning
- Incorporate Historic Preservation into Planning Documents
- Revisit Floodplain Regulations and Ordinances
- Coordinate Regionally and with the State
- Structural Adaptation Measures
- Educate

Subsequently, a best practice guide for planning techniques to make historic resources more resilient was distributed in September 2017.

Summary

Municipal capabilities to mitigate coastal flood damage have increased slightly since the 2017 edition of the hazard mitigation plan was adopted. This is because the City updated its POCD and continues to invest in flooding infrastructure.

4.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk of coastal flooding within the City. This flooding can be the result of astronomical high tides, hurricanes, nor'easters, or storm surge. Coastal flooding can impact

² <https://tnc.app.box.com/s/8nne60yjk2g3m1mgzkfa86rndxyjiawf>

many roads and neighborhoods, potentially cause severe damage, and impede transportation in the City. Refer to Figure 4-3 for areas susceptible to storm surge from hurricanes.

UConn CIRCA has developed a tool to aid in understanding flood vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute to a community's flood sensitivity, exposure, adaptive capacity, and ultimately the overall flood vulnerability. The CCVI has been used as a tool to characterize flood vulnerability for the City. The distribution of flood vulnerability throughout the community can be seen in. The CCVI demonstrates that flood vulnerability in the city ranges from moderate to high. Most of the vulnerability score is due to coastal flood exposure.

Vulnerability Analysis of Areas along Coastal Waters

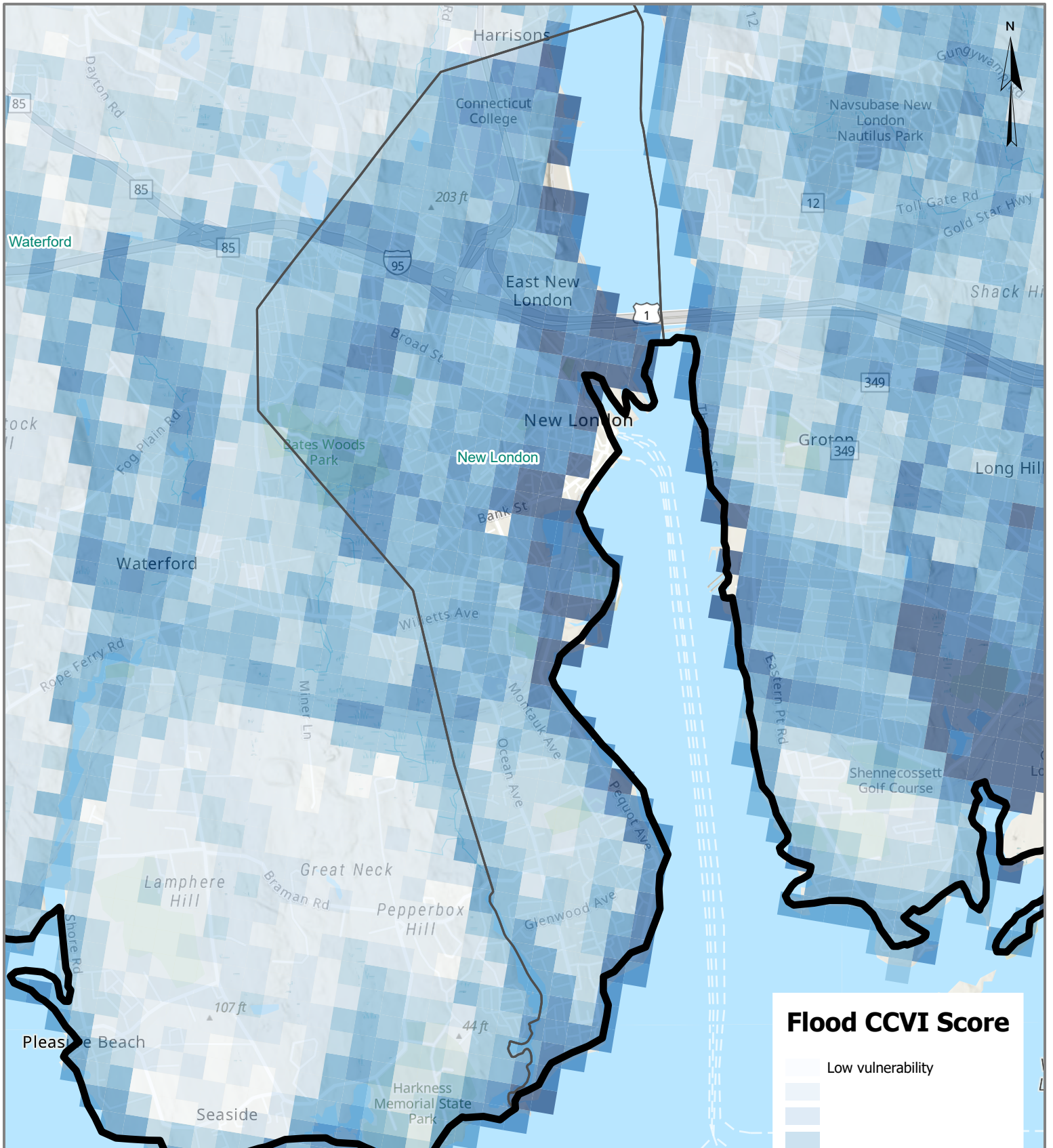
The low-lying shoreline areas of the city are subject to periodic flooding. Tidally influenced flooding also occurs along lower Fenger Brook/Alewife Cove and the Thames River. FEMA has defined 1% annual chance and 0.2% annual chance floodplains associated with coastal flooding, as well as 1% annual chance floodplains with wave velocity for the City.

Stuart Avenue near the Ocean Beach parking lot experiences frequent flooding. City personnel report that alternatives to reduce the contributing watershed and help alleviate flooding from rainfall have been implemented but flooding from tidal waters is expected to continue to occur in this area. The other specific areas discussed in Section 3.3.1 have varying connectivity to tidal and coastal flooding, although the low elevations certainly imply at least indirect connections to coastal flooding.

Areas of potential flooding of roads that border the Thames River include Water Street, Hamilton Street, East Street, Howard Street, Smith Street, Nameaug Street, Pequot Avenue, Shaw Street, the northern side of Trumbull Street, the southern part of the City, Rockbourne Lane, Parkway South and sections of Admiral Drive. The retaining wall on Pequot Avenue has been noted as a vulnerable piece of coastal infrastructure.

Residential neighborhoods along Alewife Cove, especially in the areas of Alewife Parkway, are at risk of flooding. Roadway flooding could result in delays in emergency response. Roads near Shaw's Cove such as Hamilton Street, East Street, and Howard Street, and the Glenwood Avenue Bridge that crosses Alewife Cove are in potential flood zones which may impede emergency egress as well as emergency response.

Areas of storm surge are generally coincident with the areas of coastal flooding described above. However, the areas affected by storm surge are predicted to be more widespread than the 0.2% annual chance floodplain for Category Two hurricanes, with stronger hurricanes pushing storm surge further inland. Areas along the Thames River such as the State Pier, downtown, Shaw's Cove, and Fort Trumbull appear to be at particular risk. The neighborhoods adjacent to Osprey Beach and Ocean Beach are quite vulnerable to storm surge, as well. The timing of evacuations from the southern part of the City and downtown prior to a hurricane event are therefore very important as the majority of the roads in this area will be flooded or washed out by a major hurricane.

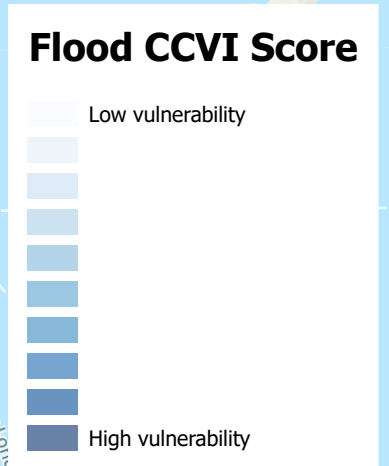
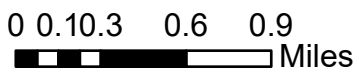


Flood CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of New London

1/17/2023



Town of Waterford, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS,

In general, it is assumed that as sea level rises, the frequency and magnitude of coastal flooding in the City will increase, with structures and roadways closest to existing sea level being affected more quickly. In addition, tidal marsh areas along Alewife Cove will either migrate inland or be eroded by constant inundation.

Green Harbor Beach has been specifically noted as vulnerable to coastal flooding and is often inundated during high tide.

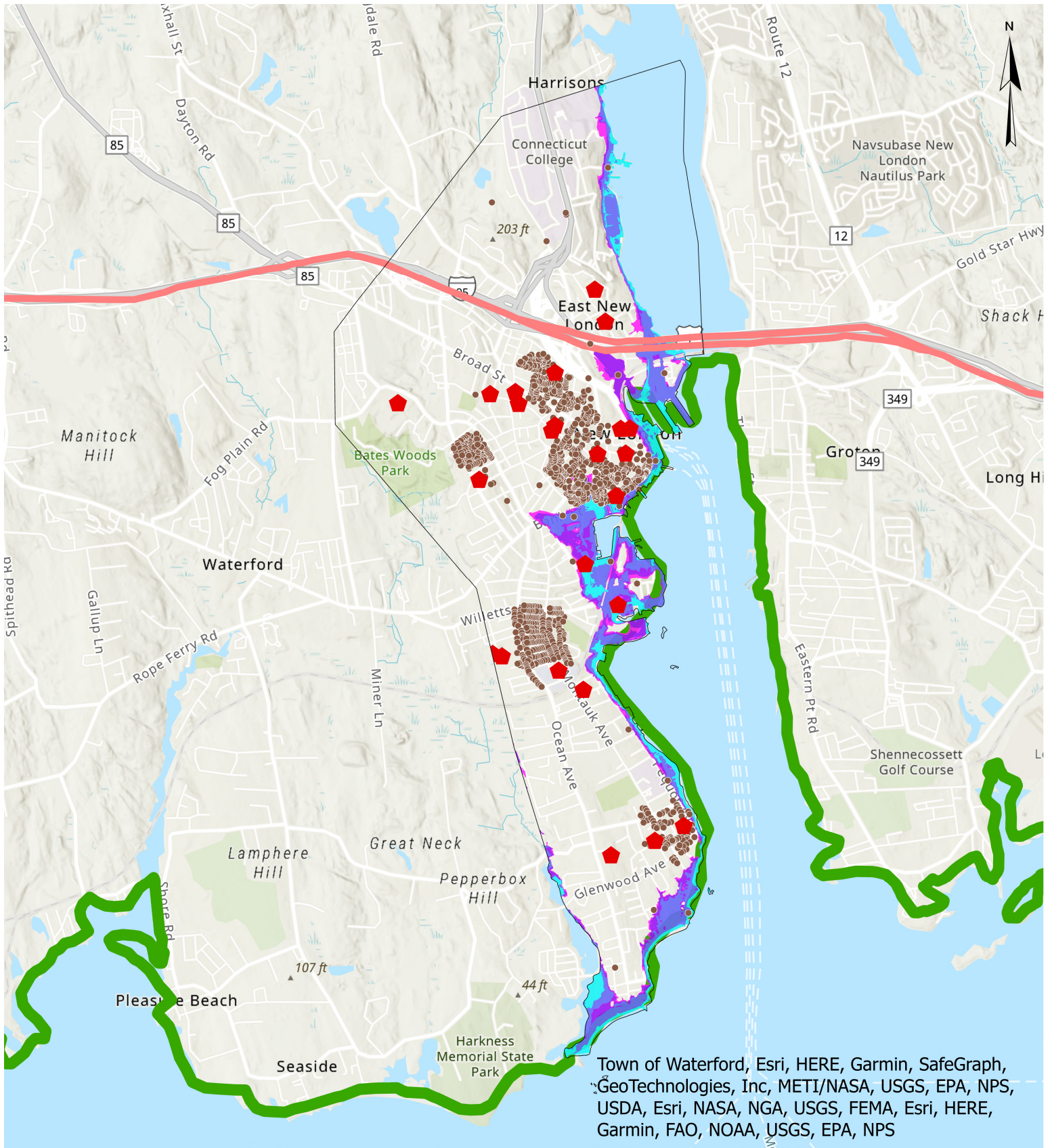
Vulnerability Analysis of Private Properties

The coastal areas of the City of New London include properties that are inhabited year-round. This intensifies risk to life and property in coastal areas. Beachfront properties are very susceptible to damage, not only as a result of flooding but also due to the velocity zones located along the City of New London's shoreline. Although shoreline erosion is a relatively minor concern for private property owners at this point in time since most have seawalls or rocky shorefront protecting their structures, flooding and wave action remain concerns.

A review of the DFIRM for the City shows that 155 properties are located in coastal AE zones and 43 are located in VE zones. Buildings located in flood hazard areas are primarily residential but also include some commercial, industrial, and critical facility structures. Location in the velocity zone poses an increased threat to structures due to high wind and potential wave damage, as well as inundation by flood waters. Properties located more inland or behind protective seawalls are only subject to coastal flooding without wave action

As noted in Section 2.7, 17 repetitive loss properties are located in New London, which represents an increase from the 16 in 2017. Most are believed to be influenced, to some degree, by coastal flooding. Either direct flooding of coastal waters can occur, or tidal influences can cause drainage systems to fail.

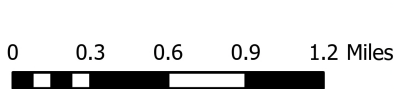
The City of New London has no formalized program currently in place to identify the location or the number of structures that are susceptible to flooding. Such information would be valuable in directing hazard mitigation efforts to locations with the greatest risk. City planners should use the DFIRM to identify the 148 structures in the City that are located in the 1% annual chance floodplain (with or without wave velocity). This could provide a list of areas to inspect following a storm event and allow for the City to track building permits from repairs following a natural hazard. This information, in turn, would provide supporting data for future grant applications.



Hurricane Storm Surge Inundation

SCCOG Hazard Mitigation and Climate Adaptation Plan
City of New London

Date: 3/6/2023



Legend

- Historic Resources
- ⬠ Critical Facilities

Hurricane Category

- 1
- 2
- 3
- 4

Vulnerability Analysis of Critical Facilities

The only critical facilities located within coastal flood zones are the WPCF and the Fire Department headquarters. Critical facilities in the City do not normally experience flooding, although it is possible even with the Fire Department protected by the levee system. Municipal staff are also concerned about flooding of the Police Department Headquarters at the eastern end of Governor Winthrop Boulevard, and coastal wastewater pumping stations. The risk of flooding to critical facilities is considered to be moderate.

In the long term, the City desires a new Fire Headquarters that is located in a more flood-resilient location. SCCOG completed an assessment of critical facilities in the region in 2017, fulfilling an action listed in the 2012 edition of the multi-jurisdiction hazard mitigation plan. The Fire Headquarters was addressed in this study. The assessment determined that the City should undertake stormwater improvements and backflow prevention in the short term and pursue dry floodproofing of the utility room and wet floodproofing of remaining lower areas in the long term. These recommendations are incorporated into the list of actions in Section 8 of this annex. The assessment did not recommend that the Fire Headquarters should be relocated in the short-term, but this hazard mitigation plan absolutely supports relocation of the Fire Headquarters outside the SFHA if the opportunity arises for some other reason such as the availability of land.

4.2.3.1 Hazard Losses

There are no reported losses for the City of New London related to coastal flooding. FEMA HAZUS-MH 6.0 was used to develop losses associated with coastal flooding events. Table 4-1 presents the direct and business interruption related losses for the 100-year coastal flood event. Additional HAZUS-generated loss estimates for coastal floods and downscaled flood losses based on the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document.

Table 4-1 HAZUS-MH Coastal Flood Related Economic Impacts

New London	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	\$39,310,000	\$13,910,000	\$1,160,000	\$1,170,000	\$55,550,000
Contents	\$28,760,000	\$49,080,000	\$2,760,000	\$8,940,000	\$89,540,000
Inventory	\$0	\$5,260,000	\$430,000	\$0	\$5,700,000
Subtotal	\$68,070,000	\$68,250,000	\$4,350,000	\$10,110,000	\$150,790,000
Business Interruption					
Income	\$550,000	\$69,810,000	\$140,000	\$12,920,000	\$83,420,000
Relocation	\$12,170,000	\$18,080,000	\$160,000	\$5,570,000	\$35,980,000
Rental Income	\$11,620,000	\$12,740,000	\$30,000	\$710,000	\$25,090,000
Wage	\$1,300,000	\$84,240,000	\$250,000	\$70,890,000	\$156,680,000
Subtotal	\$25,640,000	\$184,870,000	\$580,000	\$90,090,000	\$301,170,000
TOTAL	\$93,710,000	\$253,120,000	\$4,930,000	\$100,200,000	\$451,960,000

4.3. Shoreline Change

4.3.1 Setting and Recent Occurrences

Shoreline change is primarily a natural process caused by wind, waves, and currents; however it can also be attributed to human driven processes such as development, grading, and beach armoring or nourishment. As climate change impacts hazards such as severe storms, hurricanes and tropical storms, and sea level rise, shorelines have the potential to change at different rates than in decades past. As tidal ranges increase, and storm surge becomes higher and potentially more intense, these processes may become exacerbated. Rapidly changing shorelines can have an impact on coastal ecosystem (particularly those that provide natural buffers), erode natural shorelines resulting in encroaching seas onto developed land, and may alter those shorelines that have been hardened to protect development and infrastructure.

4.3.2 Existing Capabilities

As discussed in Section 2.6 and 4.2.2, the City is committed to planning for and regulating impacts from coastal hazards. While the city does not have specific regulations or policies for shoreline change, current existing regulations including site plan review process, floodplain regulations, and documents like the POCD all aim to limit and control disruptive coastal development, while simultaneously limiting damage to property in coastal areas.

4.3.3 Vulnerabilities and Risk Assessment

Coastal erosion is generally not an issue in the City of New London since the majority of the shorefront is either developed, rocky shorefronts consisting of stones and boulders, or modified bluffs and escarpments consisting of seawalls, bulkheads, or revetments. Several notable beaches are located within coastal flood zones including Ocean Beach Park, Osprey Beach, Guthrie Beach, and Green Harbor Beach. These beaches become flooded and attacked by wave velocity during storms. This is a concern for the City, as the beaches are important municipal facilities. As sea level rises, the effectiveness of erosion control structure will be undermined.

City officials have expressed concern regarding a retaining wall that was built near Alewife Cove on Highland Avenue. The retaining wall is experiencing erosion problems and city officials have shown interest in repairing this retaining wall.

4.3.3.1 Hazard Losses

There are no reported losses for the City of New London related to shoreline change. Future editions of this plan will revisit this topic.

5. Changing Precipitation

5.1. Climate Change Impacts

Across the United States, annual precipitation has increased in the past century, however, this change *is* dependent upon the region. Here in the northeast, precipitation totals and intensity are believed to have increased, and are projected to continue to increase during spring and winter months. However, climate change has also been linked to a reduction in snow cover extent, and an earlier spring melt. Winter precipitation may also change from snow to a wintry mix or rainfall due to warmer temperatures; so, while precipitation may increase it may not necessarily be an increase in snow.

Changes in precipitation can also shift the frequency and severity of droughts. As the climate warms, surface soil moisture is likely to decrease as evaporation rates rise. This decrease in soil moisture, and potentially longer periods of time between intense precipitation events, could potentially mean longer and stronger droughts.

These changes in precipitation can have various types of impacts. With an increase in intense precipitation, flooding events may become more frequent, damage to crops may occur, and spring flood trends may shift with less snow and more rain. Droughts on the other hand can also cause damage to crops, stress livestock and agricultural operations, and also reduce drinking water supplies or private wells.

5.2. Riverine and Pluvial Floods

5.2.1 Setting and Recent Occurrences

There are no notable inland flooding problems in the City due to overflow of watercourses. The primary inland flooding problem is believed to be due to the configurations and capacities of drainage systems. Such flooding occurs several times per year and is associated with heavy rainfall. Some of the event examples discussed in past HMPs include:

- March 2010 and March 2011 heavy rainfall and associated flooding.
- September 10, 2015: a strong storm brought heavy rain to the city, flooding Water Street and Bank Street.
- Heavy rain on September 2, 2013, overwhelmed the City's drainage systems. Flooding led to the closure of Eugene O'Neill and Governor Winthrop Boulevard, Water Street, Broad Street and Connecticut Avenue, Truman and Blackhall Streets, Bank and Tilley Streets, Pequot Avenue near Green Harbor Beach Park, and Garfield Avenue at Elm Street. The city activated pumps to remove water. Some buildings experienced flooding.
- A heavy downpour in March of 2014 caused flooding.
- A heavy downpour on August 13, 2014, caused flash flooding and power outages across the region.
- Thunderstorms on September 10, 2015 led to flash flooding that trapped numerous people in cars, requiring emergency rescues. The New London High School gym floor was damaged by the waters. Repair costs were estimated between \$50,000 and \$250,000.
- A heavy downpour on September 19, 2016 closed Ledyard Street and Connecticut Avenue

More recently, some heavy rainstorms caused severe damage in the region.

The September 2018 rain event caused severe flooding throughout the state, with several communities in the SCCOG region receiving FEMA funding for the event. Neighboring towns received several inches of rainfall including Lebanon with a reported 6.79 inches and Norwich with 4.85.

Hurricane Ida, which produced several inches of rain across the state, caused flooding in many SCCOG communities. Norwich Public Utilities recorded 6.34 inches of rainfall and Groton-New London Airport recorded 2.05 inches.

After a period of prolonged drought, a severe rainstorm event on September 5/6, 2022, caused flooding in some areas of the region. Lebanon experienced road closures and washouts, while Norwich Public Utilities observed 5.85 inches of rainfall. There were flood and flash flood warnings throughout the region and across the state. Neighboring Rhode Island reported 11 inches of rainfall in some communities.

5.2.2 Existing Capabilities

The City attempts to mitigate inland flood damage and flood hazards by utilizing a wide range of measures including restricting activities in floodprone areas, replacing culverts, promoting flood insurance, acquiring floodprone structures, maintaining drainage systems, through education and outreach, and by utilizing warning systems.

As noted in Section 2.6, the Zoning and Subdivision Regulations of the City of New London restrict development and require mitigation for projects constructed within the 1% annual chance floodplains as defined by FEMA. Such Special Flood Hazard Areas are delineated on the DFIRM published with the Flood Insurance Study for New London County that was released on either August 5, 2013 or July 18, 2011, depending on the location. These areas are presented on Figure 5-1. Most of the SFHAs mapped by FEMA in the City of New London do not appear to be associated with a watercourse and thus are more closely related to coastal flooding (Section 4.2). Bates Woods Brook and Fenger Brook are the only exceptions.

As noted in Section 2.6, New London requires two feet of freeboard for renovation or new construction in all AE and VE zones.

The city has also increased its stringency with development projects and stormwater. Proposed projects, particularly some large apartment developments in recent years, are to include stormwater retention and detention systems. The apartment projects notably included engineered detention systems to help with stormwater control.

Public Works cleans and inspects catch basins and culverts at least annually or more often if problems are noted. When inland flooding occurs, the Public Works department and the Fire Department handle the complaints depending on the location.

Previously, Stuart Avenue near the Ocean Beach parking lot, as well as Parkway South, have experienced frequent storm flooding. Drainage studies commissioned by the City in March 2008 and January 2008, respectively, characterized the problems and developed potential solutions. Three alternatives were developed for the Stuart Avenue property, which previously relied on catch basins and an outfall across Ocean Beach property to Alewife Cove. Several other alternatives were evaluated for the Parkway South property, such as modifying the drainage system, reducing the watershed to the system, and

reducing the potential for water to overflow from the system to the property. New London officials report that appropriate alternatives as recommended in both the Stuart Avenue and Parkway South studies have been implemented.

The Shaw's Cove Hurricane Protection System is one of the cornerstones of New London's structural flood mitigation activities. The 2007 POCD described the system as follows:

"As a means to protect all areas in the Shaw's Cove urban renewal area from high tides caused by coastal storms and hurricanes and from interior flooding caused by Truman Brook, a barrier system running from Howard Street to Bank Street along the shoreline of Shaw's Cove was constructed in conjunction with the Army Corps of Engineers and the Federal Railroad Administration. In addition, a 96" diameter pressure conduit was constructed to carry the Truman Brook and a pumping station was constructed to handle this drainage system during storm events. This work also included the construction of a new docking facility for unloading oil tankers, an abutment for a new railroad swing bridge, the reconstruction of the Bank Street Connector, the Coast Guard dock frontage road/crossing and the end of Sparyard Street. This construction was divided into six phases the first of which was initiated in August of 1978 and the last of which was not completed until May of 1986."

The barrier consists of 715 feet of earth dike and 800 feet of concrete flood wall situated along Shaw's Cove and New London Harbor. New London officials indicate that the Shaw's Cove pumping system is routinely utilized to pump stormwater during heavy rainfall. Modifications to this system may be possible to increase the City's ability to pump stormwater from behind the barrier and thus further reduce the flood hazards in the downtown area. Although improvements are desired and federal funds would be helpful to achieve improvements, the City has not dedicated its share (the 25% match) at the present time.

Since the 2012 HMP, the City has participated in the acquisition of a regional sand bag machine, allowing for rapid filling and deployment of flood-protection sandbags prior to a predicted event. The City has a plan and procedure for stockpiling and deploying sandbags.

New London has the capability to implement roadway-specific warning systems to alert motorists about dangerous or flooded roads.

In 2020, the City spent upwards of \$1 million to replace the pumps associated with the downtown flood protection system. This system has reportedly improved efficacy from 20% to 90%. There were no issues with stormwater flooding during the storms of 2021. The city attributes this to the upgraded system.

The city has also completed a drainage project to reduce flooding from a nearly 60-acre watershed near the Lawrence and Memorial hospital. The drainage project, located near the Lawrence and Memorial Hospital, has drastically alleviated flooding near the hospital, as well as along the Amtrak rail line and along Pequot Avenue. The city estimates the project to have cost roughly \$5 million.

Education and Outreach

New London promotes education and awareness about flood hazards and mitigation measures. The importance and availability of flood insurance is incorporated into all hazard-related public education workshops, and FEMA-provided flood insurance brochures are available at municipal buildings and the City website. Residents are encouraged to purchase flood insurance if they are in a SFHA, and to submit

insurance claims following damage events. City personnel are able to provide technical assistance to property owners regarding flood proofing techniques.

Summary

In general, municipal capabilities to mitigate flood damage have increased since the 2017 edition of the hazard mitigation plan was adopted. This is likely because the City continues to plan for and invests in flood mitigation efforts. City personnel have participated in events of the Connecticut Association of Flood Managers in recent years, and should continue to do so when time allows.

5.2.3 Vulnerabilities and Risk Assessment

This section discusses specific areas at risk of inland flooding within the City. Areas at risk from coastal flooding are discussed in Section 4.2 of this annex. Inland flooding due to poor drainage is the most common type of non-coastal flooding experienced by the City.

The CIRCA CCVI, discussed in Section 4.2.3

Vulnerability Analysis of Areas along Watercourses

Areas of potential flooding of roads and structures that border the Thames River include Water Street, Hamilton Street, East Street, Howard Street, Smith Street, Nameaug Street, Pequot Avenue, Shaw Street, the northern side of Trumbull Street, the southern part of the City, Rockbourne Lane, Parkway South and sections of Admiral Drive. Additionally, residential neighborhoods along Alewife Cove, especially in the areas of Alewife Parkway, are at risk of flooding.

Roadway flooding could result in delays in emergency response. Roads near Shaw's Cove such as Hamilton Street, East Street, and Howard Street, and the Glenwood Avenue Bridge that crosses Alewife Cove are in potential flood zones which may impede emergency egress as well as emergency response.

In addition to the areas studied by the City and described above, several other notable areas of flooding have been problematic in recent years:

- Pequot Avenue experiences flooding along many sections of its length, including the section near Parkway South referenced above. The road lies at a very low elevation.
- Green Harbor Beach experiences flooding at Pequot Avenue. Water flows down the hill and over the road and cannot drain into the sound. Frequent removal of sand from the road is necessary.
- Bank Street flooding in the downtown is believed to be caused by poor drainage, a result of both limited drainage system capacity and a lack of maintenance for many years.

Vulnerability Analysis of Private Properties

In terms of inland flooding, numerous structures are regularly affected in the City due to drainage problems. Many of these are not located in special flood hazard areas, and those located in flood hazard areas are typically in the coastal flood zones. Thus, it is not possible to tally the number of private properties affected by inland flooding through a review of the DFIRM for the City (155 properties are located in the AE zone and 43 are located in the VE zone). However, the City understands that

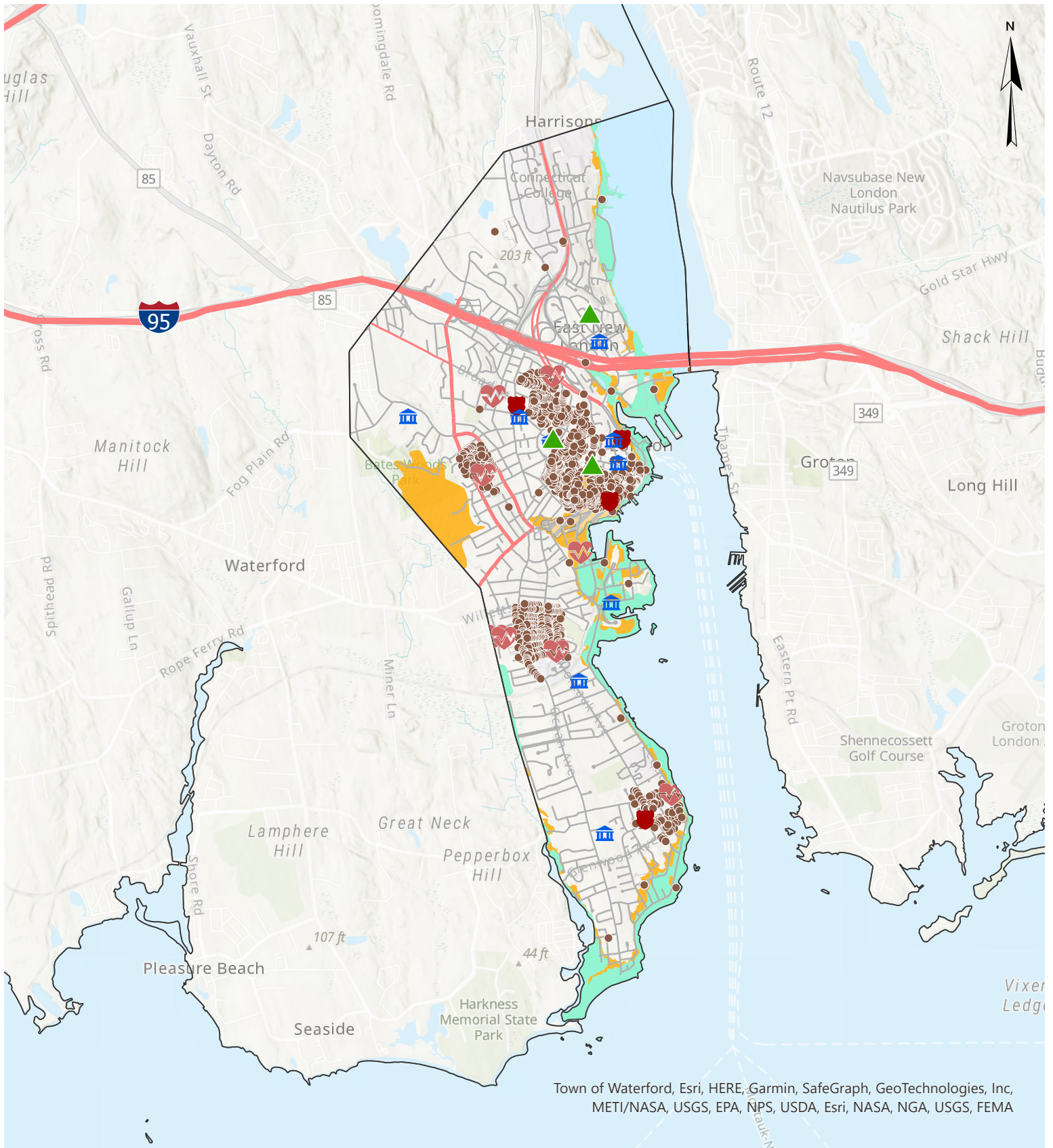
properties located along the roads listed above are most vulnerable to drainage-related flooding. In particular, properties in the Stuart Avenue, Parkway South, and Pequot Avenue areas are floodprone.

The City had 16 repetitive loss properties in 2017 and currently has 17. They appear to suffer flooding from different causes. Some of them are flooded as a result of poor drainage, others are flooded by coastal floods, and some are vulnerable to a combination of the two. Flooding at some of the properties (located on Pequot Avenue) has been studied as noted above. The increase in RL properties is likely due to a claim made during recent tropical storm events.

Three repetitive loss properties reportedly wished to pursue HMGP funds for structure elevations when the 2012 edition of this plan was developed. These are located on Lower Boulevard, Pequot Avenue, and Rockbourne Lane. However, it is not certain that the City can support the local match at the present time.

Vulnerability Analysis of Critical Facilities

As noted in Section 2.6, the only critical facilities located within flood zones are the water pollution control facility and the Fire Department headquarters. Refer to Section 4.2.3, as these are affected by coastal flooding.



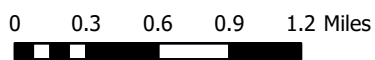
Town of Waterford, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

Critical Facilities and Historic Resources with Flood Zones

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of New London

Date: 8/1/2022



Legend

- Historic Resources
- Emergency Services
- Municipal
- Shelter or Cooling Center
- Care and Medical Facility
- 1% Annual Chance Flood Hazard Area
- .2% Annual Chance Flood Hazard Area
- Area with Reduced Risk Due to Levee

5.2.3.1 Hazard Losses

According to NFIP statistics, as of June 30, 2022, the City of New London had a total of 179 flood related losses, with a total of \$2,395,398 paid towards the claims.

Since 2017 there have also been five NOAA reported flash flood events, all having occurred on three dates. On September 12, 2018 a flash flood event resulted in flooding of the Octane Café on Tilley and Bank Street, and several roads were closed including Broad at Ledyard Street, Bank Street between Howard and Tilley Street, Bank Street at Truman Street Pequot Avenue at Green Harbor Beach, and Garfield Avenue at Elm Street.

On July 22, 2019, a vehicle was stranded on Water Street, and Bank Street was closed at Tilley street near the firehouse from flooding.

On October 16, 2019, a flash flood event resulted in flooding on Bank Street with the road becoming impassable and reports of a foot of running water in some areas. There were no reported economic damages for this, and the other flash flood events since 2012.

FEMA HAZUS-MH 6.0 was used to develop losses associated with the 100-year riverine flood event. Table 5-1 presents flood related damages for the City of New London. Additional HAZUS-generated losses for the city and region can be found in the Multi-Jurisdictional document.

Table 5-1 HAUZS-MH Riverine Flood Related Economic Impacts

New London	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	\$39,310,000	\$13,910,000	\$1,160,000	\$1,170,000	\$55,550,000
Contents	\$28,760,000	\$49,080,000	\$2,760,000	\$8,940,000	\$89,540,000
Inventory	\$0	\$5,260,000	\$430,000	\$0	\$5,690,000
Subtotal	\$68,070,000	\$68,250,000	\$4,350,000	\$10,110,000	\$150,780,000
Business Interruption					
Income	\$550,000	\$69,810,000	\$140,000	\$12,920,000	\$83,420,000
Relocation	\$12,170,000	\$18,080,000	\$160,000	\$5,570,000	\$35,980,000
Rental Income	\$11,620,000	\$12,740,000	\$30,000	\$710,000	\$25,100,000
Wage	\$1,300,000	\$84,240,000	\$250,000	\$70,890,000	\$156,680,000
Subtotal	\$25,640,000	\$184,870,000	\$580,000	\$90,090,000	\$301,180,000
Total	\$93,710,000	\$253,120,000	\$4,930,000	\$100,200,000	\$451,960,000

5.3. Drought

5.3.1 Setting and Recent Occurrences

A drought can occur during any season when there is a long, abnormally dry period of time. These events are naturally occurring during periods of limited precipitation. The effects of drought may vary throughout the city, with some being impacted more than others.

In recent years, droughts have become flashier and more frequent throughout the region. During recent events, there have been reports in the region of wells going dry on residential and farming properties. Some of the more severe and impactful events include:

- **2016** – A statewide drought that lasted almost two years and peaked in 2016, resulted in water conservation efforts throughout the southeastern part of the region, elevated fire risks in some areas, and was noted as the 11th driest spring on record.
- **2020** – From June to December, New London County experienced a moderate to severe drought, with the county being declared a Stage 3 by the Connecticut Interagency Drought Work Group.
- **2022** – During the development of this plan, the region was in an ongoing drought, with severe drought conditions in August 2022. New London County was declared a Stage 3 drought emergency on August 18, 2022.

5.3.2 Existing Capabilities

The City of New London, like many communities, does not have specific regulations geared toward drought mitigation. One of the main purposes of the City’s zoning regulations is however to facilitate the adequate provision of water throughout the city, encourage the most appropriate use of the land, and to protect subsurface water supplies

The U.S. Drought Monitor is a national resource that many state and local entities use to monitor regional conditions in relation to drought development. The weekly reporting issued by the partnership includes a drought intensity scale which includes five stages from “abnormally dry” to “exceptional drought”. While this resource is available to the City for determining drought conditions, the Connecticut Interagency Drought Workgroup (IDW) uses this and other resources to monitor drought conditions specifically for the state. The City has this IDW and state-specific drought emergency declarations as a resource to prepare for, and respond to, droughts.

5.3.3 Vulnerabilities and Risk Assessment

The entire City of New London is vulnerable to drought, but the degree of vulnerability varies. Given that a majority of the city is served by a public drinking water utility, drinking water supply challenges during a time of drought are likely to be minimal. However, this also means much of the city is likely to encounter voluntary or mandatory water conservations measures during an event in order for the utility’s water supply to sustain during extended droughts.

In addition, with most urban communities that rely on agricultural communities for fresh produce, the cascading impacts of a drought may result in reduced availability of locally grown produce, or rising prices due to crop loss or lower yields.

5.3.3.1 Hazard Losses

There have been no reported drought losses for the City of New London. Downscaled drought losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi Jurisdiction document.

5.4. Dam Failure

5.4.1 Setting and Recent Occurrences

Dam failures can be triggered suddenly with little or no warning and often in connection with natural disasters such as floods and earthquakes. Dam failures can occur during flooding when the dam breaks under the additional force of floodwaters. In addition, a dam failure can cause a chain reaction where the sudden release of floodwaters causes the next dam downstream to fail. While flooding from a dam failure generally has a limited geographic extent, the effects are potentially catastrophic depending on the downstream population. A dam failure affecting the City of New London is considered a possible event each year although the damage would likely be minimal. No dam failures have affected the City since the time of the last HMP.

5.4.2 Existing Capabilities

Dams in the region are under the jurisdiction of Connecticut DEEP. The dam safety statutes are codified in Section 22a-401 through 22a-411 inclusive of the Connecticut General Statutes. Sections 22a-409-1 and 22a-409-2 of the Regulations of Connecticut State Agencies have been enacted, which govern the registration, classification, and inspection of dams. Dams must be registered by the owner with the DEEP according to Connecticut Public Act 83-38. Owners of high and significant hazard dams are required to maintain Emergency Action Plans (EAPs) for such dams.

Summary

In general, municipal capabilities to mitigate dam failure damage have not increased since the 2017 edition of the hazard mitigation plan was adopted. However, changes in the State's regulation of dams have increased Statewide capabilities.

5.4.3 Vulnerabilities and Risk Assessment

The Connecticut DEEP administers the Dam Safety Section and designates a classification to each state-registered dam based on its potential hazard as detailed in the regional plan. The City of New London has only three dams known to be inventoried and registered with the Connecticut DEEP (Table 5-2). These include the Connecticut College Pond Dam (Class AA), Mitchell Pond Dam (Class AA), and the class BB Perry Pond dam located on Green Swamp Brook in the northwest section of the city. The Berry Pond impoundment is adjacent to I-95. Failure of any of the three dams is not believed to be of great risk to the City.

Table 5-2 Dams Registered with DEEP in the City of New London

CT Dam#	Dam Name	Dam Class	Owner Type
9501	Perry Pond Dam	BB	Private Corporation
9502	Connecticut College Pond Dam	AA	Private
9504	Mitchell Pond Dam	AA	Private

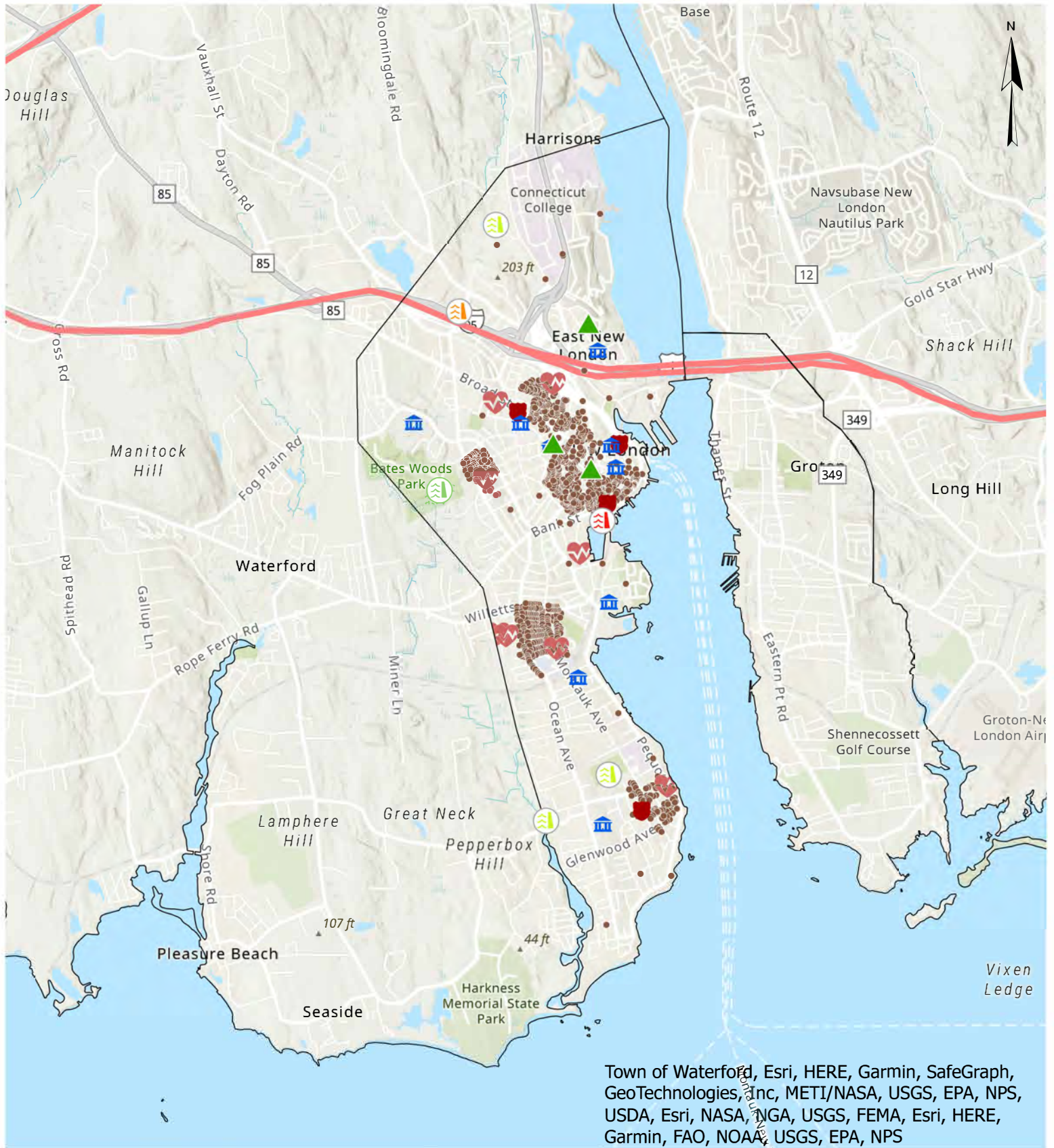
Slightly upstream of the Perry Pond dam on Green Swamp Brook is the class B Brandagee Lake Dam in Waterford. This dam is of a higher hazard class and is somewhat of a concern to the City of New

London, as its failure would overwhelm Perry Pond and flood the commercial corridor along I-95 and then neighborhoods downtown.

While dams upstream in the Thames River basin on the Shetucket and Quinebaug Rivers could potentially cause a rise in water levels in the Thames River if they failed, their failure is expected to have a minimal effect on the City of New London due to the distance involved and the significant ability of Long Island Sound and the Thames River to absorb flood waters.

5.4.3.1 Hazard Losses

There are no reported losses for the City of New London related to dam failure. Downscaled drought losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi Jurisdiction document.



Dams and Dam Failure Inundation Areas

Southeastern Connecticut Council of Governments

City of New London

Date: 2/23/2023

0 0.3 0.6 0.9 1.2 Miles



Legend

Dams

- A
- AA
- BB
- C

- Historic Resources
- Emergency Services
- Municipal
- Shelter or Cooling Center
- Care and Medical Facility

6. Rising Temperatures

6.1. Climate Change Impacts

On average, the annual temperature across the U.S. has increased by 1.8 degrees Fahrenheit when looking at the entire period of record (1895-2016). Accelerated warming patterns between 1979 and 2016 have been observed with satellite and surface data, and paleoclimate records show that some of the recent decades have been the warmest in the past 1,500 years.³

In general, periods of freeze and frost have decreased, therefore lengthening the period of time between the first winter freeze and spring thaw, since the early 1900's. These warming temperatures impact snowfall and accumulation, alter seasonal patterns, and can disrupt certain natural processes. In addition, warming temperatures can act as fuel for other natural hazards such as wildfires, droughts, hurricanes, and severe storms, and also play a role in changing precipitation patterns.

In addition to exacerbating some natural hazards, extreme heat waves are becoming more frequent, which can also have a serious impact on public health. In recent years, the region has experienced numerous heat waves, with several consecutive days of extremely hot temperatures and high heat indexes. Infrastructure can also be at risk during heat waves as some components, such as roadways or bridges, have not been designed to withstand ongoing, extreme temperatures.

6.2. Extreme Heat

6.2.1 Setting and Recent Occurrences

An extreme heat event can occur at any time during the warmer months and can be defined as temperatures that hover 10 degrees or more above the average high temperature for the region. These events typically last for a prolonged period of time and are accompanied by high humidity. A heat wave typically lasts three or more days with temperatures over 90 degrees for those days.

Since 2012, 480 days over 85 degrees have been recorded at the Norwich Public Utilities weather stations, 165 of which were over 90 degrees. During the summer of 2022, 45 days over 85 degrees were recorded, 21 of which were at least 90 degrees. A majority of these high temperature days occurred in July and August, with some of these extreme temperatures occurring outside summer months in May and October. Table 6-1 presents the daily maximum temperatures recorded at the Groton New London Airport and Norwich Public Utilities weather stations. Those values that are bold are above 90 degrees.

Table 6-1 Daily Maximum Temperatures from May to September Since 2017

	May		June		July		August		September	
	GNL	NPU	GNL	NPU	GNL	NPU	GNL	NPU	GNL	NPU
2017	85	93	89	94	88	92	87	89	86	89
2018	80	91	87	90	89	101	91	94	90	92
2019	83	85	88	91	94	96	88	91	87	84
2020	75	81	82	91	92	96	89	92	87	87
2021	88	87	86	96	86	94	88	96	82	85
2022	93	92	85	92	91	96	91	94	94	85

GNL = Groton New London station & NPU = Norwich Public Utilities station

³ <https://nca201758.globalchange.gov/chapter/2/>

6.2.2 Existing Capabilities

Similar to the monitoring methods used for hurricanes, severe storms, and winter storms, the City monitors National Weather Service and local forecasts for anticipated extreme heat event, and also monitors for NWS heat warnings and advisories. The City of New London has identified the library as the primary cooling center, and the Senior Center and Winthrop School as secondary locations. The library and senior center are both centrally located downtown making them more accessible for vulnerable populations. In the event of a projected heat event or heat wave, the City is prepared to open up the cooling centers for resident use.

The city is also continuously working with an urban forest initiative, New London Trees, to improve green space throughout New London. This grassroots initiative also works with the Connecticut Arboretum, residents, businesses, and other organizations to implement a program for sustainable urban forest management.

Summary

In general, the capabilities of mitigating extreme heat have increased since the 2017 edition of this plan as the city has identified multiple cooling centers for use during an extreme heat event, and the ongoing work with the New London Trees group.

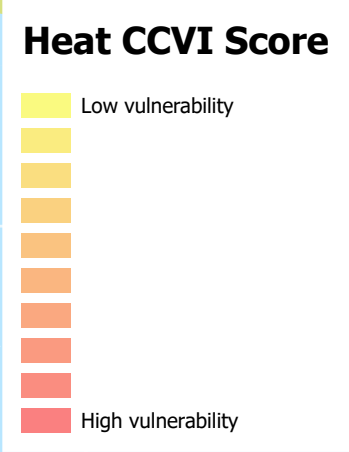
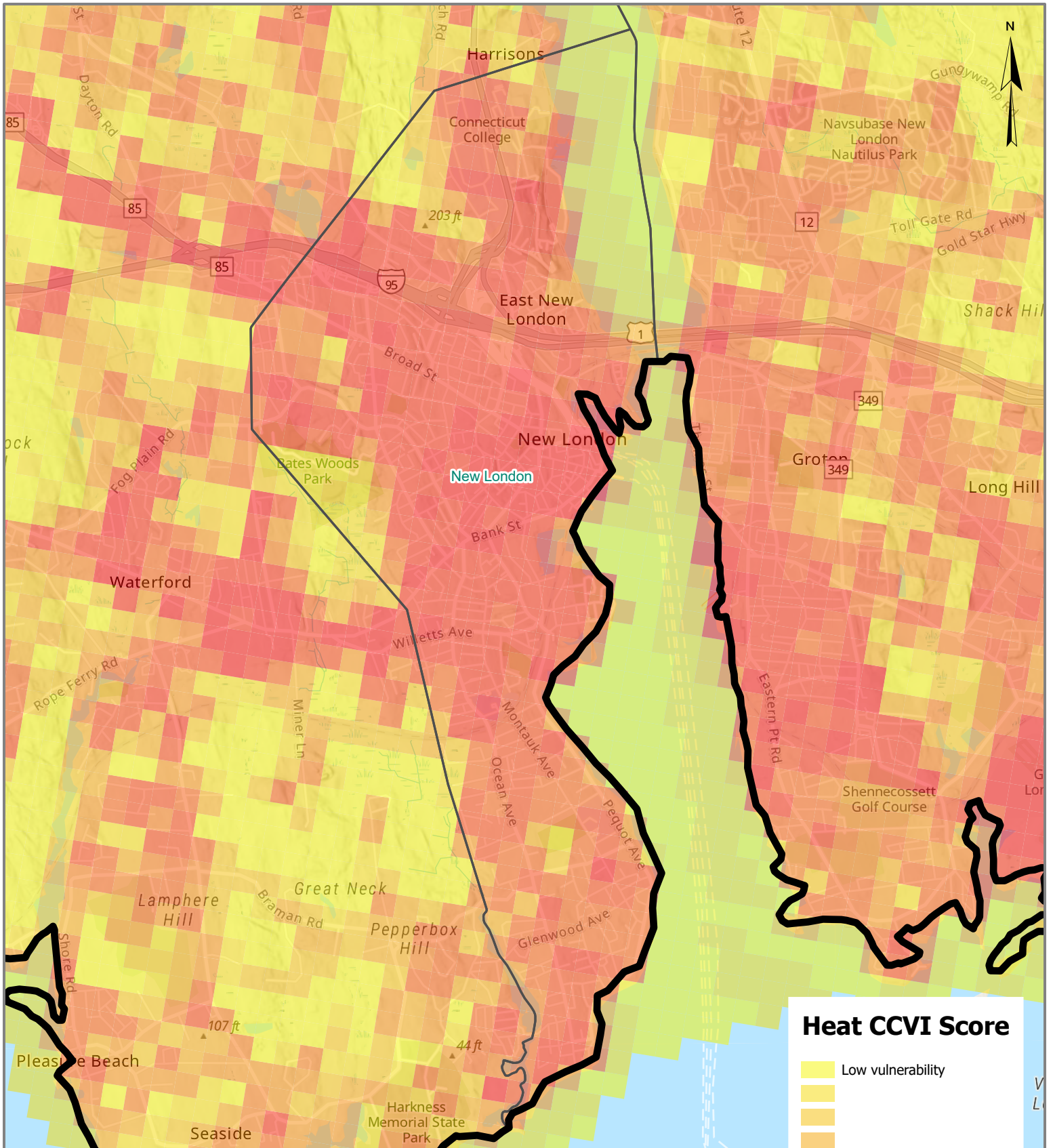
6.2.3 Vulnerabilities and Risk Assessment

While the entire city is at risk of an extreme heat event, vulnerability can widely vary based on age, health, or the type of property owned in the City. The elderly populations in New London are more vulnerable to extreme heat events, particularly when in home cooling is not available. It was noted however that while not all residents may have cooling, the library and the senior center are centrally located. Also, those in New London with certain health conditions may also be more vulnerable to the health factors associated with extreme temperatures.

Those living in the more urbanized and impervious areas of the city are at a greater risk of feeling the heat more than those with increased tree cover and green space.

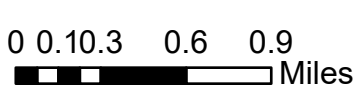
The UConn Connecticut Institute for Resilience and Climate Adaptation (CIRCA) has developed a tool to aid in understanding extreme heat vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of dozens of factors that contribute to a community's heat sensitivity, exposure, adaptive capacity, and ultimately their overall heat vulnerability. The CCVI has been used as an additional tool to characterize heat vulnerability for New London. The distribution of heat vulnerability throughout the community can be seen in Figure 6-1.

As a developed community with significant impervious surfaces and relatively high social vulnerabilities, New London has relatively high heat exposure and sensitivity. However, with ample access to open water for recreation in the southern part of the City and three cooling centers in the northern part of the City, adaptive capacity is relatively robust. Therefore, the overall heat vulnerability for New London is moderate-high to high, depending on the location.



Heat CCVI Score

SCCOG Hazard Mitigation and Climate Adaptation Plan
 City of New London
 12/9/2022



Town of Waterford, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS,

6.2.3.1 Hazard Losses

There are no reported losses for the City of New London related to extreme temperatures. Future editions of this plan will revisit this topic.

6.3. Wildfires

6.3.1 Setting and Recent Occurrences

Wildfires are considered to be highly destructive, uncontrollable fires. The most common causes of wildfires are arson, lightning strikes, and fires started from downed trees hitting electrical lines. Thus, wildfires have the potential to occur anywhere and at any time in both undeveloped and lightly developed areas of the City. Structural fires in higher density areas of the City are not directly addressed herein. No wildfires have occurred in the City since the last HMP.

6.3.2 Existing Capabilities

Monitoring of potential fire conditions is an important part of mitigation. The Connecticut DEEP Forestry Division uses the rainfall data recorded by the Automated Flood Warning system to compile forest fire probability forecasts. This allows the DEEP to monitor drier areas to be prepared for forest fire conditions. The City can access this information over the internet. The City also receives "Red Flag" warnings via local media outlets.

Existing mitigation for wildland fire control is typically focused on building codes, public education, Fire Department training, and maintaining an adequate supply of equipment. The Fire Department goes to fires as quickly as possible in the City. The City's Utilities Department provides fire protection water. Fire pumps are tested and are considered to provide excellent pressure. Each hydrant is banded such that the Fire Department knows how much pressure is available. The City does not have any dry hydrants since public water service is available throughout the City.

The Connecticut DEEP has recently changed its Open Burning Program. It now requires individuals to be nominated and designated by the Chief Executive Officer in each municipality that allows open burning and to take an online training course and exam to become certified as an "Open Burning Official." Permit template forms were also revised that provide permit requirements so that the applicant/permittee is made aware of the requirements prior to, during, and after burn activity. The regulated activity is then overseen by the City.

Summary

In general, municipal capabilities to mitigate wildfire damage have remained consistent since the 2017 edition of the hazard mitigation plan was adopted.

6.3.3 Vulnerabilities and Risk Assessment

The risk for wildfire in the City is very low for several reasons. First, the City is mostly developed such that there are few outlying areas where a wildfire could advance undetected. As such, there have been no major fires in recent history. Secondly, all developed areas of the City have public water service provided by the Utilities Department. This public water service provides sufficient water volume and pressure to fight nearly any fire. Third, the Thames River and Fishers Island Sound are nearby if additional firefighting water was necessary. Fourth, there are few notable dead ends or one-way roads

that are difficult to access in the City. Thus, if a wildfire did occur, it would likely be contained within only a few acres. Bates Woods Park and Connecticut College are the only areas in the city with forestland that would be susceptible to wildfires. The city responds to fires at Connecticut College.

6.3.3.1 Hazard Losses

There are no reported losses for the City of New London related to wildfires. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan using WUI acreage are developed in the Multi-Jurisdictional document.

7. Earthquakes

7.1. Climate Change Impacts

Earthquakes are not a climate related hazard, therefore there are no expected impacts as a result of climate change. There are however secondary impacts that could be a concern and amplify the damages of an earthquake. The deterioration of infrastructure from extreme heat or salt water as a result of coastal flooding or sea level rise may weaken certain components making them more prone to damage or collapse during an earthquake event. Flooding events can also leave some landscapes at a higher risk of landslides; an earthquake could potentially prompt a landslide in post-flooded areas.

7.2. Earthquakes

7.2.1 Setting and Recent Occurrences

An earthquake is a sudden rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth's surface. Earthquakes can cause buildings and bridges to collapse; disrupt gas, electric, and telephone lines; and often cause landslides, flash floods, fires, avalanches, and tsunamis. Earthquakes can occur at any time and often without warning. Detailed descriptions of earthquakes, scales, and effects can be found in Section 3.3.5 of the Multi-Jurisdictional HMCAP. Despite the low probability of an earthquake occurrence, earthquake damage presents a potentially catastrophic hazard to the City. However, it is very unlikely that the City would be at the epicenter of such a damaging earthquake. No major earthquakes have affected the City since the last HMP.

7.2.2 Existing Capabilities

The Connecticut Building Codes include design criteria for buildings specific to each region as adopted by Building Officials and Code Administrators (BOCA). These include the seismic coefficients for building design in the City. The City has adopted these codes for new construction, and they are enforced by the Zoning and Building Department.

Due to the infrequent nature of damaging earthquakes, City land use policies do not directly address earthquake hazards. However, the potential for an earthquake and emergency response procedures is addressed in the City's EOP.

In general, municipal capabilities to mitigate earthquake damage have not increased since the 2012 edition of the hazard mitigation plan was adopted. This is because the hazard continues to pose a low risk of damage to the City.

7.2.3 Vulnerabilities and Risk Assessment

No fault lines exist within or near the City of New London. Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known active faults. In addition, bedrock in Connecticut and New England in general is typically formed from relatively hard metamorphic rock that is highly capable of transmitting seismic energy over great distances. For example, the relatively strong earthquake that occurred recently in Virginia was felt in Connecticut because the energy was transmitted over a great distance through such hard bedrock.

Surficial earth materials behave differently in response to seismic activity. Unconsolidated materials such as sand and artificial fill can amplify the shaking associated with an earthquake. As noted in

Section 2.1, several areas of the City are underlain by stratified drift and fill material, including portions of the downtown area, Fort Trumbull, and the State Pier. These areas are potentially more at risk of earthquake damage than the areas of the City underlain by glacial till. The likelihood of soil subsidence and liquefaction is relatively higher in areas of fill. The best mitigation for future development in areas of sandy material is the application of the most stringent standards in the Connecticut Building Code, exceeding the building code requirements, or, if the City deems necessary, the possible prohibition of new construction.

The built environment in the City primarily includes older construction that is not seismically designed. Thus, it is believed that most buildings would be at least moderately damaged by a significant earthquake. Those City residents who live or work in older, non-reinforced masonry buildings are at the highest risk for experiencing earthquake damage.

Areas of steep slopes can collapse during an earthquake, creating landslides. Fortunately, the City has relatively limited areas of steep slopes and the majority of developed areas have been reinforced. Thus, landslides are not a concern in the City.

Seismic activity can also break utility lines such as water mains, gas mains, electric and telephone lines, and stormwater management systems. Damage to utility lines can lead to fires, especially in electric and gas mains. Dam failure can also pose a significant threat to developed areas during an earthquake. For this HMP, dam failure has been addressed separately in Section 10.0. Several types of utility infrastructure in the City are located above ground. A quick and coordinated response by the City's Utilities Department will be necessary to inspect damaged water and sewer utilities following an earthquake, to isolate damaged areas, and to bring backup systems online. This is covered in the City's EOP.

A *HAZUS-MH* analysis of the potential economic and societal impacts to the SCCOG region from earthquake damage is detailed in the Multi-Jurisdictional HMP. The analysis addresses a range of potential impacts from any earthquake scenario, estimated damage to buildings by building type, potential damage to utilities and infrastructure, predicted sheltering requirements, estimated casualties, and total estimated losses and direct economic impact that may result from various earthquake scenarios.

7.2.4 Hazard Losses

There are no reported losses for the City of New London related to earthquakes.

8. Mitigation Strategies and Actions

8.1. Status of Mitigation Strategies and Actions

A total of 19 hazard mitigation actions were developed in the previous edition of this plan. The status of each is listed below.

#	Mitigation Actions and Strategies for New London 2016 - 2021	Status	Status Details
1	Undertake stormwater improvements and install backflow prevention at the Fire Department Headquarters to reduce the frequency of poor drainage flooding during heavy or intense rain events	Complete	The City spent upwards of a \$1 million to replace the pumps associated with the downtown flood protection system, which reportedly improved the efficacy from 20% to 90%. This was completed recently (possibly in 2020) and flooding from stormwater did not occur during the storms of 2021. Additionally, the Bank Street are reportedly has fully operational pumps now.
2	Require developers to demonstrate whether detention or retention of stormwater is the best option for reducing peak flows downstream	Capability	This is a current capability. A number of large apartment developments have been constructed in recent years and have included engineered detention systems for stormwater management.
3	Compile a list of addresses of structures within the 1% annual chance floodplain and storm surge areas, and track repair costs	Remove	The previous study by Peter Miniutti/UConn/CIRCA included an analysis of properties on South Water Street and Bank Street, but a full list of structures has not been compiled. This is not believed necessary, as the City has the ability to track floodplain activity.
4	Ensure that development at Fort Trumbull is resilient to flooding, hurricane surges, and sea level rise	Capability	This is ongoing. The City is working with DEEP to develop a resiliency plan that will allow development at this site. The goal is for the state and the Army Corps of Engineers to use this site as a pilot study area for resilience planning and development.
5	Include structures within the 1% annual chance floodplain and storm surge areas within the Reverse 9-1-1 contact database	Remove	The City may have transitioned to Everbridge instead of Reverse 9-1-1; needs to be confirmed.
6	Consider an annual "Flood Fair" to familiarize the public with floodplains, flooding, flood insurance, and floodproofing	Carry Forward with Revisions	This has not occurred.
7	Visit schools and educate children about the risks of flooding and how to prepare	Carry Forward with Revisions	This has not occurred.
8	Pursue drainage improvements at Pequot Avenue near Green Harbor Beach	Complete	This is complete and functioning. Previously there was a 60-acre watershed near the hospital that would flood the Amtrak tracks as well as Pequot Avenue. This has been successfully addressed. Project cost ended up around \$5 million (reportedly higher than planned) and was funded partially from Storm Sandy appropriations.
9	Pursue improvements to the Shaw's Cove pumping system to allow greater flood control through stormwater pumping	Complete	There is a separate Shaw's Cove pumping system that was put in place about 15-20 years ago. As far as the City staff knows, this is in-place and functioning. Follow-up with engineering is needed.

10	Upgrade stormwater collection and discharge systems to keep up with rising sea level	Carry Forward	Upgrades to meet rising sea level have not occurred. The previous study by Peter Miniutti/UConn/CIRCA is the only related analysis. The city is compliant with MS4 regulations as well.
11	Ensure that the City's wastewater treatment facility is adequately protected from coastal flooding and storm surge		Follow-up with engineering is needed.
12	Develop formalized guidance for culvert and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from http://precip.eas.cornell.edu .	Carry Forward with Revisions	The City has not formally switched over to using updated rainfall data. There are reportedly not many culverts in New London. It was recommended to use the current and revised NOAA numbers instead going forward.
13	Determine if any at-risk structures that are not yet eligible for historic designation will be eligible in the future. This may take the form of a historic resources survey.	Remove	The consultant explained that this action was a result of historic resources resiliency planning of 2016-2017, funded by SHPO using Storm Sandy appropriations. There have reportedly been no new historic designations in the city in the last few years.
14	Conduct a tabletop exercise or drill among different departments to practice coordination relative to historic resources after a severe flood event	Carry Forward	This has not occurred.
15	Conduct a one-time mailing to all properties in repetitive loss areas to inform them of options to reduce flood damage		The Building Department official is likely the floodplain manager for the city, and follow-up is needed. The city does not believe there were many RL properties with recent claims in New London.
16	Work with the State to locate NOAA weather radios in commercial buildings with large population clusters	Remove	It was explained that this action is likely outdated due to advances in notifications systems, smartphones, and social media.
17	Consider surveying all City-owned buildings to determine their ability to withstand wind loading	Carry Forward	This has not occurred.
18	Consider an annual "Wind Fair" to familiarize the public with wind hazards and potential mitigation measures	Carry Forward	This has not occurred.
19	Visit schools and educate children about the risks of wind events and how to prepare for them	Carry Forward	This has not occurred.

During the planning process, CIRCA and consultant staff facilitated a discussion with the Town staff to identify the greatest climate change concerns and challenges. The previous actions were re-evaluated in this context. Elements of eight prior actions have been carried forward into the new hazard mitigation and climate adaptation actions.

8.2. Prioritization of Specific Actions

The proposed actions for the City of New London to undertake from 2023 through 2028 are listed in Table 8-1 on the next page. The full list of actions for the region with buildups for the PERSISTS and STAPLEE scores are available in the multi-jurisdiction document.

The actions with the highest PERSISTS score and the highest STAPLEE score are different, which is consistent with the intent of the two scores. PERSISTS scores tend to be higher for actions that maximize

public safety while advancing climate science and being transferable to other communities, whereas STAPLEE scores tend to be higher for actions that are highly cost effective and technically feasible for reducing losses from hazards. The actions with the highest combined scores are:

- Develop formalized guidance for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15.
- Upgrade stormwater collection and discharge systems to keep up with rising sea level, using the CIRCA planning figures as a reference.
- Ensure that development at Fort Trumbull is resilient to flooding, storm surges, and sea level rise; coordinate with CT DEEP to develop a site specific resilience plan if needed.
- Undertake an engineering study to identify flood risk reduction options for the two underpasses that are used to access Fort Trumbull.
- Conduct feasibility study and design to make the WWTP more resilient to storm surge and sea level rise.
- Conduct feasibility study and designs to make sewer pumping stations more resilient to storm surge and sea level rise.

The City intends to focus on the above actions, along with the following two actions about cooling centers:

- Ensure that the cooling centers (library, senior center, and Winthrop school) are accessible using transit or alternate transportation options.
- Ensure that the new Community Center at Fort Trumbull has satellite sheltering and/or cooling center uses for the greater Fort Trumbull community.

This is consistent with the State's emphasis on cooling center resilience.

Table 8-1 City of New London Actions and STAPLEE and PERSISTS Scores

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERSISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NL1	Ensure that the cooling centers (library, senior center, and Winthrop school) are accessible using transit or alternate transportation options.	Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.	Preparedness & Emergency Response	Office of the Chief Elected Official	\$25,000 - \$50,000	Transit District; IJJA BBFP	7/2023 - 6/2025	High	16	3	48
NL2	Consider surveying all City-owned buildings to determine their ability to withstand wind loading.	Reduce losses from other hazards that are affected by climate change.	Property Protection	Building Official	\$25,000 - \$50,000	Municipal Operating Budget	7/2023 - 6/2025	Low	19	4	76
NL3	Develop formalized guidance for stormwater infrastructure, culvert, and bridge construction and replacement that requires utilization of the most up-to-date extreme rainfall data from NOAA Atlas 14 as it is updated to become NOAA Atlas 15.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	\$0 - \$10,000	Municipal Operating Budget	7/2023 - 6/2024	High	21	12	252
NL4	Upgrade stormwater collection and discharge systems to keep up with rising sea level, using the CIRCA planning figures as a reference.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	\$100,000 - \$500,000	Stormwater Utility Revenues	7/2026 - 6/2028	Medium	21	8	168
NL5	Execute FEMA HMA BRIC grant for flood mitigation and resiliency design along the east side of Bank Street and west side of the Amtrak rail line.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Economic Development	>\$1M	FEMA HMA Scoping Study	1/2023 - 12/2024	High	20	6	120
NL6	Ensure that development at Fort Trumbull is resilient to flooding, storm surges, and sea level rise; coordinate with CT DEEP to develop a site specific resilience plan if needed.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases	Prevention	Economic Development	\$0 - \$10,000	Municipal Operating Budget	1/2023 - 12/2024	High	21	11	231

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERSISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
		frequency and severity of floods.									
NL7	Ensure that the new Community Center at Fort Trumbull has satellite sheltering and/or cooling center uses for the greater Fort Trumbull community.	Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.	Preparedness & Emergency Response	Economic Development	\$100,000 - \$500,000	FEMA HMA; Other Preparedness Grants	7/2023 - 6/2025	High	16	8	128
NL8	Undertake an engineering study to identify flood risk reduction options for the two underpasses that are used to access Fort Trumbull.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	\$50,000 - \$100,000	DEEP Climate Resilience Fund; CIRCA Resilient Connecticut	7/2023 - 6/2025	High	20	8	160
NL9	Conduct feasibility study and design to make the WWTP more resilient to storm surge and sea level rise.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Water & Wastewater Utility Projects	Water & Sewer	\$50,000 - \$100,000	CWSRF; Municipal CIP Budget	7/2026 - 6/2028	Medium	21	8	168
NL10	Pursue Briggs Brook improvements including grading, flood management, and development of a flood resilient city park. The short-term focus should be development of appropriate feasibility studies and concept designs.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Natural Resources Protection	Economic Development	>\$1M	DEEP Climate Resilience Fund; CIRCA Resilient Connecticut	7/2026 - 6/2028	Medium	20	4	80
NL11	Conduct feasibility study and designs to make sewer pumping stations more resilient to storm surge and sea level rise.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Water & Wastewater Utility Projects	Water & Sewer	\$50,000 - \$100,000	FEMA HMA; CWSRF	7/2023 - 6/2025	High	21	8	168
NL12	Determine if any at-risk structures that are not yet eligible for	Reduce flood and erosion risks by reducing	Property Protection	Land Use Staff	\$25,000 - \$50,000	SHPO	7/2025 - 6/2026	Medium	15	6	90

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERSISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
	historic designation will be eligible in the future. This may take the form of a historic resources survey.	vulnerabilities and consequences, even as climate change increases frequency and severity of floods.									
NL13	Conduct a tabletop exercise or drill among different departments to practice coordination relative to historic structures after a severe flood event.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Preparedness & Emergency Response	Emergency Management	\$0 - \$10,000	Municipal Operating Budget	7/2025 - 6/2026	Low	13	5	65
NL14	Work with CT DEEP to update the list of repetitive loss properties and ensure that errors and updates are incorporated by FEMA.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Floodplain Manager	\$0 - \$10,000	Municipal Operating Budget	7/2023 - 12/2023	High	12	6	72
NL15	Conduct direct outreach to property owners in repetitive loss areas with information about how to mitigation flood losses.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Floodplain Manager	\$0 - \$10,000	Municipal Operating Budget	1/2024 and annually during January	High	13	4	52
NL16	Distribute hazard mitigation and preparedness information at City sponsored events.	More than one goal	Preparedness & Emergency Response	Emergency Management	\$0 - \$10,000	Municipal Operating Budget	7/2023 - 6/2025	Medium	14	5	70
NL17	Require floodplain manager and land use staff to take free training at https://portal.ct.gov/DEEP/P2/Chemical-Management-and-Climate-Resilience/Chemical-Management-and-Climate-Resilience to reduce risks of spills from businesses during floods.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Education & Awareness	Land Use Staff	\$0 - \$10,000	Municipal Operating Budget	7/2023 - 12/2023	Low	14	6	84

Number	Hazard Mitigation and Climate Adaptation Actions	Hazard Mitigation and Climate Adaptation Goal	Type of Action	Responsible Department	Approx. Cost Range	Potential Funding Sources	Timeframe	Priority	PERSISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NL18	In collaboration with the Urban Tree Initiative, prioritize green space and urban tree plantings in new development projects and high heat or highly impervious areas.	Address risks associated with extreme heat events, especially as they interact with other hazards.	Natural Resources Protection	Land Use Staff	\$100,000 - \$500,000	DEEP Climate Resilience Fund; Urban Tree Initiative	7/2023 - 6/2027	Medium	16	7	112