CITY OF NORWICH 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 Norwich. 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 Norwich 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 Norwich is an urban community in the north-central region of New London County that was founded in 1659. The community has since grown to a population of 40,125 as of the 2020 census. The City is approximately 29 square miles in area and consists of several villages including Taftville, Norwichtown, Occum, Greenville, and Thamesville. The City is bordered by Bozrah to the west, Franklin to the northwest, Sprague to the north, Lisbon to the northeast, Preston to the east and southeast, and Montville to the south.

Norwich is located at the focus of several major transportation corridors. Major roads and bus lines allow access to Norwich and include Interstate 395, Route 2, Route 12, Route 32, Route 82, Route 97, Route 169, and Route 642. Rail lines that travel through the City include the Providence/Worcester line and the New England Central line. The rail lines allow residents and goods to travel from Norwich to New London and other communities throughout southeastern Connecticut and the eastern seaboard.

Major waterways include the Yantic River (which drains from Bozrah and Franklin), the Shetucket River (which drains from Sprague and forms the eastern boundary of the City), and the Thames River. The Thames River, a major navigable estuary in southeastern Connecticut, is formed by the confluence of the Yantic and Shetucket Rivers and drains to Long Island Sound.

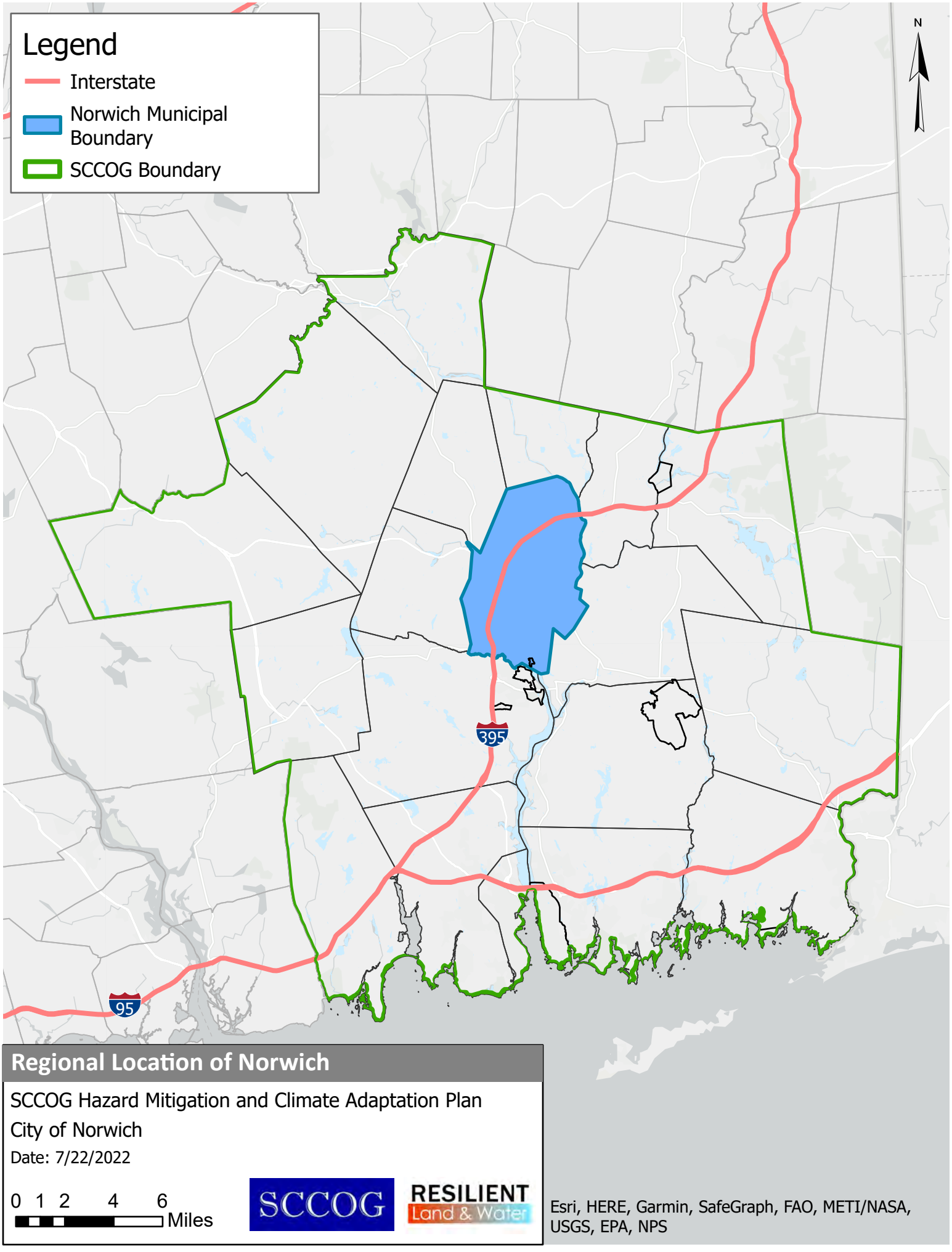
2.1. Physical Setting

The City of Norwich is located in the north-central section of the SCCOG. Elevations range from approximately mean sea level along the Thames River and Fishers Island Sound to just over 500 on Plain Hill in the northwestern section of the city. The southeastern area of the city near the confluence of the Yantic and Shetucket Rivers is the most densely developed area, while outlying areas, particularly in the northwestern portion of the city, are relatively rural. As noted in the 2002 *Plan of Conservation and Development*, many areas have rough topography, resulting in an urban community that is irregular and fragmented with a sometimes eccentric, twisting and occasionally steep street pattern.

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 Norwich.

The City of Norwich lays above five bedrock formations which trend southwest to northeast across the area. The majority of the city is underlain by the Tatnic Hill formation, while areas located to the west of Interstate 395 are underlain by the Fly Pond member of the Tatnic Hill formation, the Yantic member of the Tatnic Hill formation, the Hebron gneiss, and the Canterbury gneiss. Each of these formations consists primarily of gneiss and schist which are relatively hard metamorphic rocks.

There are three bedrock faults mapped within or near the City of Norwich boundary. The Honey Hill Fault, a thrust fault that is Devonian or Ordovician in origin, parallels the City's southern boundary with Montville. An unnamed fault runs southeast from the vicinity of Mohegan Park to intersect with the Honey Hill Fault in Preston near Happyland. A third unnamed fault runs southeast from Baltic into Preston, approximately paralleling a portion of the City's boundary with Sprague.



Regional Location of Norwich

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of Norwich

Date: 7/22/2022

The City's different surficial geologic formations include glacial till and stratified drift. Refer to the Multi-Jurisdictional HMCAP for a generalized view of surficial materials. The majority of the City is underlain by glacial till. Areas adjacent to the Shetucket River, the Yantic River, Trading Cove Brook, and Byron Brook have fairly extensive areas underlain by sand and gravel or floodplain alluvium. Till contains an unsorted mixture of clay, silt, sand, gravel, and boulders deposited by glaciers as a ground moraine. 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. However, the smaller glacial till watercourses can also cause flooding. The amount of stratified drift also has bearing on the relative intensity of earthquakes and the likelihood of soil subsidence in areas of fill.

2.2. Drainage Basins and Hydrology

The Thames River is a long tidal estuary in Connecticut. It flows south from Norwich approximately 15 miles, to New London and Groton, which flank its mouth at the Long Island Sound. All land in the city eventually drains to the Thames River, although approximately two-thirds of the City drains to the Shetucket or Yantic Rivers first. Additional sub-regional watersheds are associated with Beaver Brook (which drains to the Shetucket River in Sprague), Poquetanuck Brook (which drains to the Thames River in Montville), Trading Cove Brook (which drains to the Thames River in Norwich), and Susquetonscut Brook which drains to the Yantic River. Other notable bodies of water found throughout Norwich include Bog Meadow Reservoir, Wilcox Pond, Spaulding Pond, Eely Pond, Great Plain Brook, Ford Brook, Bobbin Mill Brook, and Goldmine Brook.

The headwater streams of the Shetucket River are heavily flood controlled such that widespread flooding is no longer an issue along this watercourse. Three significant dams are located on Shetucket River in Norwich at Occum, Taftville, and Greenville, but they do not offer any flood abatement capacities.

The Yantic River is not flood controlled, and flooding due to severe weather is a frequent issue particularly in the Yantic and Norwichtown sections of the city.

2.3. Land Cover

According to the 2016 1-meter resolution land cover developed by the NOAA Office of Coastal Management, Norwich is predominantly comprised of mixed forest, with approximately 57.13% of the city classified as such. The second largest land cover type is developed impervious, which covers about 15.52%, and next is developed open space which is about 12.43% of land cover. All land covers and their percent coverage can be found in Table 2-1.

Table 2-1 City of Norwich Land Cover

Land Cover Type (2016)	% Coverage
Barren Land	0.71
Cultivated Crops	0.74
Developed, Impervious	15.52
Developed, Open Space	12.43
Grassland/Herbaceous	2.78

Mixed Forest	57.13
Open Water	3.77
Palustrine Aquatic Bed	0.36
Palustrine Emergent Wetland	0.47
Palustrine Forested Wetland	1.82
Palustrine Scrub/Shrub Wetland	0.10
Pasture Hay	2.62
Scrub/Shrub	1.51
Unconsolidated Shore	0.05

2.4. Population, Demographics, and Development Trends

Norwich was an important colonial seaport in the 17th century and one of Connecticut's largest cities in the 18th and 19th centuries. Shipbuilding and associated industries grew in the area near the head of the Thames River, spurring the development of homes and a broad economic base. The introduction of rail lines in the 19th century further spurred industrial development particularly in the vicinity of Yantic, including textile mills. Residences were constructed to house the workers in these industries, and fine homes were built on hillsides overlooking the commercial and industrial areas. The City made a concerted effort to develop hydropower and other utilities (water, sewer) to provide service to the residents and businesses of the city. In 1904, the City purchased a commercial utility and formed Norwich Public Utilities (NPU) to provide water, sewer, natural gas, and electricity service.

The 20th century saw a decline of industry in Norwich as many larger industries moved south, the primary railroad line between Boston and New York was relocated through New London, and the nation became less reliant on shipping goods via water. As more goods began to be shipped via trucks, Norwich lost the competitive advantage of its location on the Thames. In addition, Interstate 95 bypassed Norwich such that vehicular traffic between New York and Boston also did not need to pass through the city.

According to the 2002 *Plan of Conservation and Development* for the City, 75% of the community is either developed or committed to a specific use, while 25% is considered vacant. Approximately 55% of the developed land in the city is considered residential, with 12% considered to be open space or recreation, 5% to be retail or commercial, 3% to be industrial, and the remainder to be associated with utilities, institutional, or other public use. Mohegan Park, a primarily forested area that includes hiking and biking trails, picnic areas, a beach, and playgrounds is the City's largest park. The 2002 Plan noted that over 4,000 acres of land could be developed in the city.

Today, Norwich is primarily a service center rather than an industrial hub. Casino and tourism employment is one of the top employment sectors for city residents. Commercial corridors with restaurants and shops are located along Route 32, Route 82, and other State roads in the city, as well as in downtown areas. Commercial development such as Dodd Stadium, which is home to the Connecticut Tigers Baseball team and the Norwich Municipal Ice-Skating Rink, has continued to help Norwich's economy. Dodd Stadium draws visitors from all around the southeastern Connecticut area.

Current industrial areas are located along the Yantic River, the Shetucket River, and the Thames River. The 450-acre Norwich Industrial Park has allowed many businesses to operate in Norwich including Computer Sciences Corporation, Foxwoods Resort Casino Training Center, Frito-Lay, and the Connecticut Tigers at Dodd Stadium. Other sizeable enterprises include Bob's Discount Furniture distribution center, Phelps Dodge Industries / Freeport-McMoran Copper Products, and the Mashantucket Pequot Tribal Nation's Spa at Norwich Inn.

As of the 2020 Decennial Census, the population for the city is 40,125, which equates to about 1,416 people per square mile. The 2020 American Community Survey 5-year estimates identified the annual average median income for Norwich to be $65,216, with an average of 22.6% of the population holding a bachelor's degree or higher, and an average unemployment rate of 6.4 %throughout the city.

According to the 2013 *Plan of Conservation and Development*, approximately 45% of all housing units in the City are single-family dwellings, with the remaining 55% being two-family, multi-family, apartments or condominiums. Many were built during the housing boom of the 1970's and 1980s, but most housing structures pre-date these decades and as such do not meet current or even recent building codes. As noted in previous POCDs, there is also a high percentage of housing occupied by renters in the city. This low percentage of owner occupancy can lead to increased susceptibility to natural hazards, as owners are not present on a daily basis to secure their properties.

In the time since the last HMP was written in 2017, development seems to be more focused on redeveloping former mill buildings in Norwich. Recent projects include:

- The Ponemah North Mill has been redeveloped and includes 314 units. Some portions of the mill are located in the SFHA. An additional 120 units were recently approved for the Mill.
- Chestnut Street Mill

A handful of new businesses are being constructed on Boswell Avenue. Properties in this area often experience stormwater-related floods, and therefore this development is a concern for the City. A Dollar General is being built in this area, and will utilize a large detention basin for stormwater management.

The City noted that the redevelopment of the former mills in the city is a persistent, significant challenge. Many of these properties are located in flood risk areas, and the city would like to see these blighted, underused properties redeveloped. To address this concern, the City recently submitted a proposal for technical assistance to overcome obstacles in redevelopment. As part of State of CT Covid recovery activities in October 2021, the Region 4 Statewide Recovery Steering Committee and FEMA Region 1 COVID-19 Long Term Recovery Task Force put out a solicitation for CT Long Term Recovery Project proposals. In response, the City of Norwich submitted the "Thamesville Coastal Revitalization Project" which was a request for technical assistance (not funding) for the creation of a multi-agency task force made up of Federal, State of Connecticut, U.S. Army Corps of Engineers, railroad, and other quasi-government agencies to assist it to overcome obstacles (including designated Floodway and brownfields) preventing the redevelopment of the underutilized, blighted 42+/- acre Thames River waterfront area located along Terminal Way which is within designated Opportunity and Enterprise Zones.

Overall, new development and redevelopment in Norwich is not increasing risks to natural hazards. This is primarily because redevelopment throughout the community offers significant opportunities for flood mitigation to be incorporated into buildings and for 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.

2.5. Governmental Structure

The City of Norwich is governed by a Council/Mayor/Manager government. The Mayor presides over the City Council and with the Council appoints a City Manager who serves as the chief executive officer of the City and is directly responsible for the administration of all departments, agencies, and offices. Together, the Mayor and the City Council review and approve all City business.

The City of Norwich has several departments that provide municipal services. Departments pertinent to natural hazard mitigation include the Emergency Management, Finance, Fire, Planning & Neighborhood Services, Police, Public Utilities, and Public Works Departments. In addition, there are several boards and commissions that can take an active role in hazard mitigation, including the Commission on the City Plan, Harbor Management Commission; the Board of Public Utilities Commissions; the Public Works & Capital Improvements Committee; the Public Safety Committee; the Inland Wetlands, Watercourses, and Conservation Commission; and the Zoning Board of Appeals. The general roles of most of these departments and commissions are common to most municipalities in SCCOG and were described in Section 2.8 of the Multi-Jurisdictional HMP. More specific information for the departments and commissions of the City of Norwich is noted below:

- The Board of Public Utilities Commissioners reviews and provides recommendations for expansion of public utilities such as water, sewer, and electricity and approves rate increases by NPU.
- The Commission on the City Plan is the planning authority for the City and reviews and approves new site plans. The City Council is the zoning authority of the City. The Planning & Neighborhood Services Department oversees orderly and appropriate use and development of residential, commercial, and industrial land and the conservation of natural resources. They assist the Commission on the City Plan by reviewing 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*. They administer the City's Zoning Regulations and Inland Wetlands and Watercourses Regulations, enforce building codes, perform planning studies, and provide technical assistance to developers.
- The Emergency Management Department strives to protect life and property from natural and man-made disasters through meaningful public information and education programs as well as Emergency Preparedness (planning, mitigation, response, and recovery). The department oversees emergency response in the City during natural and man-made disasters. The Emergency Management website (http://www.cityofnorwich.org – Click on "Emergency Management") provides information for residents about natural hazard preparedness, terrorism, sheltering, and joining the statewide Reverse 9-1-1- system. This department also oversees the Community Emergency Response Team (CERT) that provides support to the City's first responders and to the City's shelters.

- The Finance Department is responsible for accounting and financial reporting, budgeting, information technology, payroll, purchasing and accounts payable, and tax collection. Coordination with the Finance Department is essential to constructing successful mitigation projects.
- The City of Norwich Fire Services consists of two career (full-time) stations and five volunteer stations. The Norwich Fire Department has 59 career firefighters and administrative staff and responds to approximately 2,200 fire and emergency-related calls each year with an average response time of two minutes. The volunteer system is comprised of the Taftville, Yantic, Occum, East Great Plain, and Laurel Hill volunteer fire departments. They also participate in more than 200 prevention and public education events each year and have fire prevention tips for all seasons on their website. They provide fire suppression, fire prevention, rescue, and hazardous materials response services to the City.
- The Harbor Management Commission provides guidance for economic growth and enhanced public enjoyment of the City's tidal waterfront including the lower sections of the Shetucket and Yantic Rivers and the Thames River. It maintains the City's Harbor Management Plan and recently released a vision plan for future waterfront development, as well as assigning mooring locations.
- The Inland Wetlands, Watercourses, and Conservation Commission is the Inland Wetlands Regulatory Agency for the City of Norwich and reviews plans for compliance with said regulations and maintains the City's inland wetlands map.
- NPU provides electricity, potable water, natural gas, and sewer service to the City of Norwich and the surrounding region. They maintain and test fire hydrants utilized by the Fire Department.
- The Police Department provides preventative planning for public safety, enforcement of laws, administration of police personnel, traffic authority, and issuance and recording of permits for vendors, auctioneers, and firearms. There are 82 paid members. During a hazard event, they provide situation containment and control services.
- The Public Safety Committee reviews all public safety matters in the City and recommends expenditures to the City Council for repairing or purchasing equipment.
- The Public Works & Capital Improvement Committee reviews and recommends capital improvements in the City.
- The Public Works Department includes the Engineering and Administration Division, Streets and Parks Division, Building Maintenance Division, Fleet Maintenance Division, and daily operation of the Transfer Station. They provide services including safe, efficient and well-maintained infrastructure of roads, bridges, snow removal and deicing on roads; tree and tree limb removal in rights-of-way; and maintain and upgrades storm drainage systems to prevent flooding caused by rainfall.
- The Zoning Board of Appeals reviews projects that were denied by the City Council or were cited by the Planning & Development Department, and those that require variances.

In addition to the departments described above, the City of Norwich has several other departments similar to surrounding municipalities, including Human Resources, attorneys, etc. The roles of City departments have not changed since the time of the previous HMP. Thus, the City of Norwich 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 Norwich is

densely developed in certain areas but practically rural in outlying areas, presenting a range of 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, *A Waterfront Vision for the City of Norwich*, Zoning Regulations, and Inland Wetland Regulations. The Zoning Regulations have been updated to incorporate the latest NFIP requirements that match suggestions provided in previous HMPs.

Emergency Operations Plan

The City has an Emergency Operations Plan (EOP) that is updated by the Emergency Management Director and certified by the City Manager annually. This document provides general procedures to be instituted by the City Manager and/or designee, Emergency Management Department, 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 as noted in the Severe Weather Annex of the EOP. The EOP is directly related to providing emergency services prior to, during, and following a natural hazard event.

Plan of Conservation and Development (2013)

The Norwich POCD 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 2002 edition of the POCD predated the 2005 edition of the HMP, but it included many strategies pertinent to natural hazard mitigation. Recommendation strategies from the 2002 POCD were noted as being a high or low priority, and were as follows:

High Priority

- Identify steep slopes with additional natural resource potential, such as those associated with scenic view sheds or those within proximity to surface water bodies and prioritize them for conservation efforts.
- Continue the strict enforcement of floodplain regulations to minimize potential flood hazards and property damage during flood events.
- Continue to support linear park and trail systems along Norwich's major rivers, including a possible expansion of the Norwich Heritage Riverfront Walkway.
- Seek out additional funding for open space acquisition from Federal/State programs & encourage the private donation of open space.
- Improve public access to coastal areas and expand river walkways.
- Explore opportunities to market water service regionally while preserving capacity to meet Norwich demands.
- Continue to implement comprehensive plans to maintain and upgrade water service infrastructure.

Low Priority

- Identify rock outcrops with additional natural resource potential, such as those located atop ridgelines or those located along rivers and prioritize them for conservation efforts.
- Consider additional regulations and design standards for the development of properties with slopes greater than 15%.
- Explore means to remove existing structures from the floodplain and relocate associated residents and businesses.
- Investigate means to remove outdated industrial-age dams on the major rivers.
- Continue to regulate development within and adjacent to inland wetlands.
- Ensure the City has a system in place for periodic cleaning of storm sewers and drainage systems.
- Establish a municipal land acquisition fund to expand existing public land holdings or to purchase other significant natural areas.
- Coordinate with NPU to provide full access to all emergency surface water supplies.
- Provide leadership in developing a regional approach to the development of new water supplies and existing resources.

The Norwich POCD was most recently updated in 2013. The update includes the following new actions aligned with hazard mitigation:

- Strive to preserve natural resources such as wetlands, watercourses, steep slopes, 100 year flood zones, and NDDB identified areas.
- Protect coastal resources from the effects of seas level rise through the aid of federal programs for coastal management.

Therefore, the 2002 and 2013 editions of the Norwich POCD are considered consistent with the current goals and actions of the hazard mitigation plan. The next update to the POCD (scheduled for 2023) will continue to incorporate the elements of the hazard mitigation plan.

Harbor Management Plan

The Harbor Management Plan of the City of Norwich, as enacted under City Ordinance 1229, authorizes the Harbor Master to carry out harbor management directives and enforce all provisions of the Plan, including collecting fees for mooring permits and assigning mooring locations; standardizing mooring tackle requirements; and enforcing wake and speed, waterskiing, motor, noise, and refuse regulations. In particular, this ordinance allows the City to have a list of persons who currently have boats moored such that removal or emergency response can be coordinated. The Harbor Management Plan was updated in 2012, and was undergoing additional updates as of 2017 and is now the Waterfront Vision Plan.

Zoning Regulations

The Zoning Regulations of the City of Norwich were last updated on November 2, 2015. They include a variety of preventative regulations pertinent to mitigating natural hazards. These regulations are applied during the permitting process for new construction and during substantial improvement of existing structures.

Chapter 3.4 discusses floodplain and floodway zoning in the City. The City has adopted the FIS and FIRM released by FEMA in July 2011 and utilizes areas on the FIRM denoted as Zone A, Zone AE, and floodway as its regulatory flood hazard map. In particular:

- Chapter 3.4.3.3 notes that any structure partially located within a floodplain or is considered to be entirely within the floodplain and must comply with the more restrictive building standards.
- Chapter 3.4.4.1 authorizes the Zoning Enforcement Officer to verify the floodplain and floodway boundary using the elevations provided in the New London County FIS. Chapter 14.3.2 authorizes the Zoning Enforcement Officer to investigate floodway data from other sources for Zone A floodplains and to request flood data for watercourses not mapped by FEMA.
- Chapter 3.4.5 notes prohibited uses within the floodplain and floodway and specifies that floodway encroachments must certify that there will be no net increase in flood levels during the base flood discharge, no residential buildings will be permitted in floodways, and new construction or substantial improvements cannot be located entirely or partially over water unless the structure is a water dependent use.
- Chapter 3.4.6 assigns permitted uses within the floodplain and floodway that require a permit from the Zoning Enforcement officer and authorizes that officer to request erosion and sediment control plans and any other information necessary to comply with the Zoning Regulations.
- Chapter 3.4.7 notes uses requiring a special permit in floodplains and the floodway. Such permits are issued by the Commission on the City Plan. These include dams, paving, excavation, and new structures. In particular, all new construction or substantial improvement of residential structures, including manufactured or mobile homes, shall have the lowest floor (including the basement) elevated 1.5 feet above the base flood elevation with utilities also located to prevent water from entering or accumulating during flooding.
    - All new construction or substantial improvement of non-residential structures must also meet this requirement. Non-residential structures must also be floodproofed to 1.5 feet above the base flood elevation with walls capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.
    - This section also requires that the water holding capacity of the floodplain (except in tidally influenced areas) not be reduced and authorizes the City to require storage compensation.
    - This section currently requires that residential structures repaired as a result of substantial damage be elevated to or above the base flood elevation.
- Section 3.4.8 notes that variances may be granted by the Zoning Board of Appeals.

The City of Norwich found that this most recent 2015 update to the Zoning Regulations had inadvertently led to noncompliance with FEMA requirements. The City Council, which is Norwich's zoning authority, amended both ZR Section 3.4 and the "Flood Related Terms" in the Definitions Section. These amended regulations became effective on June 1, 2017.

Code of Ordinances

Chapter 19-23 of Norwich's Code of Ordinances presents the City's Subdivision Regulations and notes that all public utilities and facilities, such as sewer, gas, electrical, and water systems, must be located and constructed to minimize or eliminate flood damage. Chapter 19-23 also requires that applicants submit a coastal site plan if the activity is located within the Coastal Area Management Boundary of the City. The coastal site plan requirements are codified in Chapter 17.1.5. This area is located within 1,000 feet of the Thames River and the lower sections of the Yantic and Shetucket Rivers as defined by the Connecticut DEEP. It authorizes the commission to consider impacts to coastal resources from the proposed development.

Inland Wetland and Watercourses Regulations

The Inland Wetlands and Watercourses Regulations in the City of Norwich were last amended on June 1, 2010. 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 regulations by preventing fill and sedimentation that could lead to increased flood stages.

2.7. Critical Facilities, Sheltering Capacity, and Evacuation

The City of Norwich 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 presented on figures throughout this annex and summarized in Table 2-2 .

As shown on Table 2-2, only four critical facilities (the Yantic Fire Station, the water pollution control facility, Stanton Elementary School, and Occum Fire Department which is only partially in the SFHA) are located within the 1% annual chance floodplain, and no critical facilities are located within potential hurricane surge zones. These facilities are described in more detail below.

Table 2-2 City of Norwich Critical Facilities

Facility	Address or Location	Emergency Power	Shelter	Cooling Center	In SFHA
Emergency Services					
Fire Department Headquarters - Station 1	10 North Thames Street	✓			
Greeneville Fire Department - Station 2	446 North Main Street	✓			
East Great Plain Volunteer Fire Department	488 New London Turnpike	✓			
Laurel Hill Volunteer Fire Company	509 Laurel Hill Road	✓			
Occum Volunteer Fire Department	44 Taftville-Occum Road	✓			✓
Taftville Fire Company No. 2 (Volunteer)	134 Providence Street	✓			
Yantic Fire Engine Company No. 1 (Volunteer)	151 Yantic Road	✓			✓
Police Department	70 Thames Street	✓			

Emergency Management Building	10 McKinley Avenue				
Municipal Facilities					
City Hall / backup EOC / Public Works*	100 Broadway	✓			
Norwich Public Utilities / EOC	173 North Main Street	✓			
Rose City Senior Center	8 Mahan Drive	✓	✓	✓	
Public Works Headquarters	50 Clinton Avenue	✓			
Public Works - Fleet Management	Asylum Street				
Water Pollution Control Facility	Falls Avenue	✓			✓
Otis Library	261 Main Street	✓		✓	
Health Care/Senior Living					
Backus Hospital	326 Washington Street	✓			
Norwich Public Schools					
Samuel Huntington Elementary	80 West Town Street				
Thomas W. Mahan Elementary	94 Salem Turnpike				
John M. Moriarty Elementary	20 Lawler Lane	✓	✓		
John B. Stanton Elementary	386 New London Turnpike				✓
Uncas Elementary	280 Elizabeth Street Extension	✓	✓		
Veterans Memorial Elementary	80 Crouch Avenue				
Wequonnoc Elementary	155 Providence Street				
Kelly Middle	25 Mahan Drive	✓	✓		
Teachers' Memorial Middle	15 Teachers Drive	✓	✓		
Deborah Tennant-Zinewich - Special Education	30 Case Street				
Hickory Street (Special Education)	201 Hickory Street				
Alternate Public Schools					
Integrated Day Charter School	68 Thermos Avenue				
Norwich Technical High School	7 Mahan Drive				
Private Schools					
Wildwood Christian School	35 Wawecus Hill Road				
Montessori Day	218 Dudley Street				
Norwich Free Academy	305 Broadway				

* Building & Maintenance

Fire Departments

The City has seven fire stations; five are volunteer companies while two house career fire fighters. Many of the fire stations are historic. In particular, the Yantic Fire Engine Company No. 1 was established in 1847, and the Greeneville Fire Station was established in 1896. These buildings have been recently renovated and the City is continuing to explore ways to mitigate flooding in the vicinity of the Yantic Fire Engine Company. The seven fire departments provide excellent fire and rescue response to the City, and have pump trucks, brush trucks, and boats to provide fire response and rescue services.

The City believes that the Yantic Fire Station could be well-qualified for a grant that would fund relocation of that Fire Department. The building is historic, limiting on-site mitigation options. The City will continue to explore possible actions to address the vulnerability of this facility.

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. Two fire stations (Yantic and Occum) and

the Norwich Public Works facility were included in the assessment. The assessment determined that all three faced current flood risks and would experience increasing flood risks. Recommendations are incorporated into the list of actions in Section 0of this annex and summarized in Table 2-3.

Table 2-3 Southeastern CT Critical Facility Assessment Recommendations Summary for Norwich

Facility	Address	Short-Term (0-20 years)	Long-Term (>20 years)
Yantic FD	151 Yantic Rd	Eliminate basement	Relocate facility
Occum FD	44 Taftville Occum Rd	Eliminate basement	Relocate facility
Public Works	50 Clinton Ave	Dry floodproof the utility room	Wet floodproof all remaining lower areas

Municipal Facilities

NPU provides electric, water, sewer, and natural gas service to the City and the surrounding area. The City's Emergency Operations Center (EOC) operates out of NPU's headquarters, while the City's backup EOC is located at the Norwich Fire department Headquarters station located at 10 North Thames Street. Both facilities have generators for emergency power. The City's water pollution control facility on Hollyhock Island (at the mouth of the Yantic River) is located within the 1% annual chance floodplain, and several of the city's water and sewer pumping stations may also be located in the floodplain. The Rose City Senior Center is one of the City's backup shelters and is not susceptible to flooding. Public Works facilities are not located within the 1% annual chance floodplain although the headquarters is located within the 0.2% annual chance floodplain.

Literature is an important means of conveying and educating the public. Located in the main lobby of City Hall are several pamphlets describing emergency checklists, home emergency plans, wildfires, evacuation routes, etc. In addition, this information is sent to all new homeowners in the City.

Health Care Facilities

The William W. Backus Hospital is partially located within the 0.2% annual chance floodplain of the Yantic River. This facility provides emergency, advanced outpatient, and inpatient services to the City of Norwich and the surrounding region. The hospital also posts emergency response procedures for natural hazards on its website. Residents can also travel to Windham Hospital in Willimantic for care.

Norwich includes many small commercial health care, senior living, and assisted living facilities throughout the city. For example, the West Side Walk-In Medical Center is available for minor health problems. These commercial entities have their own Emergency Operations Plans.

Norwich houses populations of people who are elderly and/or have disabilities. Not surprisingly, the more populated areas include a higher percentage of individuals who may require special assistance or different means of notification before and during natural hazards. The City does not keep a list of elderly or disabled residents who may need additional help in case of an emergency simply because the City has too great a population to maintain an accurate list.

Schools

The City of Norwich has a large public-school system that encompasses seven elementary schools, two middle schools, and two special education facilities. These facilities are considered to be critical facilities because they house a large student population that may not be prepared for emergencies to the extent of an adult. Students may choose to attend either Norwich Free Academy, a semi-public high school that is publicly endowed by local municipalities and also funded by private sponsors which accepts students from around the world, or the Norwich Technical High School, one of seven Connecticut regional technical high schools. Norwich Free Academy is also home to the Slater Memorial Museum, which attracts many visitors to Norwich. The Integrated Independent Day School offers alternative public pre-secondary education to Norwich Residents.

Several private schools are also located in the City. For example, the Wildwood Christian School and the Montessori Day School both offer pre-secondary education. The Integrated Day Charter School educates pre-K to 8th graders. Similar to the public schools, the City considers these to be critical facilities due to the ages of the children attending.

The City of Norwich also offers GED programs for adults and boasts the Three Rivers Community College. However, these adult education facilities are not considered to be critical facilities since they cater to adult students.

Shelters

The City of Norwich has four primary shelters for residents and can activate an additional 10 shelters in case of a regional emergency. Each primary shelter has a backup generator and is staffed by the American Red Cross. The primary shelters are listed in Table 2-4. Additional sheltering space would be needed if Groton evacuated due to a hurricane, coastal flooding, or an accident at the Millstone Nuclear Facility in Waterford. Under that scenario, the City has agreements in place to provide short-term shelter to approximately 33,000 people. Of the additional shelters, three are certified by the American Red Cross.

Table 2-4 Primary Sheltering Capacity in Norwich

Facility	Address or Location	Short-Term Capacity	Long-Term Capacity
Kelly Middle School*	25 Mahan Drive	2,000	1,774
John M. Moriarty Elementary	20 Lawler Lane	900	775
Uncas Elementary School	280 Elizabeth Street Extension	1,000	599
Teachers' Memorial Middle	15 Teachers Drive	2,000	1,774
	Total	**5,900**	**4,922**

*Shelter for disabled and special needs residents

Communications

The City has a robust communication system. All departments can communicate via portable radios on separate UHF and VHF communications frequencies as well as by cell phone and email. The City is also part of the Statewide CT Alerts "Everbridge" Reverse 9-1-1 system to provide emergency notification and response to areas affected by a natural hazard. Residents can communicate issues either by directly

calling municipal departments or by utilizing a web tool located on the homepage of the City's website. Since the 2017 HMP both Fire and Emergency Management communications have been updated. As of May 2022, the entire public safety radio system was being redone and upgraded. The new system was expected to become operational in late summer/early fall.

The Office of Emergency Management visits several civic groups each year to educate them on the threats that face the community, how to prepare, and how to relocate if necessary.

Evacuation Routes

The Emergency Management Director has a three-phase coastal evacuation plan on file that can be activated because of an emergency at the Millstone Nuclear Power Plant in Waterford, a coastal flooding emergency, or a hurricane. The evacuation map includes evacuation routes connected to the shelters in the City. If the City of Norwich needed to evacuate, residents would utilize Interstate 395, Route 2, Route 12, Route 32, Route 82, Route 97, or Route 169 to leave the City.

Additional Groups

In addition to City offices, The American Red Cross and the Salvation Army help provide shelter and vital services during disasters and participate in public education activities.

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 Norwich has 21 RL properties. Of these, ten are residential, and 11 are commercial. In total, claims payments for these properties sums to $1,475,790.11.

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 2-5.

Table 2-5 City of Norwich Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Facilities		At-Risk Historic Assets	
	Value	Number	Value	Number	Value	Number
Hurricane/Tropical Storm	$1,715,350,900	14,153	$7,473,700	32	$230,009,700	1,849
Severe Thunderstorm	$1,715,350,900	14,153	$7,473,700	32	$230,009,700	1,849
Severe Winter Storm	$1,715,350,900	14,153	$7,473,700	32	$230,009,700	1,849
Tornado	$1,715,350,900	14,153	$7,473,700	32	$230,009,700	1,849

Drought	$315,995,700	2,112	$1,759,100	8	$1,587,800	11
Flood						
1% Annual Chance	$266,674,780	1,316	$1,759,100	11	$28,292,100	108
0.2% Annual Chance	$316,016,080	1544	$4,940,600	15	$5,728,170	29
Storm Surge						
Category 1	$7,729,200	51	-	1	-	1
Category 2	$8,298,000	57	-	1	-	1
Category 3	$30,639,900	229	-	3	$3,391,600	16
Category 4	$37,692,800	354	-	3	$3,527,700	20
Earthquakes	$1,715,350,900	14,153	$7,473,700	32	$230,009,700	1,849
Wildfire	$188,376,800	1,364	$1,759,100	9	$1,453,800	9

2.10. Community Climate Change Challenges

As is with all of the SCCOG communities, the City of Norwich 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 Norwich

What are the City's Top Climate Change Concerns?

Flooding: Significant redevelopment needs have been identified for Norwich's many mill buildings. However, most are near rivers, and future riverine flood risks could be greater than today's flood risks. This makes redevelopment challenging.

Extreme Heat: Numerous urban heat sources are located throughout Norwich from centuries of development, roadways, parking lots, etc.

Others: Due to its complex geography of many developed historic neighborhoods such as downtown, Taftville, Greenville, and Norwichtown, the City has unique opportunities to simultaneously address stormwater and urban heat island challenges.

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

Flooding: Develop appropriate flood mitigation recommendations after FEMA completes the re-mapping of the Spaulding Brook corridor; and execute the Thamesville Coastal Revitalization Project planned by Federal agencies.

Extreme Heat: Conduct an impervious surface evaluation to inventory largely paved parcels to reduce imperviousness, increase green space, and address parking requirement needs in the city.

Others: Create more greenspace in the Greenville Area and other urban heat islands in the City such as the Route 82 corridor. This should be accomplished by developing a master plan with typical concept designs to be applied in Greenville and along Route 82.

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.

The last major hurricane or tropical storm wind event to affect the City prior to the 2012 edition of the HMP was associated with Hurricane Irene in August 2011. While trees fell throughout the City, power outages lasted up to a week in outlying rural areas since tree density was greater in these areas. Some areas in the southern portion of the City did not lose power at all.

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 and wave action

[1] https://nca2018.globalchange.gov/chapter/2/

was 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. City officials describe the impact of this Storm on Norwich as minimal. Nevertheless, the City of Norwich received nearly $800,000 in disaster relief from FEMA to cover the cost of damages from the storm.

On August 2, 2020, Tropical Strom Isaias swept through the State brining 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. NPU reported a peak of 6,500 outages just after the storm. 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 (Hurricane 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.

  Schools were closed in the City after Ida as there were almost a dozen roads that were impassable, making safe bus transportation impossible. Several roads, apartment complexes and business parking lots experienced moderate to severe flooding. The city opened their shelter and offered sandbags to residents in need, and the fire chief and the department were continuously monitoring the Yantic River flood stages as the storm came and went.

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 ranges from 115 to 140 miles per hours, and the ultimate design wind speed for Norwich is 125 miles per hour; design wind speed is chosen 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. Norwich has adopted the Connecticut Building Code as its building code.

The City has on file a report summarizing the ability of operational municipal buildings to withstand wind loading; this does not include abandoned buildings acquired by the City, but which are vacant. The three primary shelters of the City are rated to withstand winds from a Category 3 Hurricane.

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 only a few areas of the City. The City has two tree wardens within the Public Works Department; both can post notification and schedule tree removal. The Public Works staff also monitor trees as part of their normal rounds and include a budget for minor tree maintenance. The City has its own bucket truck and tree crew but will also hire outside contractors for larger jobs; the City has a standing contract with Linden Tree for tree maintenance and removal. Norwich staff describe their tree maintenance program as very robust.

After a storm, debris is brought to the City transfer station for disposal and reuse.

The City of Norwich receives utility service from NPU and Algonquin Gas. NPU provides electricity, potable water, natural gas, and sewer service to the City and the surrounding region. NPU and Algonquin Gas perform trimming near their utilities and hire contractors for larger jobs. Coordination between the City and NPU is very strong; in fact, the current Emergency Operations Center is located at the NPU Administrative and Operations Center Building.

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. NOAA weather radios are located in a number of locations with large populations, including every school, Dodd Stadium, and the Norwich Marina. Norwich staff note that these radios are often stolen and regularly need to be replaced.

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 residents of an impending

evacuation. The City works with local marinas to ensure personal watercraft are removed in a timely manner prior to severe wind events.

Although hurricanes that have impacted Norwich 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-needed basis for long-term evacuees. In the case of an extended power outage, residents would be directed to one of the five primary shelters in the City to stay or for showering and charging services.

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 Super Storm Sandy in 2012 and continues 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 potentially 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 had relatively extensive outages in some areas because of tree damage to utility lines.

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 in the 1970s and 1980s and do not meet current building codes. Older buildings in the City and mobile homes are particularly susceptible to roof and window damage from high wind events, particularly in the many historic districts in the city. 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 SCCOG was evaluated in the Multi-Jurisdictional HMCAP. A separate analysis was not performed specifically for the City of Norwich.

3.2.3.1 Hazard Losses

Since 2017 the city has received $452,544 in FEMA PA funds for project costs of $501,540. This was all received for Hurricane Sandy. Almost half of these funds were received for public utility purposes, with the remainder for debris removal, protective measures, and state management costs (Figure 3-1).

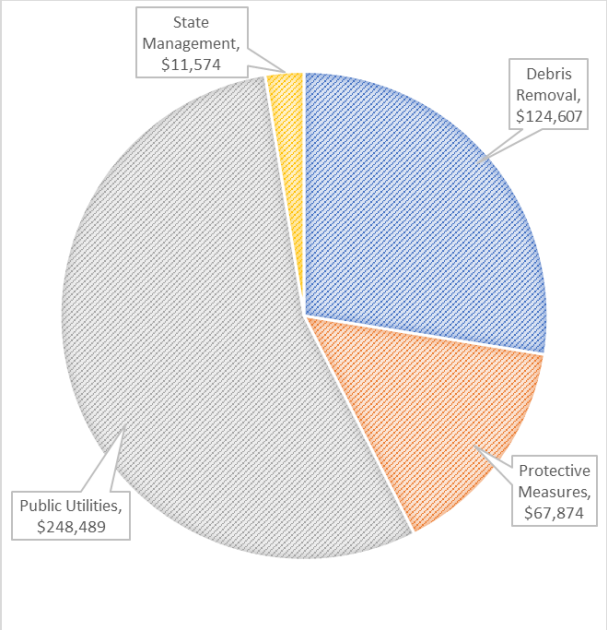


Figure 3-1 Tropical Storm Isaias FEMA Funding Categories

In addition to PA, FEMA also offers property owners and renters Individual Assistance (IA) funding after a declared disaster. In the wake of Hurricane Ida 45 property owners received funding totaling $321,869, and three renters received IA totaling $13,282.

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 3-3presents hurricane related damages for the City of Norwich. 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

Norwich	Return Period	Residential	Commercial	Industrial	Others	Total
	10-year	$65,340	$0	$0	$0	$65,340
	20-year	$4,508,980	$294,490	$26,840	$109,940	$4,940,250
	50-year	$30,527,340	$3,001,150	$265,510	$983,640	$34,777,640
	100-year	$63,776,990	$11,162,730	$1,093,280	$4,938,460	$80,971,460
	200-year	$112,249,500	$28,491,810	$3,193,060	$13,389,840	$157,324,210
	500-year	$210,249,480	$61,817,450	$7,648,780	$30,803,930	$310,519,640
	1,000-year	$304,140,230	$98,898,790	$12,394,920	$46,692,910	$462,126,850

Table 3-2 HAZUS-MH Hurricane Related Building Damage

Norwich	Return Period	Minor	Moderate	Severe	Destruction	Total
	10-year	11	0	0	0	11
	20-year	53	4	0	0	57

	50-year	523	72	3	0	598
	100-year	1,272	230	11	2	1,515
	200-year	2,109	520	37	12	2,678
	500-year	3,019	1,070	126	44	4,259
	1,000-year	3,460	1,496	239	87	5,282

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

Norwich	Return Period	Debris Generated (Tons)	Households Displaced	Individuals Seeking Temporary Shelter
	10-year	12	0	0
	20-year	645	0	0
	50-year	5,961	0	0
	100-year	11,389	7	2
	200-year	19,186	38	20
	500-year	32,853	171	111
	1,000-year	44,714	345	223

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. No tornadoes have occurred in the City since the last HMP.

A selection of summer storm damage in the City of Norwich as reported to the NCDC is presented below:

- April 12, 2008: An isolated severe thunderstorm produced penny-sized hail in Norwichtown.
- July 2, 2008: A severe thunderstorm produced quarter to half-dollar (up to 1.25-inch) hail along Dunham Street, with nickel-sized hail being reported in Norwichtown and penny-sized hail throughout the City. A roof was reported as being blown off of a roof in Norwichtown, resulting in $100,000 in damage.
- July 23, 2008: A severe thunderstorm downed a few trees on Dunham Street. A contractor at the Norwich Housing Authority was struck or nearly directly struck by lightning, suffering minor injuries.
- May 12, 2009: A severe thunderstorm produced nickel-sized hail in Norwich.
- May 4, 2010: Scattered severe thunderstorms produced strong gusts that downed large branches in Norwich.
- May 8, 2010: Lightning struck a transformer, causing 5,000 people to lose power in the City.
- On July 25, 2013, the combination of a moist airmass and a wave of low pressure tracking north along a cold front just to the east of Long Island resulted in scattered showers and thunderstorms across Southeast Connecticut. The redevelopment of these showers and storms over the same area led to a period of persistent heavy rain, which resulted in flash flooding. The City of Norwich was hit the hardest with total accumulation estimates of 5 to 8 inches.

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 the Pawcatuck section of Stonington, and another further north 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 reports event associated with a severe thunderstorm and wind event. Since 2012 there has been one report of hail and two reports of thunderstorm related wind.

Damages for the wind events totaled $6,000. 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 more severe storms prior to the 2017 HMP include:

- The winter of 2010 – 2011 produced significant snowfall in Norwich. The City had to shovel the roofs of several municipal buildings. City Hall had minor damage to its gutters, and two vacant schools (Buckingham School and Greeneville School) sustained roof damage. The schools were set to be torn down and have since been removed. One business had to replace its roof after it was damaged, and the City compiled several reports on private roofs being damaged during snow removal. For example, a snowblower hit a gas line on one roof.
- Winter Storm Alfred in late October 2011 caused significant tree damage and additional power outages for several days in outlying areas. Trees which were able to withstand the heavy winds of Irene were not able to withstand both wind and snow load during Storm Alfred.
- 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.
- In January 2015, the City received 36 inches of snow in a single day.

The year 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. The public assistance reimbursement for the February 2013 storm was $29,919.39.

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 downs trees throughout the region as a result of this storm.
- On January 28, 2022, the region was hit by 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.

Information for protecting City residents during cold weather, and for mitigating icing and insulating pipes at residences, is provided to the public through the City's Human Services department, as well as United Way and TBCCA.

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. Salt and sand are stored at the Public Works facility. The City has established plowing routes that prioritize access to and from critical facilities. The Connecticut Department of Transportation (DOT) plows State roads. As two Connecticut DOT facilities are located in Norwich (District 2 Headquarters on Route 82 and a satellite garage in Occum), winter plowing of State roads in the city is generally timely. During snow events, the Public Works Department will send a plow out with emergency response vehicles on their way to difficult-to-access areas. Parking bans implemented during such events are effective at helping keep roads clear.

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. The City monitors and shovels the roofs of municipal buildings, and most residents and businesses also shoveled or plowed their roofs. The City has a priority program for snow removal from roofs: The Police Headquarters are cleared first, followed by the Fire Department, then City Hall, then other facilities.

Summary

In general, municipal capabilities to mitigate snowstorm damage have increased slightly since the 2012 edition of the hazard mitigation plan was adopted. This is because the City continues to experience heavy snow each winter and has made changes as needed.

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.

The majority of City buildings were constructed relatively recently and therefore not particularly 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.

The Reid and Hughes Building is a large multi-story building in the downtown area. This building has a flat roof that is deteriorated. The City is in discussions with the Historic Commission to demolish the building, but in the meantime, it still stands and is a serious hazard, as a large snow event could collapse the roof and potentially lead to damage in the area surrounding the building.

Icing is not an issue anywhere 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 Norwich since 2017. In the past decade, the city has received FEMA PA funds in the amount of $639,516 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 meter (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).

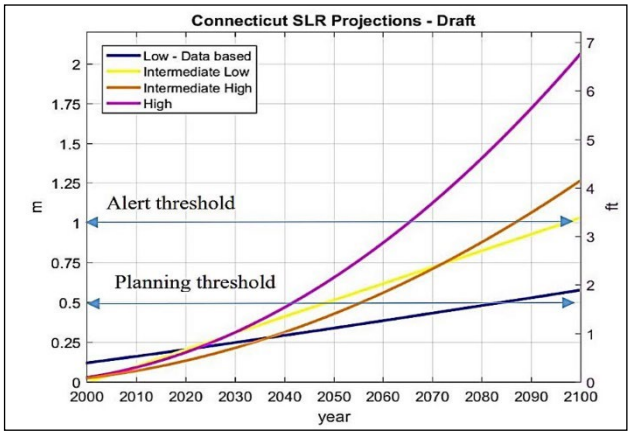


Figure 4-1 Four Localized Sea Level Rise Scenarios for

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 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

Despite being located well-inland from the Connecticut shoreline, the City of Norwich has coastal resource areas that are tidally influenced. The coastal area of the City of Norwich consists of nearly 14 miles of riverfront associated with the Thames River, the lower section of the Yantic River upstream to Uncas Leap, and the lower section of the Shetucket River Greeneville Dam. The shoreline of the City of Norwich contains developed shorefront along these rivers, with estuarine embayments (defined as a protected coastal water body with a direct connection to Fishers Island Sound) located at the confluence of the Shetucket River and the Yantic River, upstream of Hollyhock Island on the Yantic River, and just downstream of Greeneville Dam on the Shetucket River. The coastal resources found in Connecticut and described by DEEP are listed in the Multi-Jurisdictional HMCAP.

Homes, businesses, and industry are located in close proximity to the shorefront along the coastal area. However, the City's location at the headwaters of the Thames River places many properties at higher elevations than low-lying areas adjacent to Long Island Sound. As such, the City does not typically experience coastal flooding, and only a few areas are at risk of coastal storm surge from hurricanes.

While coastal flooding is relatively infrequent in the City, hurricanes and tropical storms have the potential to induce coastal flooding and storm surge that can impact structures. No coastal flooding or storm surge events have occurred since the time of the previous HMP. However, the City is concerned with the potential long-term effects of sea level rise and its potential to exacerbate coastal 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 and the coastal management area, encouraging the elevation of homes and roadways, maintaining hard structures in good condition, and providing signage and warning systems. Subsequent to the date of the previous edition of this plan, the City entered the Community Rating System (CRS) program at Class 8, and the process of applying to the CRS program has helped enhance capabilities for flood risk management.

As noted in Section 5.2.2 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) including floodway areas. As noted by the Zoning Regulations, building activities in the floodplain 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. In addition, the City requires the submission of a coastal site plan for any project located within the coastal area management boundary.

The new Norwich Intermodal Transportation Center, constructed in 2010-2011 on an island at the mouth of the Yantic River, is a good example of recent construction abiding by flood damage prevention regulations. The lower levels of the transportation center may be flooded by coastal storm surges.

As noted in Section 2.6, the City of Norwich has *A Waterfront Vision for the City of Norwich* which includes increasing public access and walkways near the riverfronts. This plan suggests that non-water

dependent uses will be moved away from the shoreline and replaced with land uses more appropriate for the floodplain in the future.

The shoreline of Norwich contains many coastal flood control structures. Small, private bulkheads can be found in many of the commercially and industrially developed coastal neighborhoods. Larger structures such as the Trading Cove Dike and the Long Rock Dike are also located on the Thames River and provide a modicum of shoreline protection.

Like many communities, the City lacks existing policies and mitigation measures that are specifically designed to address sea level rise. Although the City of Norwich 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 to structures, such as requiring that new buildings located in the floodplain have 18 inches of freeboard above the base flood elevation.

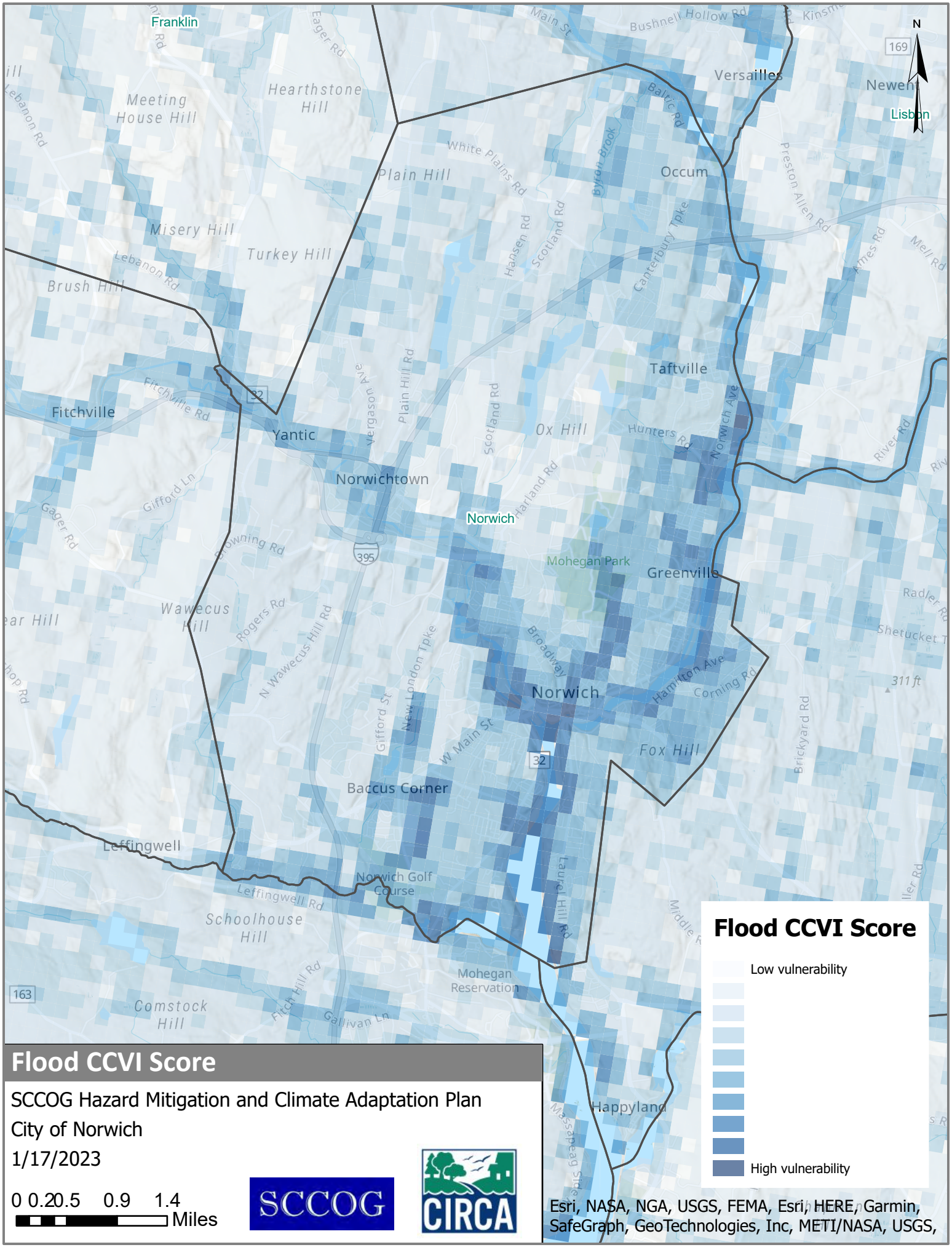
Summary

Municipal capabilities to mitigate coastal flood damage have increased since the 2017 edition of the HMP, primarily through the process of entering the CRS program. In the coming years, the City plans to reassess its risks of coastal and tidally-influenced flooding from the Thames River, and will modify its capabilities as needed.

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. As noted above in the historic record, coastal flooding typically only occurs due to storm surge. Refer to Figure 4-3 for a depiction of areas susceptible to storm surge.

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 Figure 4-2. The CCVI demonstrates that flood vulnerability in the city ranges from low to high. Most of the vulnerability score is due to tidally influenced areas along the Thames River.


Franklin
Meeting House Hill
Hearthstone Hill
Misery Hill
Turkey Hill
Brush Hill
Plain Hill
White Plains Rd
Versailles
Occum
Taftville
Fitchville
Yantic
Norwichtown
Norwich
Ox Hill
Hunters Rd
Mohegan Park
Greenville
Wawecus Hill
Baccus Corner
Leffingwell
Norwich Golf Course
Schoolhouse Hill
Mohegan Reservation
Comstock Hill
Fox Hill
Happyland
Newent
Lisbon
311 ft
N
Flood CCVI Score
Low vulnerability
High vulnerability
Flood CCVI Score
SCCOG Hazard Mitigation and Climate Adaptation Plan
City of Norwich
1/17/2023
0 0.20.5 0.9 1.4
Miles
SCCOG
CIRCA
Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS,

Vulnerability Analysis of Areas Along Coastal Waters

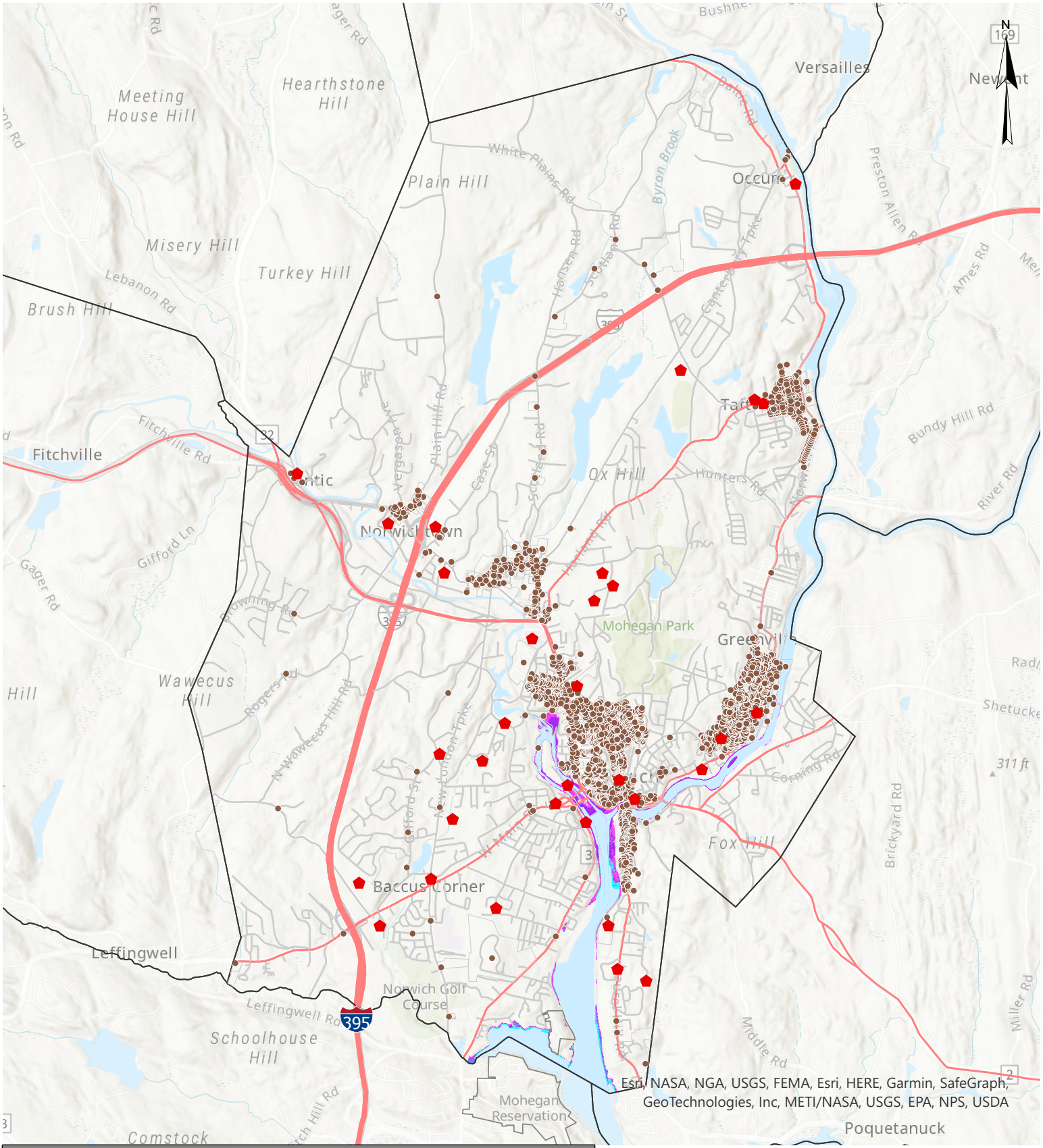
As noted in Section 5.2.3, the low-lying shoreline areas of the city along the Yantic, Shetucket, and Thames River are subject to periodic inland flooding. The area potentially flooded by storm surge is not as extensive as the 1% annual chance floodplain. In general, the coastal area affected by storm surge is limited to areas immediately within and adjacent to the rivers. Due to the similarity of the areas, it may be difficult for City officials to judge whether an area is being affected by inland flooding or coastal storm surge during a particularly heavy rainfall associated with a hurricane or nor'easter.

Based on the 2008 FEMA mapping, the Shetucket River will only be affected by storm surge from a Category Three or Category Four Hurricane. A Category Three hurricane would produce storm surge within the channel up to 8th Street, although only one structure in the vicinity of Route 2 would be affected. A Category Four hurricane would produce storm surge up to the Greeneville Dam, and industries in the vicinity of 8th Street may be affected.

Similar to the Shetucket River, areas along the lower section of the Yantic River are also only affected by storm surge from a Category Three or Category Four hurricane. A business on Yantic Street and homes on Watercress Avenue and Sturtevant Avenue could potentially be impacted by storm surge. While the wastewater treatment facility on Hollyhock Island may only be affected by storm surge from a Category Four Hurricane, the remainder of the island is at risk of storm surge from a Category Three hurricane. Several commercial structures, including the American Wharf marina and the new Norwich Intermodal Transportation Center would be affected. Business and parking garages on Chelsea Harbor Drive and Market Street would also be affected by storm surge from a Category Three hurricane.

Areas adjacent to the Thames River would also be affected by storm surge. On the west side of the Thames, condominiums near South Thames Street would be affected by storm surge from Category Three and Category Four hurricanes, as would homes in the vicinity of South Street and Rose Street. Two homes in Trading Cove would also be affected by storm surge from a Category Two Hurricane, with additional homes being affected from larger storms. Railroads on both the west side and the east side of the Thames River may also be affected by storm surge. On the east side of the Thames, only an industrial area known as New Wharf would be affected by storm surge from a Category Three or Category Four Hurricane.

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. Areas adjacent to Trading Cove are likely to be affected first.



Hurricane Storm Surge Inundation Areas

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of Norwich

Date: 8/3/2022

0 0.4 0.8 1.2 1.6 Miles

SCCOG

RESILIENT Land & Water

Legend

- Historic Resources
- Critical Facilities

Hurricane Category

- 1
- 2
- 3
- 4

Vulnerability Analysis of Private Properties

The coastal areas of the City of Norwich have properties that are inhabited year-round. This intensifies risk to life and property in coastal areas. Waterfront properties are very susceptible to damage from storm surge although FEMA has not established any coastal velocity zones in Norwich. Shoreline erosion is a relatively minor concern for private property owners at this point in time since coastal flooding is very infrequent.

Buildings located in flood hazard areas are primarily commercial or industrial but also include some residential and critical facility structures as noted in Section 4.3.1. Most of the structures that are threatened by flooding are also located within the 1% annual chance floodplain.

The City of Norwich 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 recently released FEMA storm surge mapping to identify the structures in the City that are at risk for storm surge. 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.

Vulnerability Analysis of Critical Facilities

As shown on Figure 4-3, the only critical facility located within potential storm surge areas is the City's wastewater treatment facility on the Yantic River. No additional facilities are located in hurricane storm surge zone.

4.2.3.1 Hazard Losses

There are no reported losses for the City of Norwich related to coastal flooding.

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 Norwich since the majority of the shorefront is almost fully developed (particularly along the industrial areas). Two dikes also protect the shoreline of the Thames River in the southern portion of Norwich. However, as sea level rises, the effectiveness of these structures could be undermined such that erosion will be able to occur landward of the walls necessitating expansion of the structures.

4.3.3.1 Hazard Losses

There are no reported losses for the City of Norwich related to shoreline change.

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

Flooding is the primary natural hazard that impacts the City each year as documented in the previous HMP. While riverine flooding is of primary concern, nuisance flooding and poor drainage are also issues at several locations in the City. Flooding is typically caused by heavy rainstorms but can also be caused by relatively light rains falling on frozen ground, ice jams, or dam failures (as discussed in Section 10). A major concern to City officials and residents of Norwich is flooding along the Yantic River, a watercourse that is not protected by upstream flood protection projects as exist along the Shetucket River.

The maximum flood of record in Norwich occurred in September 1938 as a result of a major hurricane moving through New England. Refer to the Multi-Jurisdictional HMCAP for a description of this hurricane. If this flood were to reoccur at the present time, it would approximate a 0.3% annual chance flood. During this flood, high water marks of eight feet (8') were recorded at the corner of Bath and Franklin Streets north of the confluence of the Shetucket and Thames Rivers, and marks of five feet five inches (5'5") were recorded above the railroad track to Laurel Hill at the Shetucket River. The USGS gaging station on the Yantic River recorded an approximately 1% annual chance flood.

A selection of flood events that have impacted the City of Norwich since 1990, as listed in the Yantic River Natural Hazard Mitigation Plan (2000), by the NCDC, and from accounts by City officials are listed below:

- January 1994: An ice jam followed by a quick thaw caused minor flooding at numerous locations along the Yantic River.

- March 1998: Flood height on the Yantic River measured at slightly more than 11 feet (a 10% annual chance flood).
- October 28, 2006: Flash flooding closed side roads adjacent to Interstate 395.
- March 2, 2007: Widespread flash flooding occurred due to heavy rainfall. Several roads were closed in Yantic.
- April 16, 2007: A nor'easter produced heavy rainfall that led to flooding along the Yantic River.
- February 13, 2008: Heavy rainfall fell on top of two to three inches of snow, causing several businesses on West Town Street to have three to five feet of water in their basements. The Yantic River crested nearly seven inches above flood stage.
- March 8, 2008: A heavy rain event totaling 4.81 inches caused businesses along Boswell Avenue to accumulate several inches of water resulting in minor property damage.
- December 12, 2008: Widespread rainfall produced up to 4.5 inches of rain in Norwich, causing major flooding along the Yantic River. The Yantic River crested at 11.82 feet and impacted Yantic and Norwichtown with many businesses forced to close due to flooding. Flooding from poor drainage also impacted Greeneville. In the East Great Plain area, floodwaters washed out the culvert beneath Montville Road that conveys Trading Cove Brook.
- July 2, 2009: Several roads in Norwichtown were flooded due to heavy rain, including a low-lying underpass beneath a railroad bridge on Wawecus Street that was closed for much of the day. Mediterranean Lane was also closed due to flooding. Fire crews were dispatched to assist residents with pumping water out of their basements in areas that typically experience flooding such as Bliss Place off Washington Street.
- March 2010 floods: Two heavy rainfall events occurred producing significant flooding in the region. The City experienced more flooded basements than it ever experienced previously, including in areas that never had an issue with flooding. Route 82 had a significant flood near the entrance to KFC and Staples, and over 9,000 sandbags were deployed to protect buildings across the City. Crouch Avenue experienced slumping hillsides due to the sustained heavy rainfall. Sections of West Town Street, New London Turnpike, Wawecus Street, and Mohegan Park Road were closed, as was the "Canada Bridge" on Sherman Street over the Yantic River. The Yantic Fire Engine Company No. 1 sustained flood damage. One employee parking lot was closed at Backus Hospital. Water rescues were performed on Interstate 395 in Norwich. The NCDC listed an estimated $280,000 in property damage to homes and businesses occurred.

On March 30, 2014, a wave of low pressure tracked northeast along a stationary frontal boundary from the Tennessee River Valley to the Mid-Atlantic Coast and into the Atlantic Ocean. Several inches of rain fell across Southern Connecticut resulting in flooding on the Yantic River. Anywhere from two to five inches of rain fell across southern New England. The Yantic River at Yantic exceeded its flood stage of 9.0 feet at 7:00 AM, crested at 10.10 feet at 10:00 AM and fell back within its banks at 5:45 PM. Numerous roads in Norwich were under two feet of water as a result. West Town Street under Interstate 395 was closed. A swift-water rescue had to be performed to extract someone from a car.

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

Hurricane Ida, which produced several inches of rain across the state, caused flooding along the Yantic River in multiple locations. Parking lots and roadways were also flooded as a result of drainage issues. City officials and staff monitored the Yantic River, and it was noted that the levels for the river reach the 6th highest levels in history. The Laurel Hill/Sunnyside area also suffered severe flooding during the storm. The city feels that the solution for this in the future is sewer system separation; currently new connections cannot be added due to it being combined. This area is also an environmental justice community which makes this a high priority project. The stream from the Spauling Pond Dam flooded, Great Plain Brook flooded (which normally does not flood), Mohegan Park Road flooded which severely impacted McKinley Avenue, and the intersection of North Main and Boswell also flooded. Backus Hospital reported three feet of flooding in the parking lots due to sheetflow from the middle school. The city reported that there were some areas that flooded during Ida that do not typically flood during heavy rain events. The incidents were primarily localized, however not necessarily associated with floodplains.

After a period of prolonged drought, a severe rainstorm event on September 5/6, 2022, caused flooding in some areas of the region. Nearby Lebanon experienced road closures and washouts, while NPU 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 bridges and culverts, promoting flood insurance, acquiring floodprone structures, maintaining drainage systems, through education and outreach, and by utilizing warning systems. As noted earlier, the City is a Class 8 participant in the CRS, and this participation has helped enhance capabilities for flood risk management. Additional mitigation measures have been put in place by the State and Federal government upstream of Norwich that help to reduce flooding downstream, including several protection projects.

Flood Control Structural Projects

As noted in the Multi-Jurisdictional HMCAP, several significant flood control projects have been constructed by the USACE upstream of Norwich on the Shetucket and Quinebaug Rivers. These flood protection projects were completed in the 1950's and 1960's and greatly reduce the incidence and severity of flooding in Norwich. The USACE also deepened and widened a 700-foot section of the lower portion of the Shetucket River in 1958-1959, significantly improving the flood conveyance of the river downstream of Greenville Dam. In addition, two small reservoirs were constructed by the Soil Conservation Service (now the Natural Resources Conservation Service) in 1963 and 1964 on Spaulding Pond Brook to provide moderate control of upland runoff.

A flood prevention plan written by the Soil Conservation Service and the U.S. Department of Agriculture and sponsored by the Connecticut DEP in 1970 recommended the construction of two flood control dams upstream of Norwich in the Town of Lebanon. These dams would have reduced flooding potential along the Yantic River. However, strong opposition within the Town of Lebanon prevented this plan from being implemented.

Bridge Replacements, Drainage, and Maintenance

The Department of Public Works cleans and inspects catch basins and culverts at least annually or more often if problems are noted. When flooding occurs, the Public Works department or the Fire Department would handle the complaints depending on the location. For example, public works would inspect bridges and culverts and erect barricades to close roads, while the Fire Department responds to calls requesting help for flooded basements. The City uses a message system on its webpage and fields phone calls related to drainage complaints. Drainage complaints are reviewed by the Public Works Director. No formal logs are kept unless a project results.

The Canada Bridge was recently upgraded since the 2017 plan. The bridge is 1.5 feet higher than its previous configuration. The project also raised a section of Asylum Street 1.5 to two feet.

Regulations, Codes, and Ordinances

The City of Norwich has planning and zoning tools in place that incorporate floodplain management. The City of Norwich has included floodplain regulations in its zoning ordinance since January 1991, recently revised them in 2017. The City utilizes the 1% annual chance floodplain as defined by FEMA to regulate floodplain and floodway activities and requires 100 percent compensatory storage for any encroachment in the floodplain. The City also requires freeboard of 18 inches for new construction or substantial renovations, a greater amount of freeboard than the 12 inches recommended in some communities.

The City's zoning regulations allow for the Commission on the City Plan to require additional mitigation to reduce potential flooding. For example, the Norwich Commission on the City Plan required the Norwichtown Mall to erect a four-foot high concrete floodproofing reinforcement abutting the entire perimeter of its exterior walls. As part of this project, the State rebuilt the streambank on both sides of the Yantic River with rip-rap where the Yantic River crosses through the Norwichtown Mall property.

Regulations covering development in inland wetland areas have been in existence since July 1974 and enforced by the City's Inland Wetlands, Watercourses and Conservation Commission. The City Council has also adopted a map prepared by the Inland Wetlands Watercourses and Conservation Commission which regulates building in wetland areas. With regard to stormwater drainage, the City Department of Public Works pursues a policy of zero percent increase in stormwater runoff when reviewing major development projects within the watershed, but this policy is not written.

Changes to the State's MS4 requirements will affect local stormwater runoff regulations. They require retaining water on site in order to improve downstream water quality. The City will monitor the application of these new requirements to determine the effects they have on flood risk. City officials are reviewing limitations on impermeable surfaces in the local Zoning Regulations as part of the MS4 update.

Acquisitions, Elevations, and Property Protection

The City of Norwich has long accepted State and Federal assistance to remove floodprone properties from the floodplain. FEMA helped the City acquire one commercial property and three residential properties across the street from the Public Works Headquarters following the floods of 1982. These properties, and the former Pleasant Street mall property, are now all open space.

The State of Connecticut acquired and demolished twelve residences within the Yantic River's flood zone prior to the 2005 edition of the HMP. Part of the acquisition occurred at the intersection of Clinton Avenue and Wawecus Street. This area of vacant land will remain as open space for the City of Norwich.

The City has acquired the old Nutmeg Industries headquarters in the years subsequent to the 2012 edition of the HMP. The Company has relocated to a new building outside the flood zone.

While acquisition, especially commercial acquisitions, has historically been a high priority for the City, in recent years the City has had to change course. Officials report that the City owns many empty structures that it has acquired over the years and is at capacity with regards to maintenance and monitoring. Until these properties are demolished or sold, the City is not interested in performing additional acquisitions. However, the City will pursue acquisitions of commercial floodprone properties if the acquisition project includes conversion to open space, and if funding is available. The City is also focused on smart redevelopment for some properties versus acquisitions as these structures are vital components of the city's grand list and are critical for economic development. The City also supports acquisitions performed by land conservancies and similar organizations.

Norwich has 2,000 flood-protection sandbags that are filled and ready for deployment in case of emergency. They have an additional 20,000 bags that are empty. An REPT grant was used to purchase an automated sandbagger that can rapidly fill bags as needed. These bags are deployed prior flood events to protect non-residential structures. The Emergency Manager maintains a call list of organizations that can be contacted for volunteer assistance with emergency flood response activities. This list was recently used to recruit volunteers to help direct traffic during a parade. Similar activities could be helpful during road flooding.

City staff recently undertook the effort of identifying at-risk historic structures that have not yet been placed on a local, state, or national registry. The City identified almost a dozen properties, had these structures evaluated by the State Historic Preservation Office (SHPO), and was able to successfully get these properties on a local and state historic registry. As such, these structures can now be flood proofed and redevelopment within the historic resource regulations.

Flood Watches and Warnings

The Emergency Management Director, Fire Department, and Police Department access weather reports through the National Weather Service and utilize Reverse 9-1-1 to telephone warnings into affected areas when flooding is imminent. The City also carries out public information and education programs about flood dangers and mitigation measures during non-emergency conditions.

The City has a specific warning procedure for Norwich Commons. Weather alerts sent to the Emergency Manager are forwarded to store owners. Deployable floodgates have been installed at many of these properties and this warning allows store owners to deploy them. The City also provides sandbags to supplement the floodgates.

The City has compiled a list of addresses of structures within the Special Flood Hazard Area. They are able to use this information to send out warnings and alerts. The City has also begun tracking repair costs for these properties to help determine long-term damage costs from flooding.

Summary

In general, municipal capabilities to mitigate flood damage have increased since the 2017 edition of the hazard mitigation plan was adopted, partly through the process of entering the CRS program.

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 overbank flooding along the Yantic River is the most common type of flooding experienced by the City, although nuisance flooding in basements is also extremely common. The City has observed that there appears to be large watersheds that are a challenge during heavy precipitation events. Natural drainage cannot be sustained in some of these watershed and intermittent streams sometimes "become rivers".

Vulnerability Analysis of Areas along Watercourses

Major inland watercourses and water bodies in Norwich have the 1% annual chance floodplain defined by FEMA. The majority of watercourses do not present flooding hazards to residents, buildings, or roadways. However, some watercourses do present recurring flooding issues. Impacts to structures are discussed below. This section discusses roadways and other floodprone areas along the major watercourses and water bodies in the city. Refer to Figure 5-1 for the location of the 1% annual chance floodplain in the City.

Table 5-1 Roadways Flooded by Nearby Watercourses in the City of Norwich

Watercourse or Water Body	Road	Crossing
Yantic River	New London Turnpike	Bridge over Yantic River
	Sherman Street	Bridge over Yantic River with utilities beneath
	West Main Street	Two bridges over Yantic River at Hollyhock Island
Bobbin Mill Brook	Town Street	Culvert beneath road and commercial parking lot
	East Town Street	Culvert
	Scotland Road	Culvert near pond outlet
Spaulding Pond Brook	Main Street (Route 32)	Underground culvert system from downstream of Hickory Street and beneath each street and along most of Chestnut Street. The culvert daylights at the Shetucket River downstream of Main Street
	Bath Street	
	Willow Street	
	Chestnut Avenue	
	Lake Street	
	Broad Street	
	Hickory Street	
	East Baltic Street	Underground culvert system from outlet of Spaulding Pond to above Hickory Street
	Mohegan Park Road No. 2	
Ford Brook	New London Turnpike	Culvert
	Stanton Elementary School driveway	Underground culvert beneath school parking lot
	Newton Street	Culvert
Great Plain Brook	Village Court	

	New London Turnpike	Underground culvert from beneath Three Rivers Community College parking lot to Norwich Golf Course. Lower section near New London Turnpike and Village Court in 0.2% annual chance floodplain
	Melrose Park Road	
Tributary to Shetucket River from Mediterranean Lane	Boswell Avenue (Route 12)	Culvert – Road has flooded three or four times over past decade by Hess Station

Flooding is a concern for many roadways throughout Norwich. Flooding may inhibit emergency response times as well as damage roads and guardrails, undermine power lines, scour bridges, and wash out culverts.

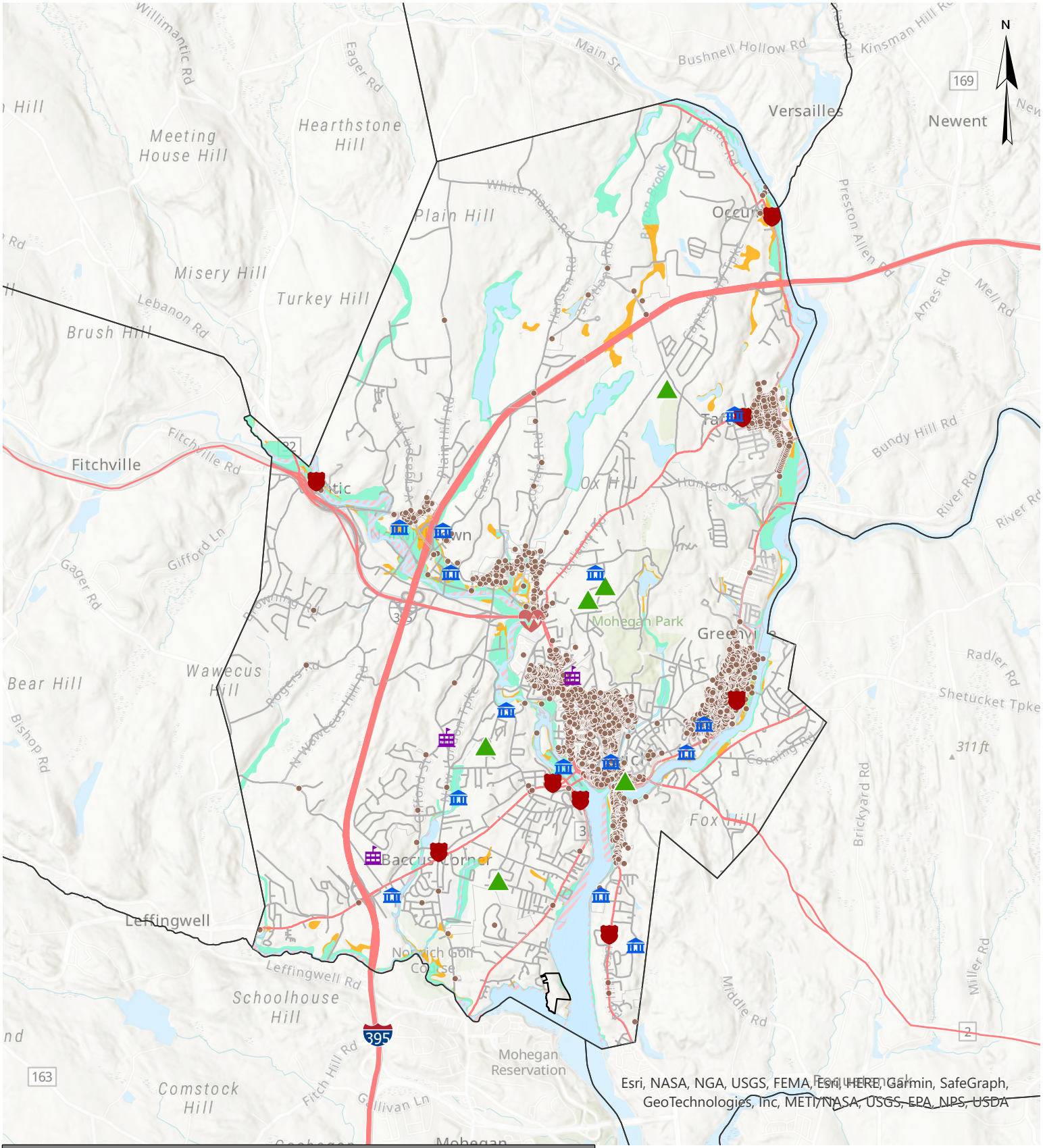
Many areas in Norwich have extensive underground culvert systems. Several flooding sources in Norwich are associated with culverts of insufficient capacity to convey water during major storms. As a result, water backs up and occasionally floods the road near these culverts. Several of these culvert systems are decades old and may be undersized for the increased frequency and magnitude of rainfall over historical averages that Connecticut has been experienced recently. Table 5-1presents roadways in Norwich that have experienced recurring flooding issues.

The 2011 FIRM for New London County maps a floodway through the downtown area of Norwich. The Norwich City Planner and Emergency Management Director note that there is an underground culvert in that area that pipes water through the system and claim that it was not accounted for in the FEMA mapping. Those officials have presented this site, as well as two other sites (including a development on West Town Street near Interstate 395, along the Yantic River), to FEMA for reassessment. The City reports that, as of summer 2022 this survey work has been completed, however it is unclear when any of the findings will be released.

Poor drainage flooding is also an issue in several areas. The City reports that Mohegan Park road has issues with poor drainage in its low-lying areas, as does the bottom of Case Street, Bozrah Avenue, Shays Lane, Leffingwell / Sachem Plains, Montville Road, Glenwood Avenue, Smith Avenue, Wilderness Road, Mediterranean Lane, Boswell Avenue, and St. Regis Avenue. St. Regis Avenue has been noted to have an inadequate drainage system which includes undersized piping in the State's Right-Of-Way.

The "Canada Bridge" on Sherman Street, which was recently replaced, passes over the Yantic River. This bridge has had issues with silt buildup and during periods of high water it is affected by the backwater of a downstream dam. Some of the materials that have built up over time were removed during the replacement; the city is hopeful that the larger conveyance will reduce siltation. The city is monitoring this issue upon recent upgrades. Removing the downstream dam would also eliminate the threat to the bridge and the exposed utilities that hang beneath it by greatly lowering the water surface elevation beneath the bridge during flooding events.

The New England Central rail line parallels the Yantic and Thames Rivers on its path through Norwich. Although portions of the line are within the flood zone, the rail bed is elevated in many places and creates a dike effect that isolates flood waters from inland areas.



Critical Facilities and Historic Resources with Flood Zones

SCCOG Hazard Mitigation and Climate Adaptation Plan

City of Norwich

Date: 8/1/2022

0 0.4 0.8 1.2 1.6 Miles

SCCOG

RESILIENT Land & Water

Legend

- Historic Resources
- Emergency Services
- Municipal
- School
- Shelter or Cooling Center
- Care and Medical Facility
- 1% Annual Chance Flood Hazard Area
- .2% Annual Chance Flood Hazard Area
- Floodway

Ice Jams are an issue upstream of Norwich in Baltic on the Shetucket River. This is partially due to the backwater effect of the Occum Dam located approximately two miles downstream of Baltic in Norwich. Ice Jams have also historically been an issue along the Yantic River but are less frequent. Typically, ice jams do not cause flooding that affects structures.

Vulnerability Analysis of Private Properties

While most structures affected by flooding in the City are located along the Yantic River, there are several watercourses and water bodies in the City that have adjacent structures located within the 1% annual chance floodplain (mapped as Zone AE). The majority of these structures are residential.

Ponemah Mills, previously an empty industrial building, is being refurbished and made into residential apartments and condominiums. This will result in the creation of a new hazard as the building is vulnerable to flooding but had previously not had tenants.

Note also that the Shetucket River and Spaulding Pond Brook have a significant number of structures located within the 1% annual chance floodplain. However, flood control activities (Section 5.2.2) located upstream of Norwich in the headwater streams of the Shetucket River and in the headwaters of Spaulding Pond Brook have greatly reduced the frequency and magnitude of flooding along these watercourses. Norwichtown Brook is impounded by the Bog Meadow Reservoir in its headwaters. While this impoundment is for water supply and not flood control, it also reduces the frequency and magnitude of flooding downstream.

There are several areas of commercial and industrial properties along the Yantic River that have been identified as being located within the 1% annual chance floodplain and are considered to be susceptible to damage.

- West Town Street – A gas pipeline facility owned by the Algonquin Transmission Company
- Clinton Avenue – A mix of commercial buildings and an old industrial building
- Yantic Road – A tavern and several commercial buildings near the Yantic Fire Engine Company No. 1
- Pleasant Street & Sturtevant Street – Shop-Rite Plaza
- Connecticut Avenue – Plas-Pack Industries, Inc. experiences flooding, as does an electrical substation nearby.
- Rollins Road – Electrical substations
- Wawecus Street - Phelps-Dodge Industrial Plant – flooding of the access driveway restricts vehicular access to the facility. Freeport McMoRan is also flooded by the Yantic River.
- The Dollar General being constructed on Boswell Avenue will be located outside of the floodway after it was noted by City officials that the initial plan placed it within that high hazard zone. Nevertheless, the building is still in a SFHA and at risk of flooding.
- The newly refurbished office space known as "Foundry 66" in the downtown area is at risk of flooding.

Since the 2012 HMP, Nutmeg Industries has moved out of its property located along the Yantic River and relocated to a new headquarters building at 1 Ohio Avenue, which is outside of the floodprone area. The City has acquired the old building utilizing funds provided by the HMGP.

As of 2012, repetitive flood insurance claims had been filed at 19 properties in the City of Norwich over the preceding twenty-five years. These repeat claims demonstrate the serious nature of the flood hazards in the City of Norwich, particularly along the Yantic River. Six of the repetitive loss properties had been mitigated through buyouts. The remaining repetitive loss properties were located along the Yantic River (11), Great Plain Brook (1), and Norwichtown Brook (1). As of 2017, 21 repetitive loss properties are listed in Norwich, representing an increase of two. One of these is located along Ford Brook, while the other is in an undetermined location. In general, the repetitive loss list for Norwich had some inconsistencies and potential errors in both 2012 and 2017 – more than any other SCCOG jurisdiction – and could benefit from efforts to permanently correct errors. As of 2022, the city still has 21 RL properties; 10 are residential and 11 are commercial.

The City of Norwich 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 recently released DFIRM to identify the approximately 389 structures in the City that are located in the 1% annual chance floodplain. This could provide a list of addresses to inspect following a storm event and allow for the City to track building permits for repairs following a natural hazard. This information, in turn, would provide supporting data for future grant applications.

Vulnerability Analysis of Critical Facilities

As noted in Section 2.7, the only critical facilities located within a 1% annual chance floodplain are the waste water treatment facility on the Thames River, the Yantic Fire Engine Company No. 1, the Occum Fire Department, and John B. Stanton Elementary School. The wastewater treatment facility and the elementary school do not typically experience flooding. The risk of inland flooding to these facilities is therefore considered to be low. The Yantic Fire Engine Company No. 1 is frequently flooded, and the Fire Department moves equipment out of this building when major floods are forecast. The City is continuing to explore ways to mitigate flooding in this area. The Occum Fire Department is partly in the SFHA along the Shetucket River and has not flooded as often as the Yantic Fire Department.

The City's Department of Public Works offices and garage are located in the 0.2% annual chance floodplain of the Yantic River on the periphery of the 1% annual chance floodplain. This facility is located on the north side of Clinton Avenue and is susceptible to flood damage. The City stores sandbags at this facility which they deploy to protect the structure when major floods are forecast.

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 two at-risk fire stations (Yantic and Occum) and the Norwich Public Works facility were included in the assessment. The assessment determined that all three faced current flood risks and would experience increasing flood risks. Recommendations are incorporated into the list of actions in Section 0of this annex and summarized in the table below.

Table 5-2 Norwich Critical Facility Flood Risks

Facility	Address	Short-Term (0-20 years)	Long-Term (>20 years)
Yantic FD	151 Yantic Rd	Eliminate basement	Relocate facility
Occum FD	44 Taftville Occum Rd	Eliminate basement	Relocate facility

Public Works	50 Clinton Ave	Dry floodproof the utility room	Wet floodproof all remaining lower areas

5.2.3.1 Hazard Losses

According to NFIP statistics, as of June 30, 2022, the City of Norwich has had a total of 229 flood related losses, with a total of $2,163,179 paid towards the claims.

Since 2017 there have also been seven NOAA reported flash flood events, all having occurred on six different dates. There were several road closures and stranded vehicles. There were no reported financial losses associated with these events, however there were road closures, and power needed to be turned off at some residences due to flooding.

The City also received FEMA Public Assistance (PA) reimbursements for the September 25, 2018, event. The federal share of funds received was $10,831 which was a portion of the total $16,118 in project costs. Almost all of these funds were received for protective measures, with a small portion for state management costs (Figure 5-2).

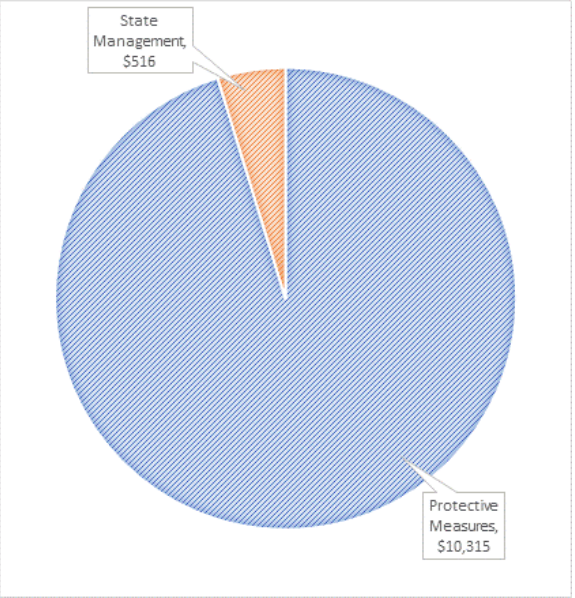


Figure 5-2 September 2018 Storm FEMA Funding Categories

FEMA HAZUS-MH 6.0 was used to develop losses associated with the 100-year riverine flood event. Table 5-3 presents flood related damages for the City of Norwich. Additional HAZUS-generated losses for the city and region can be found in the Multi-Jurisdictional document.

Table 5-3 HAZUS-MH Riverine Flood Related Economic Impacts

Norwich	2022 Results				
	Residential	Commercial	Industrial	Other	Total
Direct					
Building	$61,020,000	$67,760,000	$8,560,000	$13,030,000	$150,370,000
Contents	$33,810,000	$195,080,000	$20,890,000	$49,230,000	$299,010,000
Inventory	$0	$29,740,000	$2,570,000	$530,000	$32,840,000
Subtotal	$94,830,000	$292,580,000	$32,020,000	$62,790,000	$482,220,000
Business Interruption					
Income	$1,360,000	$97,760,000	$260,000	$9,330,000	$108,710,000
Relocation	$11,390,000	$34,460,000	$460,000	$9,280,000	$55,590,000
Rental Income	$9,910,000	$22,690,000	$70,000	$3,000,000	$35,670,000
Wage	$3,200,000	$140,800,000	$470,000	$161,340,000	$305,810,000
Subtotal	$25,860,000	$295,710,000	$1,260,000	$182,950,000	$505,780,000

Total	**$120,690,000**	**$588,290,000**	**$33,280,000**	**$245,740,000**	**$988,000,000**

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 sectors 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 Norwich, 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 protect the public health, safety, and welfare of residents. Clean, adequate water supply is certainly a public health concern.

The City is served by NPU, which relies on Deep River Reservoir in Colchester and the Stony Brook Reservoir in Montville. In addition, the Norwichtown Well is a backup source of supply, and NPU has two emergency surface water supplies in Norwich: the Fairview and Bog Meadow Reservoirs. Having a City-owned utility with multiple water supply sources potentially increases drought resilience, increasing the city's capacity to provide adequate water.

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 of Norwich 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 Norwich is vulnerable to drought, but the degree of vulnerability varies. A majority of the properties in the city rely on NPU for their water service, therefore the risk of private wells drying up is minimal in Norwich. However, these surface water sources are faced with water level and quality challenges during extended periods of drought. As such, residents may be imposed with mandatory water conservation requirements during these times.

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 Norwich since 2017. Since 2012 there has been one record of a Norwich entity receiving funding from the United States Department of Agriculture in the wake of a drought event. The Farm Service Agency received $5,534 in 2016 in what appears to be in response to a declared drought event. 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 floodwater. In addition, a dam failure can cause a chain reaction where the sudden release of floodwater 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 Norwich is considered a possible event each year with potentially critical effects. No dam failures have affected the City since the time of the last HMP.

The 1955 floods washed out dams on the Shetucket River, causing damage in Norwich. However, the best-known example of a dam failure impacting the City of Norwich occurred several years later. A dam failure occurred on March 6, 1963, on Spaulding Pond Brook. This failure occurred during a moderate storm on the Spaulding Pond Dam, 400 feet above the center of the City of Norwich. Thousands of gallons of water poured into the city, leaving six dead and causing $6 million in property damage.

5.4.2 Existing Capabilities

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. As noted in the Multi-Jurisdictional HMCAP, the City of Norwich is home to six Class C (high hazard) dams and three Class B (significant hazard) dams. In addition, there are three dams located upstream of Norwich whose failure could potentially lead to flooding within the City. These dams are listed on Table 5-4.

Table 5-4 Dams Registered with DEEP in the City of Norwich

CT Dam#	Dam Name	Dam Class	Owner Type

10411	Fords Pond Dam	A	Private
10413	Falls Mill Lower Dam	A	Municipal
10415	Chiangi Dam	A	Private
10416	Hunters Pond Dam	A	Private
10423	Wilcox Pond Dam	A	Private Corporation
10424	Plain Hill Pond	A	Private
10425	Fly Pond Dam	A	Private
10426	Cote Pond Dam	A	Private
10427	Turnpike Pond Dam	A	Private Corporation
10429	Occum Pond Hydro Dam	A	Municipal
10430	Wildowsky Pond Dam	A	Private
10406	Taftville Reservoir #1 Dam	B	Municipal
10407	Bog Meadow Reservoir Dam	B	Municipal
10409	Taftville Reservoir #3 Dam	B	Municipal
10401	Taftville Reservoir #2 Dam	BB	Municipal
10410	Cradnall Property Dam	BB	Municipal
10412	Falls Mill Upper Dam	BB	Municipal
10403	Taftville Hydro Dam #4	C	Power Utility
10404	Fairview Reservoir Dam And Dikes	C	Municipal
10405	Greenville Hydro Dam	C	Municipal
10417	Spaulding Pond Dike	C	Municipal
10418	Skating Pond Dam	C	Municipal
10419	Spaulding Pond Dam	C	Municipal

Dams in the region whose failure could impact the City of Norwich are under the jurisdiction of the 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 EAPs for such dams.

NPU maintains an EAP for each of its dams, as does the City of Norwich. All eight EAPs maintained by NPU were updated in 2015-2017 to incorporate changes in the State's dam safety regulations and the new requirements for failure analysis and inundation mapping.

Two of the private dams listed in Table 5-4are each hydropower dams and have EAPs, and the Fitchville Pond Dam in Bozrah was formerly used to provide power to mills in Yantic but is no longer active. An EAP does exist for the dam. Recently completed "Rehabilitation Assessment" reports for the two Spaulding Pond Dams are also available to the Norwich Emergency Management Director to supplement the EAPs for those dams.

The City has included dam failure inundation areas within its Everbridge reverse 9-1-1 contact database, allowing it to alert residents in case there is a risk of failure.

While the existence of dams is usually stable, changes do occur. A privately-owned significant hazard (Class B) dam in Bozrah on the Yantic River, the Gilman Dam, was removed in 2006 to 2007. A Class B dam in southeastern Norwich, the Cradnall Property Dam, was downgraded by the Connecticut DEEP to no longer being a significant hazard dam sometime before 2007.

The City owns the Upper Falls Dam on the Yantic River. This former hydropower dam is located downstream of the Sherman Street bridge. The City wishes to remove this dam as part of a Sherman Street bridge project since backwater conditions from this dam exacerbate flooding at the Sherman Street bridge. This project has not yet been completed, but the City continues to be interested in at least investigating the impacts that removal would have. The City has recently applied for grant fundings to pursue the removal of this dam with Connecticut DEEP.

The City of Norwich and NPU have together conducted a number of emergency drills using the EAPs on file. Most recently, a dam failure tabletop exercise was completed in 2019 to facilitate entry into the CRS program. Although CRS points were not awarded for the tabletop exercise, the experience was valuable for NPU and the City.

Summary

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

5.4.3 Vulnerabilities and Risk Assessment

The potential impacts related to the failure of Class C and Class B dams within and upstream of Norwich are described below. Where information was available, the descriptions below are based on information available at the Connecticut DEEP Dam Safety Section. For dams without a formal dam failure analysis, a qualitative assessment was prepared for this HMP. Refer to Figure 5-3for a location map showing the dams and potential dam failure inundation areas (where available).

- *Bog Meadow Reservoir Dam* – Bog Meadow Reservoir has a Class B dam that impounds the headwaters of Norwichtown Brook. The reservoir was formerly used for water supply but is inactive. This dam is owned and maintained by NPU. An EOP was prepared for the dam in 2009 and an EAP was developed in 2015-2017 in accordance with the new dam safety regulations.

  The potential dam failure inundation area of the Bog Meadow Reservoir Dam was originally prepared by Lenard & Dilaj Engineers sometime in the late 1970s. The potential inundation area includes both residential and commercial areas as well as Interstate 395. No structures would be affected until floodwaters reached the vicinity of West Town Street, at which point many commercial and industrial buildings would be affected on West Town Street, Case Street, Clinton Avenue, Wawecus Street, Pleasant Street, and Sturtevant Street. The Public Works Headquarters would also be impacted on Clinton Avenue. Residences on West Town Street, Lee Avenue, Sholes Avenue, Woodrow Avenue, Everett Avenue, Sturtevant Street, and Pleasant Street would also be impacted. The inundation area ends at the Yantic River under the assumption that the increase in stage would not reach the level of the 1% annual chance flood.

- *Deep River Reservoir Dam* – Deep River Reservoir has a Class C dam that impounds Deep River in Colchester. The reservoir is used for potable water supply. This dam is owned and maintained by NPU. An EOP was prepared for the dam in 2009 and an EAP was developed in 2015-2017 in accordance with the new dam safety regulations.

  The potential dam failure inundation area of the Deep River Reservoir Dam was originally prepared by Lenard & Dilaj Engineers sometime in the late 1970s. The potential inundation area includes primarily residential areas and a few roadways. No structures would be affected until floodwaters reached the vicinity of Reservoir Road in Lebanon, at which point the Deep River Water Treatment Plan owned and operated by NPU would be inundated as would 10 nearby structures that appear predominantly residential.

  Floodwaters would then likely overtop Route 2 and proceed to the Yantic River where it would inundate an area wider than the 1% annual chance flood event. An alcohol and drug treatment facility on Camp Moween Road would be inundated, as would a residence on Camp Moween Road and a residence on Norwich Avenue. Those two roads may also overtop. Downstream of Camp Moween Road, three additional homes on Norwich Avenue would be affected before floodwaters subside within the 1% annual chance floodplain of the Yantic River and eventually the Yantic River channel.

- *Fairview Reservoir Dam* – Fairview Reservoir has a Class C dam located approximately two miles north of the center of the City of Norwich that impounds the headwaters of Bobbin Mill Brook. The reservoir was formerly used for potable water supply but is currently inactive. NPU owns and maintains the dam. An EOP with an associated dam failure inundation area was prepared for the dam in 2009 and an EAP was developed in 2015-2017 in accordance with the new dam safety regulations.

  The potential dam failure inundation area generally follows the channel of Bobbin Mill Brook to its confluence with the Yantic River. The inactive treatment works located immediately downstream of the dam would be affected by a dam failure almost immediately. Six homes on Scotland Road, one on Huntington Lane, and one on East Town Street would be affected next. East Town Street and Town Street would both be overtopped, with several commercial buildings on Town Street being inundated along with three homes on Butts Lane. The mapped inundation area ends at Route 2, although it is likely that the lower section of the Yantic River would swell with floodwaters.

- *Fitchville Pond Dam* – Fitchville Pond has a Class C dam that is an impoundment of the Yantic River. The impoundment was formerly used to provide power to mills in Yantic. The dam is privately owned. Today the impoundment is used for recreation and is heavily silted in such that the dam does not impound a significant amount of water. While a dam failure inundation area for this impoundment is not believed to exist, the 0.2% annual chance floodplain of the Yantic River between the dam and Yantic would provide a suitable interim dam failure inundation area.

- *Greeneville Dam* – Greeneville Dam is a Class C dam located on the Shetucket River and owned by the City of Norwich Dept. of Public Utilities. The dam was constructed in 1888 and is a timber crib structure used for hydroelectric power generation. Failure of this dam would likely result in an inundation area similar to the 1% annual chance flood event for areas downstream along the Shetucket River from the dam to the Thames River. This would cause the inundation of several industries nearby 8th Street. An EAP was developed in 2015-2017 in accordance with the new dam safety regulations.
- *Scotland Dam* – The Scotland Dam is a Class C dam located on the Shetucket River near the Windham, Scotland, and Franklin boundary that is privately owned and used for hydroelectric power generation. Failure of this dam would likely result in an inundation area similar to the 0.2% annual chance flood event for areas downstream along the Shetucket River from the dam to Occum Pond, with lesser impacts downstream in Norwich. This would cause the inundation of several industries nearby 8th Street. Thus, a dam failure could result in the flooding of homes and businesses along Route 97 in Norwich. See the Sprague Annex for the location of this dam.

- *Spaulding Pond Dam (Site #1 & Site #2)* – The two Spaulding Pond Dams are both Class C dams located in Mohegan Park that are impoundments of Spaulding Pond Brook. The upper dam (Site #1) is owned by the City of Norwich and the impoundment is used for recreation. This dam failed in 1963 as noted in Section 10.1. The lower dam (Site #2) was constructed by the Natural Resources Conservation Service in the 1960s for flood control purposes (see Section 3.2). The lower impoundment is much smaller than the upper impoundment so the inundation level and the amount of damage would likely be less for a failure of this dam than for the upper dam.

  Failure of the upper dam would inundate a major parking area in Mohegan Park, Mohegan Park Road, and likely washout Spaulding Pond Dam (Site #2) downstream above Mohegan Park Road, combining floodwaters from both impoundments. Floodwaters would then continue downstream, overtopping Mohegan Park Road, inundating a condominium complex, and impacting several homes and apartment buildings in the vicinity of East Baltic Street. Homes in the vicinity of Hickory Street, Brook Street, Baltic Street, and Broad Street would also be affected. Commercial buildings on Lake Street, Pond Street, Franklin Street, Chestnut Avenue, Chestnut Street, Willow Street, Bath Street, Main Street, and City Landing would also likely experience floodwaters. The Thames River would likely absorb the floodwaters without further inundation.

  A "Rehabilitation Assessment" was recently completed for the two Spaulding Pond Dams. These reports are available to the Norwich Emergency Management Director to supplement the EAPs for those dams.

- *Taftville Dam #4* – Taftville Dam #4 is a Class C dam located on the Shetucket River and privately owned. The dam impounds water for hydroelectric power generation. Failure of this dam would likely result in an inundation area similar to the 1% annual chance flood event for areas downstream along the Shetucket River from the dam to the Thames River. This would cause the inundation of several industries in Taftville as well as downstream nearby 8th Street.

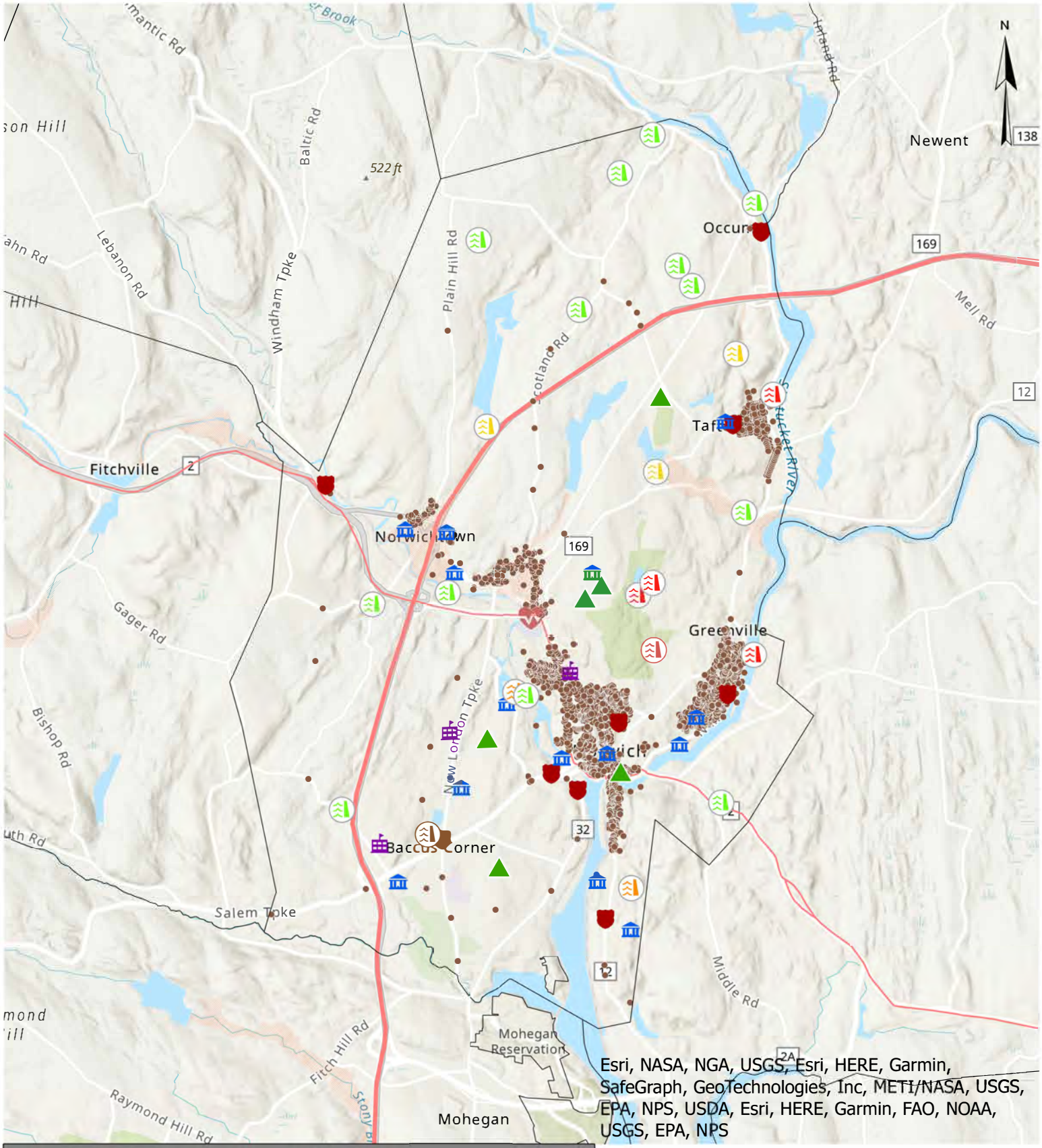
- *Taftville Reservoir #1 Dam* – Taftville Reservoir #1 has a Class B dam that impounds the headwaters of Hunter Brook. The reservoir was formerly used for water supply but is currently inactive. The area around the impoundment is currently used for recreation. The dam is owned and maintained by NPU and the City of Norwich. An EOP for the dam was prepared in 2009 and an EAP was developed in 2015-2017 in accordance with the new dam safety regulations.

  Currently, the water level in the inactive reservoir is typically maintained six or seven feet below normal pool level. However, failure of the dam at full pool elevation could cause immediate flooding of nine homes on Route 169, as well as one home of Tetreault Avenue, one home on Oakland Drive, and approximately 40 homes and commercial structures on Hunters Road. The Hunters Pond Dam, a Class A dam located on Hunters Road just upstream of Route 12, could also breach. Approximately 20 additional residential structures located on Route 12 / Route 97, Prentice Street, and Bolduc Lane would also be inundated. The Shetucket River is expected to absorb the floodwaters without additional downstream flooding.

- *Taftville Reservoir #3 Dam* – Taftville Reservoir #3 has a Class B dam that impounds an unnamed tributary to the Shetucket River. The dam impounds less than one acre and ultimately the dam will be fully breached and drained. According to the EOP prepared for the dam in 2009, the dam is remotely located and is accessible only by a 15-minute walk. Dam failure inundation mapping prepared by Milone & MacBroom, Inc. in conjunction with the EOP shows that the potential inundation area stretches downstream to Interstate 395 and does not intersect any structures. Thus, the hazard classification of the dam may not be accurate. An EAP was developed in 2015-2017 in accordance with the new dam safety regulations.

5.4.3.1 Hazard Losses

There are no reported losses for the City of Norwich 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 Norwich

Date: 2/23/2023

0 0.45 0.9 1.35 1.8 Miles

SCCOG

RESILIENT Land & Water

Legend

Dams

- A
- B
- BB
- C
- Historic Resources
- Emergency Services
- Municipal
- School
- Shelter or Cooling Center
- Care and Medical Facility
- Dam Failure Inundation Area

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. 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.[2]

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 NPU 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 NPU 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										

[2] 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 Norwich has identified the Senior Center and the library as cooling centers in Norwich. In the event of a projected heat event or heat wave, the City is prepared to open up the cooling centers for resident cooling use.

The City is also interested in expanding and improving public recreational trails that aid in providing cooling. Norwich recently submitted two grants to Connecticut DEEP Rec Trails program to expand the 8th Street Greenville Park along the Shetucket River, and to add a bike loop on NPU property which extends into the Town of Preston. While the project has yet to be funded, the city is going to continue to pursue funding, and looks for more areas for passive recreation and green/open space.

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.

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 Norwich. The elderly populations in Norwich are more vulnerable to extreme heat events, particularly when in home cooling is not available. In addition, those with certain health conditions, such as heart or respiratory illness, may be at greater risk of health related illness or death.

The city has noted that the Greenville area in Norwich has some “barren areas” which have reduced green cover and could benefit from an increase in vegetation. The creation of more green or open space would likely help mitigate extreme heat impacts.

Another concern of the city is the Route 82 corridor. This highly impervious corridor stretches from the southwest corner of Norwich at the Bozrah municipal border and runs northeast crossing over the Yantice River terminating just before downtown Norwich. Along this entire roadway there is a high density of impervious surfaces including buildings, parking lots, and roadways. City staff feels this is a large source of heat for the neighborhoods the roadway traverses. The road will soon have roundabouts as upgrades are being made, however the corridor is in need of greening.

Overall, the city feels that the amount of impervious coverage in the city needs to be evaluated and addressed. As noted by residents, there are some parcels that are almost entirely paved; this contributes to heat emissions and also exacerbates flooding in some areas. Some of these parcels have likely been paved excessively to adhere to outdated parking requirements. An assessment of impervious coverage in the city is something that may be able to address the high imperviousness in some areas.

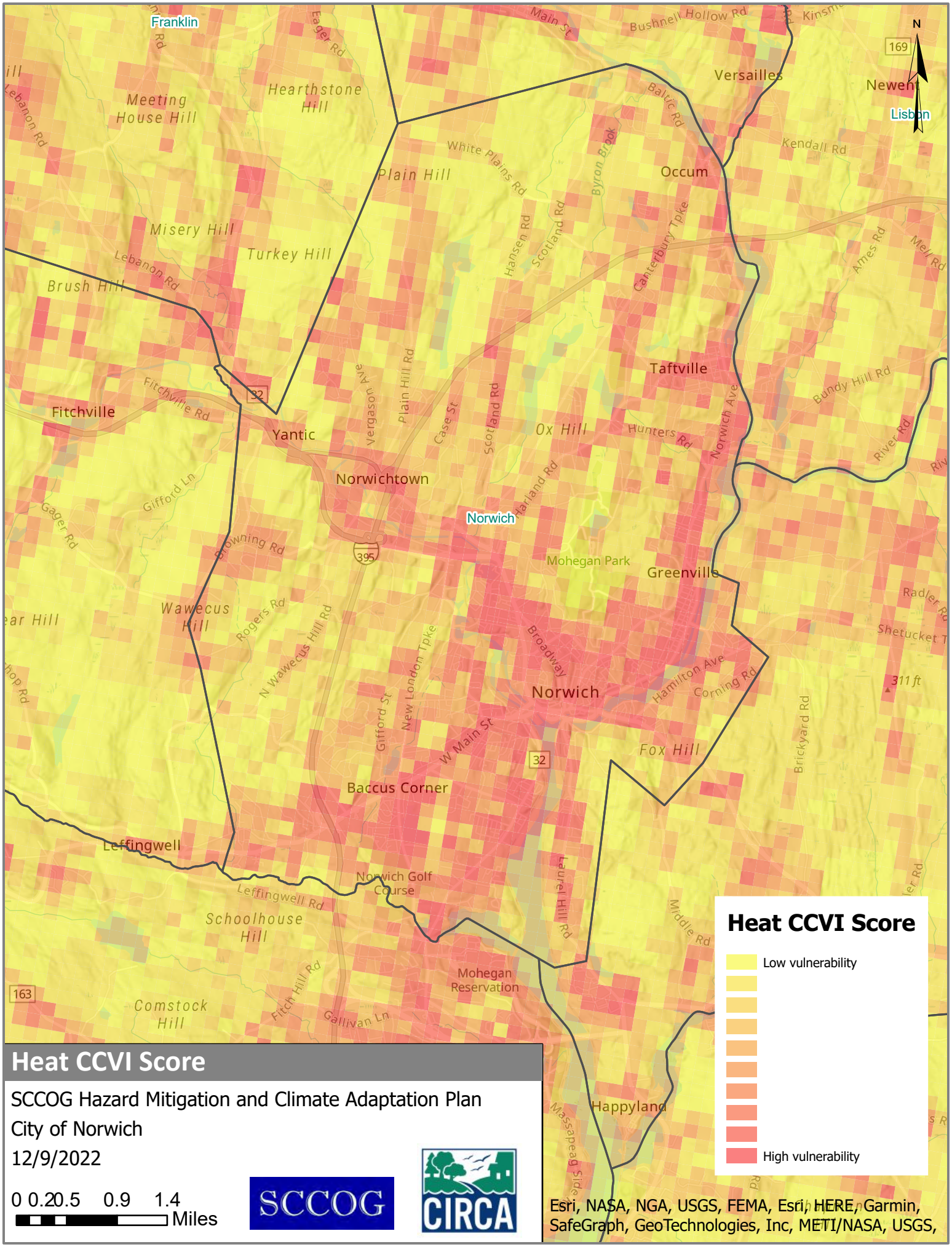
UConn CIRCA has developed a tool to aid in understanding extreme heat vulnerability for communities across the state. This tool, known as the Climate Change Vulnerability Index (CCVI), is comprised of

dozens of factors that contribute to a community's heat sensitivity, exposure, adaptive capacity, and ultimately the overall heat vulnerability. The CCVI has been used as a tool to characterize heat vulnerability for Norwich. The distribution of heat vulnerability throughout the community can be seen in Figure 6-1.

Norwich has noticeably higher heat exposure compared to surrounding towns, due primarily to significant impervious surfaces as well as some high-density areas. Heat sensitivity in Norwich is also relatively high due to social vulnerabilities. However, proximity to critical facilities such as shelters, including two cooling centers, results in relatively high adaptive capacity as well. Therefore, the overall heat vulnerability for Norwich is moderate to high depending on location.

6.2.3.1 Hazard Losses

There are no reported losses for the City of Norwich related to extreme temperatures.


Heat CCVI Score
Low vulnerability
High vulnerability
Franklin
Norwich
Norwichtown
Yantic
Fitchville
Taftville
Occum
Versailles
Newent
Lisbon
Greenville
Baccus Corner
Leffingwell
Mohegan Park
Mohegan Reservation
Norwich Golf Course
Happyland
Meeting House Hill
Hearthstone Hill
Plain Hill
Misery Hill
Turkey Hill
Brush Hill
Wawecus Hill
Schoolhouse Hill
Comstock Hill
Ox Hill
Fox Hill
Main St
Bushnell Hollow Rd
White Plains Rd
Baltic Rd
Kendall Rd
Lebanon Rd
Fitchville Rd
Plain Hill Rd
Case St
Scotland Rd
Hansen Rd
Canterbury Tpke
Ames Rd
Bundy Hill Rd
River Rd
Norwich Ave
Hunters Rd
Harland Rd
Gifford Ln
Gager Rd
Browning Rd
Rogers Rd
N Wawecus Hill Rd
New London Tpke
Broadway
W Main St
Gifford St
Hamilton Ave
Corning Rd
Brickyard Rd
Laurel Hill Rd
Middle Rd
Leffingwell Rd
Fitch Hill Rd
Gallivan Ln
Massapeag Side Rd
Radler Rd
Shetucket T
311 ft
Eager Rd
Vergason Ave
Byron Brook
Mell Rd
32
395
169
163
N
Heat CCVI Score
SCCOG Hazard Mitigation and Climate Adaptation Plan
City of Norwich
12/9/2022
0 0.20.5 0.9 1.4
Miles
SCCOG
CIRCA
Esri, NASA, NGA, USGS, FEMA, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS,

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 City's EOP recommends a 30 to 50 foot cleared radius be maintained around homes and buildings to prevent wildfires.

The Fire Department goes to fires as quickly as possible in the City. NPU provides fire protection water. Fire pumps are tested weekly and are considered to provide excellent pressure. Each hydrant is banded such that the Fire Department knows how much pressure is available. The City also has several dry hydrants in outlying areas that are not connected to public water service. Water service that will assist with firefighting was extended to Ponemah Mills as part of the renovation of that property.

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." Norwich has designated the Fire Chief and Fire Marshals of the Norwich Fire Department as the Open Burning Officials. 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 City has three areas that are concerns for wildfires due to difficult access. Each is located in the northern portion of the city. These are the undeveloped watershed lands surrounding Bog Meadow Reservoir, undeveloped lands between Barbers Road and Cold Brook, and undeveloped areas along Byron Brook east of Scotland Road. There are no developed roads in these areas and access roads are

few; where they do exist, they are typically one-way. The City must utilize off-road equipment to fight fires in these areas; thus, the risk of wildfire in these areas is considered moderate.

The risk for wildlife in the remainder of the City is considered low for most areas for several reasons. First, the City has widespread development 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, nearly all developed areas of the City have public water service provided by NPU. This public water service provides sufficient water volume and pressure to fight nearly any fire. Outlying areas have dry hydrants that provide additional firefighting water. Third, the Thames River, the Yantic River, and the Shetucket River are near most developed areas 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, and emergency vehicles can typically turn around in private driveways on these roads. Finally, the City has agreements with its neighbors to provide assistance in case of an emergency. Thus, if a wildfire did occur, it would likely be contained within only a few acres.

6.3.3.1 Hazard Losses

There are no reported losses for the City of Norwich 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 8 of the Multi-Jurisdictional HMP. 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.

City Departments have adequate backup supplies and facilities for continued functionality following an earthquake.

Due to the infrequent nature of damaging earthquakes, City land use policies do not directly address earthquake hazards. Earthquakes are indirectly addressed through policies preventing residential development in areas prone to collapse such as below steep slopes or areas prone to liquefaction. 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

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, very few areas of the City are underlain by stratified drift. These areas are potentially more

at risk of earthquake damage than the areas of the City underlain by glacial till. 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 areas that are not at increased risk during an earthquake due to unstable soils are the areas underlain by glacial till.

Three bedrock fault lines exist within or near the City of Norwich. Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known active faults. However, 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.

The built environment in the City primarily includes some more recent construction that is seismically designed. However, most buildings were built in the 1970s and 1980s or before and therefore are not built to current building codes. In addition, many buildings are renter-occupied and therefore may not be fully maintained, thereby increasing the risk of damage from an earthquake. 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. The City has many areas of steep slopes and bluffs particularly overlooking the Thames River. Thus, landslides are 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. As noted previously, several types of utility infrastructure in the City are located above ground. A quick and coordinated response with NPU will be necessary to inspect damaged utilities following an earthquake, to isolate damaged areas, and to bring backup systems online. This is covered in the City and NPU EOPs.

7.2.4 Hazard Losses

There are no reported losses for the City of Norwich related to earthquakes. Downscaled losses from the 2019 Connecticut Natural Hazard Mitigation Plan are developed in the Multi-Jurisdictional document. In addition, a *HAZUS-MH* analysis of the potential economic and societal impacts to the SCCOG region from earthquake damage is detailed in the Multi-Jurisdictional HMCAP. 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. Potential economic impacts can be seen in Table 7-1, with additional information developed in the Multi-Jurisdictional document.

Table 7-1 HAZUS-MH Earthquake Related Economic Impacts

Norwich	Residential	Commercial	Industrial	Others	Total
	$435,130,000	$1,016,620,000	$100,120,000	$451,410,000	2,003,280,000

8. Mitigation Strategies and Actions

8.1. Status of Mitigation Strategies and Actions

A total of 23 hazard mitigation actions were developed in the previous edition of this plan. The status of each is listed below.

#	Mitigation Actions and Strategies for Norwich 2016 - 2021	Status	Status Details
1	Identify rock outcrops and steep slopes with additional natural resource potential and prioritize for conservation efforts	Carry Forward	Steep slopes are still a concern for Norwich; future development regulations might be changed to prevent/control some development on parcels that include steep areas - The City did recently create a conservation easement for one property with steep slopes.
2	Continue to support linear park and trail systems in the 1% annual chance floodplain, and expand the Heritage Riverfront Walkway	Carry Forward	There is still interest in this action.
3	Consider additional regulations and design standards for development of properties with slopes greater than 15%		See #1.
4	Improve Norwich staff participation in local and regional planning exercises that increase readiness to respond to disasters.	Capability	For example, NPU conducted a dam failure drill with the Norwich EMD, engineering staff, and planning staff.
5	Implement necessary upgrades to communication capabilities, specifically the city radio communications system	Underway/Complete	Both Fire and Emergency Management communications have been updated in recent years. In addition, the entire public safety radio system is being redone; the new system should be operational in August. We can mark this as complete.
6	Eliminate basement of Yantic Fire Engine Co. No. 1 building	Remove or Revise	Though the facility has flooded in the past, Yantic FD is reportedly reluctant to make changes to its building.
7	Eliminate basement of Occum Fire Department building	Carry Forward with Revisions	The Occum FD has not reported flooding so this might not be a concern. A new study of the floodplain might be needed to assess the extent of flood risk.
8	Dry floodproof the utility room at Public Works	Carry Forward	This is still an interest, although flooding has reportedly not been much of a concern in this area in recent years.
9	Continue to regulate new development activities within SFHAs to the greatest extent possible within Town land use regulations	Capability	The action can be retired.
10	Compile a list of addresses of structures within the 1% annual chance floodplain and storm surge areas, and track repair costs	Remove	This is reportedly very hard to do, and it remains unclear what the benefits would be for the City. SD/SI is tracked, and flood maps are always reviewed before any building projects occur. The City is also seeing more flood concerns outside of regulated floodplains, to the point that this

			action would not be helpful. In other words, the City is capable of managing its SFHAs.
11	Incorporate information on the availability of flood insurance into all hazard-related public education workshops	Complete	Complete/as needed.
12	Make available FEMA-provided flood insurance brochures and encourage residents to purchase insurance if they are in a SFHA	Remove	Retire action. This information is available on the Norwich website. Brochures are not particularly helpful at the present time.
13	Distribute a brochure outlining the risks of floodprone areas, mitigation strategies, and contacts		Retire action. See #12.
14	Consider removing the silt buildup from the vicinity of the Canada Bridge on Sherman Street	Complete	The bridge replacement is currently underway and will be completed over the next couple years, and some material will be removed in the process. The new bridge will have a larger opening and silt buildup will likely be less of a concern.
15	Work with Connecticut DEEP and FEMA to eliminate errors in the list of repetitive loss properties	Carry Forward with Revisions	This has not happened. City staff report not having much ability to change the list given the other parties involved. It was noted that the AW-501 modification forms were completed for CRS entry.
16	Convert previously residential structures owned by the City into open space, prioritizing those that are floodprone.	Carry Forward with Revisions	Carry forward with revisions. There is one such property on Clinton Avenue (privately owned house next to state land), but the City does not get many of these types of properties.
17	Pursue the creation of additional open space on City-owned properties, prioritizing those within SFHAs.	Carry Forward with Revisions	Carry forward with revisions/combine with #16. The City owns 26 Shipping Street but will likely sell this for redevelopment rather than turn it into open space. Economic development concerns are important to the City.
18	Use grant funding to acquire floodprone private residential properties that pose significant health and safety risks from owners that approach the City.	Carry Forward	See #16 above, as well.
19	Pursue acquisition of commercial floodprone properties and convert to open space, if funding is available.	Carry Forward with Revisions	This must be balanced with economic development concerns; if there's an opportunity for economic development, there will be pushback against the idea of turning it into open space. Possibly be more specific i.e., "acquire riverfront properties." ***Overall, a new action is needed to replace or improve actions #16 through #19 to facilitate effective, desired acquisitions.***
20	Assist NPU with completion of their sewer separation project.	Carry Forward	Carry forward. It sounds like some work has been done on this action, but it is not complete; perhaps revisit. Residential properties still do have gutters tied into the system. There is a

			$400 rebate if an owned removes gutter connection.
21	Make information on wind-resistant construction techniques available to all building permit applicants	Complete	The building code has been revised to 135 mph so that braced wall designs must now be incorporated into new constructions.
22	Investigate feasibility of removing the Upper Falls dam on the Yantic River to eliminate backwater flooding at Sherman Street	Carry Forward	The City is waiting to hear back about a grant application (DEEP) for this project.
23	Investigate feasibility and utility of removing the dam downstream of the Canada Bridge.	Carry Forward	This is the Upper Falls dam referred to in the previous action (#23)

During the planning process, CIRCA and consultant staff facilitated a discussion with the City staff to identify the greatest climate change concerns and challenges. The previous actions were re-evaluated in this context. Elements of 12 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 Norwich 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:

- Execute the Thamesville Coastal Revitalization Project planned by Federal agencies. The cost estimate is for staff support.
- Create more greenspace in the Greenville Area and other urban heat islands in the City such as the Route 82 corridor. This should be accomplished by developing a master plan with typical concept designs to be applied in Greenville and along Route 82.
- Conduct an impervious surface evaluation to inventory largely paved parcels to ultimately reduce imperviousness, increase green space, and address parking requirement needs in the city. Utilize the Holyoke Impervious Surface Management Plan (refer to Mass MVP report inventory) as a potential template.

The city intends to focus on the above actions, along with the sole action about cooling centers:

- Ensure that the cooling centers (library and senior center) are accessible using transit or alternate transportation options.

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

Table 8-1 City of Norwich 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	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NW1	Ensure that the cooling centers (library and senior center) 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; IIJA BBFP	7/2023 - 6/2025	High	16	3	48
NW2	Conduct a study of the floodplain surrounding the Occum Fire Department building to determine the extent of flood risk. This determination may be used to modify or retire the recommendations in the Southeastern Connecticut Critical Facilities Assessment to eliminate the basement.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Floodplain Manager	$10,000 - $25,000	Municipal Operating Budget	7/2024 - 6/2025	Low	12	5	60
NW3	Annually FEMA grant information to Yantic Fire Company to ensure they are aware of opportunities to reduce flood risk to the building. This action replaces full execution of the recommendations in the Southeastern Connecticut Critical Facilities Assessment.	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	12	4	48
NW4	Dry floodproof the utility room at Public Works as recommended in the Southeastern Connecticut Critical Facilities Assessment.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Public Works	$100,000 - $500,000	FEMA HMA; Municipal CIP Budget	7/2024 - 6/2025	Medium	18	8	144
NW5	Pursue a FEMA map revision for the Terminal Way area, as the floodway designation is not consistent with the tidal	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases	Property Protection	Planning and Neighborhood Services	$10,000 - $25,000	Municipal Operating Budget	7/2024 - 6/2025	Medium	10	9	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	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
	characteristics of the Thames River estuary.	frequency and severity of floods.									
NW6	Execute the Thamesville Coastal Revitalization Project planned by Federal agencies. The cost estimate is for staff support.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Office of the Chief Elected Official	$0 - $10,000	Municipal Operating Budget	7/2023 - 6/2025	High	21	9	189
NW7	Implement recommendations of the ARPA-funded drainage study located in the watershed that includes Kelly Middle School and Backus Hospital.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	$500,000 - $1M	FEMA HMA; Municipal CIP Budget	7/2023 - 6/2025	High	17	7	119
NW8	Replace undersized culverts in Hunters Road to reduce risk of flooding and washouts.	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	LOTCIP; FEMA HMA; Municipal CIP Budget	7/2025 - 6/2026	High	14	8	112
NW9	Develop designs for eventual installation of a new stormwater system in the Laurel Hill/Sunnyside area.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	Public Works	$25,000 - $50,000	FEMA HMA; Municipal CIP Budget	7/2025 - 6/2026	Medium	14	7	98
NW10	Develop appropriate flood mitigation recommendations after FEMA completes the re-mapping of the Spaulding Pond/Spaulding Brook corridor. These recommendations can then be carried into the next edition of this plan.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Property Protection	Planning and Neighborhood Services	$25,000 - $50,000	DEEP Climate Resilience Fund; CIRCA Resilient Connecticut	7/2025 - 6/2026	Medium	18	8	144

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	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NW11	Assist NPU with completion of the sewer separation project through coordination and direct support as needed.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Water & Wastewater Utility Projects	Public Works	>$1M	CWSRF; NPU CIP Budget	7/2023 - 6/2025	Medium	14	7	98
NW12	Working with an engineering firm or non-profit conservation entity, determine the feasibility of removing the Upper Falls dam on the Yantic River to eliminate backwater flooding at Sherman Street	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	NOAA/NFWF; LISFF; IIJA RFPBR	7/2025 - 6/2026	Medium	17	7	119
NW13	Create more greenspace in the Greenville Area and other urban heat islands in the City such as the Route 82 corridor. This should be accomplished by developing a master plan with typical concept designs to be applied in Greenville and along Route 82.	Address risks associated with extreme heat events, especially as they interact with other hazards.	Natural Resources Protection	Planning and Neighborhood Services	$100,000 - $500,000	DEEP Climate Resilience Fund; CIRCA Resilient Connecticut; LISFF	7/2024 - 6/2025	High	21	9	189
NW14	Conduct an impervious surface evaluation to inventory largely paved parcels to ultimately reduce imperviousness, increase green space, and address parking requirement needs in the city. Utilize the Holyoke Impervious Surface Management Plan (refer to Mass MVP report inventory) as a potential template.	Address risks associated with extreme heat events, especially as they interact with other hazards.	Natural Resources Protection	Planning and Neighborhood Services	$100,000 - $500,000	DEEP Climate Resilience Fund; CIRCA Resilient Connecticut; LISFF	7/2025 - 6/2026	High	22	9	198
NW15	Support additional linear park and trail systems in the 1% annual chance floodplain and expand the Heritage Riverfront Walkway.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Natural Resources Protection	Planning and Neighborhood Services	>$1M	FEMA HMA (for acquisitions); Trail Grants	7/2023 - 6/2027	Medium	16	4	64

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	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NW16	Directly support voluntary acquisitions (buyouts) of 1, 2, 3, and 4-unit residential structures (i.e., houses) in areas of flood risk and convert to open space.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Natural Resources Protection	Planning and Neighborhood Services	>$1M	FEMA HMA	7/2023 - 6/2028	Medium	15	6	90
NW17	Directly support voluntary acquisitions (buyouts) of commercial and industrial properties in areas of flood risk and convert to open space when these properties cannot be feasibly re-used or redeveloped.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Natural Resources Protection	Planning and Neighborhood Services	>$1M	FEMA HMA	7/2023 - 6/2028	Medium	15	6	90
NW18	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
NW19	Conduct direct outreach to property owners in repetitive loss areas with information about how to mitigation flood losses and coordinate with CRS activities.	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
NW20	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	Planning and Neighborhood Services	$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	PERISTS Score	STAPLEE Score	PERSISTS x STAPLEE =
NW21	Identify rock outcrops and steep slopes with additional natural resource potential and prioritize for conservation efforts.	Reduce losses from other hazards that are affected by climate change.	Prevention	Planning and Neighborhood Services	$0 - $10,000	Municipal Operating Budget	7/2023 - 12/2023	Low	13	6	78
NW22	Consider additional regulations and design standards for development of properties with slopes greater than 15%.	Reduce losses from other hazards that are affected by climate change.	Prevention	Planning and Neighborhood Services	$0 - $10,000	Municipal Operating Budget	7/2023 - 12/2023	Low	13	7	91
NW 23	Conduct study and design to reduce flood risk at the Bean Hill Substation. This action is for the study and design; construction is deferred.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	NPU Electric Division	$100,000 - $500,000	NPU CIP budget; DEEP Climate Resilience Fund; FEMA HMA	7/2023 - 6/2025	High	18	10	180
NW 24	Conduct study and design to reduce flood risk at the Shipping Street Sewer Pumping Station. This action is for the study and design; construction is deferred.	Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.	Structural Projects	NPU Sewer Division	$100,000 - $500,000	NPU CIP budget; DEEP Climate Resilience Fund; FEMA HMA	7/2023 - 6/2025	High	16	10	160