Capitol Region Natural Hazard Mitigation and Climate Adaptation Plan Update

2024 – 2029

Approval Pending Adoption X
Initial Municipal Adoption X
FEMA Approval X

Prepared for:

Capitol Region Council of Governments

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Acknowledgements

Representatives from the 38 member municipalities of the Capitol Region Council of Governments contributed to the development of this Plan Update. The following individuals served as the primary project contacts and led the efforts in each community during the planning process. Additional personnel from each municipality also involved in plan development are listed in the plan annex for each municipal or tribal entity. We thank all contributors for their input and work.

Municipality	Local Coordinator Name	Local Coordinator Title
Andover	Eric Anderson	Town Administrator
Avon	Bruce Appell	Fire Marshal, Emergency Manager
Berlin	Rich Cop	Fire Marshal, Emergency Manager
Bloomfield	Jon Colman	Assistant Director, Building & Land Use
Bolton	Patrice L. Carson	Director of Community Development
Canton	Chris Arciero	Emergency Management Director
Columbia	Jennifer LaVoie	Executive Administrative Assistant
Coventry	James Drumm	Town Manager
East Granby	Kenneth Beliveau	Fire Marshal and Emergency Management Director
East Hartford	Steve Hnatuk	Deputy Development Director
East Windsor	Ruthanne Calabrese	Town Planner
Ellington	Lisa Houlihan	Town Planner
Enfield	Laurie Whitten	Director of Planning
Farmington	Arnold Russell	Director of Public Works / Town Engineer
Glastonbury	Jonathan Luiz	Glastonbury Town Manager
Granby	Abigail St. Peter Kenyon	Community Development Director
Hartford	Christopher Hayes	Director of Public Works
Hebron	Matthew Bordeaux	Director of Planning and Development
Manchester	Emma Peterson	Principal Comprehensive Planner
Mansfield	Adam Libros	Emergency Management Director
Marlborough	Peter Hughes	Director of Planning and Development
New Britain	Mark Moriarty and Raul Ortiz	Director of Public Works/Fire Chief and Emergency Management Director
Newington	Paul Dickson	Town Planner
Plainville	Mark S. DeVoe	Planning Director
Rocky Hill	Mike Garrahy	Fire Chief
Simsbury	Thomas Roy	Town Engineer
Somers	Todd Rolland	Director of Public Works
South Windsor	Marco Mucciacciaro	Superintendent of Streets
Southington	Mark Sciota	Southington Town Manager
Stafford	Jim Desso	Emergency Management Director
Suffield	Bill Hawkins	Director of Planning and Development

Municipality	Local Coordinator Name	Local Coordinator Title
Tolland	David Corcoran	Planning Director
Vernon	Michael Purcaro	Town Manager
West Hartford	Duane Martin	Director of Community Development
Wethersfield	Denise Bradley	Town Planner
Willington	Stuart Cobb	Emergency Management Director
Windsor	Suzanne Choate	Town Engineer
Windsor Locks	Phil Sissick	Director of Public Works

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Acronyms and Abbreviations

Acronym	Definition
BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation
BOCA	Building Officials and Code Administration
BRIC	Building Resilient Infrastructure and Communities
CGS	Connecticut General Statute
CAO	Chief Administrative Officer
CCVI	Climate Change Vulnerability Index
CEO	Chief Elected Official
CEQ	Connecticut Council on Environmental Quality
CIP	Capital Improvements Program
CIRCA	Connecticut Institute for Resilience and Climate Adaptation
CLEAR	Center for Land Use Education and Research
CRCOG	Capitol Region Council of Governments
CRS	Community Rating System
CSO	Combined Sewer Overflow
DCRF	DEEP Climate Resilience Fund
DECD	Department of Economic and Community Development
DEMHS	Connecticut Division of Emergency Management and Homeland Security
DEEP	Connecticut Department of Energy & Environmental Protection
DESPP	Connecticut Department of Emergency Services and Public Protection
DMA 2000	Disaster Mitigation Act of 2000
DOT	Connecticut Department of Transportation
DPH	Connecticut Department of Public Health
DPW	Department of Public Works (or Director of Public Works)
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FHMP	Flood Hazard Management Plan
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FMP	Flood Management Program
FPMS	Floodplain Management Studies
GC3	Governor's Council on Climate Change
GIS	Geographic Information System
GPS	Global Positioning System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program

Acronym	Definition
IA	Individual Assistance
IBC	International Building Code
ICC	International Code Council
IT	Information Technology
LID	Low Impact Development
LOMA	Letter of Map Amendment
MDC	Metropolitan District Commission of Connecticut
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NDDB	Natural Diversity Data Base
NEMO	Nonpoint Education for Municipal Officials
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum of 1929
NHMP	Natural Hazard Mitigation Plan
NOAA	National Oceanic & Atmospheric Administration
NRCC	Northeast Regional Climate Center
NRCS	National Resources Conservation Service
NRI	National Risk Index
NU	Northeast Utilities
OEM	Office of Emergency Management
OPM	Connecticut Office of Policy and Management
NIMS	National Incident Management System
PA	Public Assistance
PDM	Pre-Disaster Mitigation Program
POCD	Plan of Conservation and Development
RCC	Regional Coordinating Center
RESP	Regional Emergency Support Plan
RPA	Regional Planning Agencies
RPO	Regional Planning Organization
SBA	U.S. Small Business Administration
SCEL	Stream Channel Encroachment Line
SHMO	State Hazard Mitigation Officer
SHPO	State Historic Preservation Office
SHSGP	State Homeland Security Grant Program
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, Environmental
SSO	Sanitary Sewer Overflow
USACE	U.S. Army Corps of Engineers

Acronym	Definition
USDA	U.S. Department of Agriculture
USDHS	U.S. Department of Homeland Security
USGS	U.S. Geological Survey
WUI	Wildland/Urban Interface

Capitol Region Council of Governments

Natural Hazard Mitigation and Climate Adaptation Plan Update: 2024 – 2029

Executive Summary

Introduction

Connecticut's Capitol Region encompasses the City of Hartford and 37 surrounding urban, suburban, and rural communities. The Capitol Region Council of Governments (CRCOG) received Federal Emergency Management Agency (FEMA) funds through the Connecticut Department of Emergency Services and Public Protection (DESPP) to develop a Natural Hazard Mitigation Plan (HMP) Update for the 38 municipalities comprising the region:

Town of Andover	Town of East Windsor	Town of Marlborough	Town of Suffield
Town of Avon	Town of Ellington	City of New Britain	Town of Tolland
Town of Berlin	Town of Enfield	Town of Newington	Town of Vernon
Town of Bloomfield	Town of Farmington	Town of Plainville	Town of West Hartford
Town of Bolton	Town of Glastonbury	Town of Rocky Hill	Town of Wethersfield
Town of Canton	Town of Granby	Town of Simsbury	Town of Willington
Town of Columbia	City of Hartford	Town of Somers	Town of Windsor
Town of Coventry	Town of Hebron	Town of South Windsor	Town of Windsor Locks
Town of East Granby	Town of Manchester	Town of Southington	
Town of East Hartford	Town of Mansfield	Town of Stafford	

CRCOG staff and municipal officials from each community contributed to this planning project. The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) prepared this plan update, building upon the existing Capitol Region Natural Hazard Mitigation Plan of 2019 prepared by Milone and MacBroom, Inc. CRCOG is working with CIRCA to identify unmet climate-related needs related to flooding and extreme heat through participation in the *Resilient Connecticut* program, with a duration of about 18 months from April 2023 through September 2024. CRCOG therefore elected to align the *Resilient Connecticut* planning process with this update of the region's Hazard Mitigation Plan. This alignment has resulted in development of a combined Hazard Mitigation and Climate Adaptation Plan ("HMCAP"). The alignment of the planning efforts, and the adoption of this combined Hazard Mitigation and Climate Adaptation Plan, will help position local hazard mitigation, climate adaptation, and resilience efforts for the State's "resilience project pipeline."

The purpose of this plan is to identify natural hazards and climate change impacts likely to affect the Capitol Region and its nearly one million residents, assess vulnerabilities to these hazards, and set forth mitigation strategies that will reduce the loss of life and property, economic disruptions, and the cost of post-disaster recovery for the region's communities. The benefits of preparing a Hazard Mitigation and Climate Adaptation Plan include:

- Improving the region's ability to deal with natural disasters and reduce losses

- Improving the region's resilience to the impacts of climate change
- Reducing the need for emergency response to natural disasters
- Enabling municipalities to access FEMA Hazard Mitigation Assistance Grants upon formal adoption of an approved plan
- Improving post-disaster recovery implementation

The hazards included in this planning process in 2023-24 included all of those profiled and analyzed 5 years earlier, with the addition of extreme heat. For this Plan Update, hazards were organized by climate driver (described in the below section).

The impacts of these natural hazards and climate change impacts were evaluated as well as the locations and groups of people particularly vulnerable to the effects of these hazards and impacts. Mitigation goals and strategies were developed to reduce or prevent the damages to life and property that can result from these natural hazards and climate change impacts. Each participating municipality identified its own mitigation goals and strategies and assumes responsibility for implementation of those measures.

Planning Process

This Plan Update was developed for the Capitol Region Council of Governments by the Connecticut Institute for Resilience and Climate Adaptation, in collaboration with the region's 38 municipalities, and DESPP/DEMHS.

The active planning process for the multi-jurisdiction hazard mitigation plan update commenced in April 2023 and ended in December 2023, spanning a period of 9 months. For this 4th edition of the plan, CRCOG elected to link the planning process to a parallel planning process administered by 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
- Direct incorporation of new Environmental Justice (EJ) mapping developed by CIRCA in 2022-2023
- Positioning of the 38 municipalities for new funding sources in Connecticut such as the new DEEP DCRF
- Consistency with the 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 6, 2023, with a presentation to the CRCOG Policy Board. During this presentation, 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 in May. Local planning team meetings commenced in May 2023 and primarily ended in August 2023, although additional meetings were held in November 2023 as needed. Meeting dates for each local planning team are listed in Table 1 below. Meeting notes were prepared to document the meetings and the status of prior mitigation actions. Additional follow-up by email communication was conducted by CIRCA as needed to answer questions that could not be addressed in local planning meetings. Meeting notes are provided in Appendix A.

Local planning team meetings were held in each of the 38 municipalities and included local staff from a variety of departments including administration, planning, emergency management, police, fire, public health, public works, and engineering. In some towns, citizens and elected officials also participated.

Table 1: Summary of Local Planning Meeting Dates

Town	Meeting Date
Andover	6/22/2023
Avon	7/18/2023
Berlin	11/6/2023
Bloomfield	8/7/2023
Bolton	5/25/2023
Canton	6/23/2023
Columbia	6/21/2023
Coventry	6/29/2023
East Granby	8/29/2023
East Hartford	8/17/2023
East Windsor	5/30/2023
Ellington	6/22/2023
Enfield	7/10/2023
Farmington	6/7/2023
Glastonbury	6/15/2023
Granby	5/22/2023
Hartford	6/12/2023
Hebron	6/20/2023
Manchester	6/13/2023
Mansfield	5/25/2023
Marlborough	6/14/2023
New Britain	8/23/2023
Newington	8/9/2023
Plainville	6/15/2023
Rocky Hill	6/30/2023

Town	Meeting Date
Simsbury	6/26/2023
Somers	6/12/2023
South Windsor	6/26/2023
Southington	8/4/2023
Stafford	6/28/2023
Suffield	6/29/2023
Tolland	6/27/2023
Vernon	8/16/2023
West Hartford	6/16/2023
Wethersfield	6/28/2023
Willington	6/5/2023
Windsor	6/27/2023
Windsor Locks	5/22/2023

During these local planning meetings, municipal staff were asked to identify the top climate-related challenges faced by their communities. Town-reported concerns are listed below in Table 2. Common emerging themes from municipal responses included streams crossings roads, power back-up for critical facilities, areas with limited egress, tree management, and vulnerable populations.

Table 2. Top Climate Concerns Reported by CRCOG Municipalities

Town	Primary Climate Concern #1	Primary Climate Concern #2	Primary Climate Concern #3
Andover	Stream crossings	Generators for critical facilities	Limited egress for senior housing
Avon	Critical facilities in a floodplain	Tree management	Generators for critical facilities
Berlin	Critical facilities in a floodplain	Generators for critical facilities	Hotels that people are living in
Bloomfield	Drainage-related flooding	Generator for cooling center	Maintenance of flood control system
Bolton	Power outages from storms	Stream crossings (access for Mark Anthony Lane)	DEEP-owned and privately owned dams
Canton	Tree management	Microgrid for critical facilities	Dams
Columbia	Stream crossings	Stormwater infrastructure	Limited egress for specific subdivision (tree obstruction risk)
Coventry	Harmful algae in Coventry Lake	Tree management	Stream Crossings and Stormwater Management

Town	Primary Climate Concern #1	Primary Climate Concern #2	Primary Climate Concern #3
East Granby	Generators for critical facilities	Wind corridor	Stream crossings
East Hartford	Shelter capacity	Flash flooding - Hockanum River	Generators for critical facilities
East Windsor	Generators for critical facilities	Stream crossings	Agricultural fields (tobacco)
Ellington	Stream crossings	Generators for critical facilities	Limited egress for specific neighborhood
Enfield	Stream crossings	Agriculture	Historic resources
Farmington	Riverbank stabilization	Stream crossings	Backup EOC
Glastonbury	Stream crossings	Vulnerable populations (assisted living, low-income)	Uranium
Granby	Riverbank stabilization	Power outages from storms	Tree management
Hartford	Stormwater infrastructure	Combined sewers	Shelter coordination
Hebron	Water quality	Private wells	Sewer system
Manchester	Stream crossings	Stormwater infrastructure	Tree management
Mansfield	Power outages from storms	Road flooding/washouts	Public water and sewer systems
Marlborough	Stream crossings	Tree management	Vulnerable populations (elderly)
New Britain	Stormwater management	Riverbank stabilization	Water reservoir levels during droughts
Newington	Stream crossings over railroad	Stormwater infrastructure	Hotels that people are living in
Plainville	Power outages from storms	Unpredictable high-density short-duration storms	WWTP
Rocky Hill	Shelter capacity	Vulnerable populations (assisted living, elderly)	Road elevation (Beach Rd)
Simsbury	Riverbank stabilization	Stream crossings	Stormwater infrastructure
Somers	Power outages from storms	Stream crossings	Tree management
South Windsor	Stream crossings	Power outages from storms	Generators for critical facilities
Southington	Flash flooding on roads	Repetitive loss properties in Quinnipiac River flood zones	Hotels without generators

Town	Primary Climate Concern #1	Primary Climate Concern #2	Primary Climate Concern #3
Stafford	Stream crossings	Generators for critical facilities -- elderly housing	Fire station in floodplain
Suffield	Limited egress for specific neighborhood (tree obstruction risk, not flooding)	Power outages from storms	Sewer system
Tolland	Unpaved roads	Stream crossings	Geographically-influenced winter weather
Vernon	Stormwater management	Generators for critical facilities	Sewer system
West Hartford	Stream crossings	Power outages from storms	Winter storms
Wethersfield	Stream Crossings and Stormwater Management	Generators for critical facilities	Hotels that people are living in
Willington	Stream crossings	Generators for critical facilities	Treetop debris on ground
Windsor	Erodible soils with increasing precipitation		
Windsor Locks	Stream Crossings and Stormwater Management	Host location for many critical regional assets and infrastructure	Hotels that people are living in

Specific Opportunities for Input to the Planning Process

In addition to the local planning team meetings, the planning process primarily consisted of six types of efforts/events:

1. Workshops for the local coordinators:
    a. A virtual workshop with active participation methods (for example, a Jeopardy game) was conducted for the local coordinators, chief elected officials, and other municipal staff on July 24, 2023. The theme of the workshop was to present risk assessment findings and gather input.
    b. A virtual workshop with active participation methods (polling/voting with Microsoft Teams) was conducted for the local coordinators, chief elected officials, and other municipal staff on October 3, 2023. The theme of the workshop was to present State, regional, and shared hazard mitigation and climate adaptation strategies and actions.
2. General public engagement:
    a. The StoryMap was deployed along with a web-based survey.
    b. Press releases and web links were distributed.
    c. A hybrid in-person and virtual public meeting was held on October 10, 2023. Mentimeter was used to record answers to questions that were asked during the polling

segment of the meeting, allowing people at home and people present at the meeting to respond together in real-time.

   d. A virtual public meeting was held on October 12, 2023. Mentimeter was used to record answers to questions that were asked during the polling segment of the meeting.

3. Targeted stakeholder engagement:
   a. Letters were distributed to the regional planning agencies in Connecticut and Massachusetts that surround the CRCOG region. These letters described the HMCAP and invited comments and participation.
   b. CRCOG provided CIRCA with a master list of municipal and regional stakeholders with connections to environmental planning, including conservation commissions, wetland commissions, municipal committees for Sustainable Connecticut, farmers markets and farm commissions, water pollution control staff, land trusts, waste and recycling committees, clean energy tasks forces, tree wardens, and open space committees. CIRCA contacted each of these groups and shared a link to the HMCAP Story Map and online survey.
4. Targeted engagement of utilities and lifelines:
   a. CIRCA conducted targeted outreach to several regional utilities with significant presences in the CRCOG region.
      i. CIRCA and CRCOG staff met with representatives from the Metropolitan District, a non-profit municipal corporation providing water and sewer services to eight member municipalities and drinking water services to four additional non-member municipalities, all within the CRCOG region. Meeting date: 9/13/23.
      ii. CIRCA staff met with staff members from Windham Water Works, a water utility in eastern Connecticut whose service area includes parts of the Town of Mansfield in the CRCOG region. Meeting date: 7/14/23.
      iii. CIRCA and CRCOG staff met with staff members from Eversource, a power utility that provides electricity throughout the CRCOG region. Meeting date: 10/5/23.
      iv. CIRCA staff met with staff members from Aquarion Water Company, a public water supply company whose service area includes many towns in the CRCOG region. Meeting date 10/17/23.
      v. CIRCA staff met with staff members from Avangrid, an energy company that provides natural gas throughout the CRCOG region. Meeting date: 12/4/23.
   b. During these meetings with utilities, CIRCA staff provided an overview of the HMCAP process and timeline and asked for input on any utility projects or concerns relevant to natural hazards mitigation and climate adaptation planning. Further details are provided in Section II and meeting notes are provided in Appendix C.
5. Targeted engagement of environmental justice and disproportionately vulnerable communities:
   a. Additional outreach was conducted for the four state-identified Distressed Municipalities located within the CRCOG region, as well as the towns that contain census tracts ranked 8 or above on the Connecticut Environmental Justice Screening Tool, which indicates the top 20% of the most impacted census tracts in the state. An additional municipality was added to this list based on guidance from CIRCA staff. The resulting list of municipalities for targeted outreach is below:
      i. Hartford

ii. East Hartford
iii. New Britain
iv. Enfield
v. Windsor Locks
vi. East Windsor
vii. Manchester
viii. West Hartford
ix. Newington
x. Plainville
xi. Berlin
xii. Vernon

b. Further details on outreach to environmental justice and disproportionately vulnerable communities are provided in Section II.

6. COG Coordination:
    a. CIRCA attended the CRCOG Policy Board meeting on April 6, 2023, as noted above.
    b. CIRCA attended the CRCOG Planning and Development forum on May 17, 2023.
    c. CIRCA attended the CRCOG Policy Board meeting on May 24, 2023 to provide an update on the commencement of the local coordination meetings.
    d. CIRCA attended the CRCOG Municipal Services meeting on June 20, 2023 to provide a brief update of the planning process and next steps.
    e. CIRCA attended the CRCOG Policy Board meeting on December 20, 2023 to provide an update on the completion of the local coordination meetings and the availability of review drafts of all municipal annexes and the multi-jurisdictional document.

In summary, the key meeting dates memorializing the above planning process are as follows:

1. CRCOG Policy Board meeting – 4/6/23
2. CRCOG Planning and Development forum – 5/17/2023
3. Local Planning Team meetings – 5/22/23 through 8/29/23
4. CRCOG Policy Board Meeting – 5/24/23
5. CRCOG Municipal Services Meeting – 6/20/2023
6. Windham Water Works – 7/14/23
7. Workshop #1 for Local Coordinators and Planning Teams – 7/25/23
8. Metropolitan District – 9/13/23
9. Workshop #2 for Local Coordinators and Planning Teams – 10/3/23
10. Eversource – 10/5/23
11. Public Meeting #1 – 10/10/23
12. Public Meeting #2 – 10/12/23
13. Aquarion Water Company – 10/17/23
14. CRCOG Policy Board Meeting – 12/20/23

A summary of municipal participation can be found in Table 3.

Table 3. Municipal Participation Summary Table

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Andover						6/22/2023	Eric Anderson	Eric Anderson	
Avon	Tom Armstrong	Brandon Robertson	Hiram Peck		Grace Tiezzi	7/18/2023	Bruce Appell, Grace Tiezzi, Hiram W Peck		
Berlin		Chris Edge		Chris Edge		11/6/2023			
Bloomfield		Jon Colman		Jon Colman		8/7/2023		Jon Colman, Justin LaFountain	Jon Colman
Bolton	Tom Manning	Jim Rupert		Jim Rupert		5/25/2023	Patrice Carson		Jim Rupert
Canton			Neil Pade		Bob Skinner	6/23/2023	Christopher Arciero		
Columbia		Mark Walter	John Guzkowski	Mark Walter	Mark Walter	6/21/2023	Beth Lunt	Elizabeth Lunt	Mark Walter
Coventry		Lisa Thomas, John Elsesser				6/29/2023			Jim Drumm
East Granby						8/29/2023			
East Hartford	Hank Pawlowski		Carlene Shaw			8/17/2023	Doug Wilson	Lewis Tamaccio	
East Windsor		Jason Bowsza		Jason Bowsza		5/30/2023	Ruthanne Calabrese	Ruthanne Calabrese	Jason Bowsza
Ellington			Lisa Houlihan	Lori Spielman	Lori Spielman, Tom Modzelewski	6/22/2023	John Rainaldi, John Colonese, Tom Modzelewski, Walter Lee	Lisa Houlihan	Lori Spielman and Matthew Reed

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Enfield		Ellen Zoppo-Sassu		Ellen Zoppo-Sassu		7/10/2023		Lauren Whitten	
Farmington	Matt Hutvagner		Garrett Daigle and Shannon Rutherford			6/7/2023			Joseph Capodiferro
Glastonbury	Corey Turner	Jonathan Luiz	Shelley Caltagiro	Larry Niland	Jonathan Luiz	6/15/2023	Gary Haynes	Gary Haynes, Jonathan Luiz	
Granby						5/22/2023	Abby Kenyon		
Hartford		Raúl De Jesús		Randall Davis		6/12/2023 and 8/30/2023			Raúl De Jesús and Randall Davis
Hebron		Andrew Tierney				6/20/2023	Matthew Bordeaux	Matthew Bordeaux	
Manchester	Bonnie Potocki	Stephen Stephanou			Kasia Purciella, Kimberly Lord	6/13/2023	Emma Peterson	David Laiuppa, Emma Peterson	Stephen Stephanou
Mansfield		Ryan Aylesworth				5/25/2023		Adam Libros	Ryan Aylesworth
Marlborough						6/14/2023	Amy Traversa	Peter Hughes	David Porter
New Britain		Erin Stewart	Jacob Colbath	Erin Stewart		8/23/2023		Mark Moriarty	Erin Stewart
Newington				David Nagel		8/9/2023	Paul Dickson	Paul Dickson	
Plainville		Mike Paulhus		Mike Paulhus		6/15/2023	Mark DeVoe	Mark DeVoe	Mike Paulhus
Rocky Hill		Lisa Marotta		Lisa Marotta, Ray Carpentino		6/30/2023		Michael Garrahy	

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Simsbury		Wendy Makstutis		Wendy Makstutis	Tom Fitzgerald	6/26/2023	Michael Berry		Wendy Makstutis
Somers				Robert Schmidt		6/12/2023	Todd Rolland	Todd Rolland	
South Windsor	Bart Pacekonis					6/26/2023	Glenn Reynolds, Marco Mucciacciaro, Walter Summers, Vincent Stetson	Marco Mucciacciaro	Marco Mucciacciaro
Southington		Mark Sciota			David Nourse	8/4/2023			Mark Sciota
Stafford						6/28/2023			
Suffield				Colin Moll		6/29/2023		Bill Hawkins	William Morrison
Tolland		Steve Jones	David Corcoran	Steve Jones	Megan Massa	6/27/2023	David Corcoran	David Cororan	Katie Stargardter
Vernon						8/16/2023		Michael J. Purcaro	
West Hartford		Shari Cantor, Rick Ledwith		Rick Ledwith		6/16/2023	Duane Martin, Robert McCue	R Austin, Duane Martin	Shari Cantor
Wethersfield	Rich Roberts	Fred Presly		Fred Presly	Fred Presly	6/28/2023			
Willington		Erika Wiecenski		Erika Wiecenski		6/6/2023			Peter Tankaka
Windsor		Peter Souza	Patrick McMahon	Peter Souza		6/27/2023	Paul Goldberg, Peter Souza ,	Suzanne Choate	

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
							Suzanne Choate		
Windsor Locks	Peggy Sayers					5/22/2023	Jen Valentino		
CRCOG	Christopher Henchey, Jacob Knowlton, Caitlin Palmer, Kyle Shiel				Kimberly Bona, Maureen Goulet, Matt Hart, Elizabeth Sanderson, Pauline Yoder		Kyle Shiel, Maureen Goulet, Caitlin Palmer	Emily Bigl, Maureen Goulet, Caitlin Palmer	Kimberly Bona, Maureen Goulet, Matt Hart, Elizabeth Sanderson, Pauline Yoder, Kyle Sheil, Cheryl Assis, Elizabeth Sanderson, Laura Rosenbluth, Cara Radzins, Heidi Samokar, Lily Schneider, Roger Krahm, Rob Aloise

Changes to Planning Process and Plan Document for this Update

As noted above, CRCOG is working with the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) to identify unmet climate-related needs related to flooding and extreme heat through participation in the Resilient Connecticut program. CRCOG therefore elected to align the Resilient Connecticut planning process with this update of the region's Hazard Mitigation Plan. This alignment has resulted in development of a combined Hazard Mitigation and Climate Adaptation Plan ("HMCAP"). The alignment of the planning efforts, and the adoption of this combined Hazard Mitigation and Climate Adaptation Plan, will help position local hazard mitigation, climate adaptation, and resilience efforts for the State's "resilience project pipeline."

The consideration of climate change was incorporated into the HMCAP planning process and therefore directly into this HMCAP through a number of steps:

- The planning process directly incorporated outcomes of the Governor's Council on Climate Change (GC3)
- The planning process directly incorporated the *Resilient Connecticut* expansion.
- The planning process directly incorporated climate planning resources developed by UConn and CIRCA
- The plan adds extreme heat as a hazard.
- Goals were modified and changed to include climate adaptation.
- The plan references new climate-aligned funding sources like the DEEP Climate Resilience Fund (DCRF) and BRIC
- Local communities were directly asked "What are your greatest climate-driven challenges?" whereas previous iterations of the planning process in 2012 and 2017 posed the question "What projects would you complete if you had funding?"

A few of these points are addressed below.

The Governor's Council on Climate Change (GC3)

The GC3 was originally established in 2015 by Governor Dannel P. Malloy's Executive Order No. 46. The GC3 was formally tasked with examining the effectiveness of existing policies and regulations designed to reduce greenhouse gas emissions and identify new strategies to meet the state's greenhouse gas emissions reduction target of 80% below 2001 levels by 2050. The GC3 submitted its recommendations on December 18, 2018. On September 3, 2019, Governor Ned Lamont issued Executive Order No. 3, re-establishing and expanding the membership and responsibilities of the GC3. The GC3's membership now includes more than 20 members from state agencies, quasi-public agencies, businesses, local governments, and nonprofits; and is tasked with two primary objectives:

1. Monitor and report on the state's implementation of the greenhouse gas emissions reduction strategies set forth in the inaugural GC3's December 2018 report Building a Low Carbon Future for Connecticut: Achieving a 45% GHG Reduction by 2030.
2. Develop a statewide Adaptation and Resilience Plan for Connecticut that encompasses the most current and locally-scaled scientific information and analysis available with respect to the effects of climate change and provide updated recommendations for adapting to and improving the

state's resilience to such changes in areas such as infrastructure, agriculture, natural resources, and public health.

GC3 objective #2 provides the impetus for adding climate adaptation to this HMCAP. The GC3's report Phase 1 Report: Near-Term Actions (2021, https://portal.ct.gov/-/media/DEEP/climatechange/GC3/GC3_Phase1_Report_Jan2021.pdf) lists 61 individual actions. Many of these are reflected in the goals and actions found in this HMCAP.

Resilient Connecticut Expansion

"Resilient Connecticut 2.0" (stylized as *Resilient Connecticut*) is described under Section II (Planning Process). The program was initially piloted in Fairfield County and New Haven County using Superstorm Sandy appropriations through U.S. Department of Housing and Urban Development (HUD) and the National Disaster Resilience Competition (NDRC). The NDRC awarded funds to the State of Connecticut to advance flood protection efforts in Bridgeport and to develop a regional coastal resilience plan for southwest Connecticut.

Recognizing the unmet needs in southwest Connecticut, CIRCA expanded the NDRC-funded planning effort in 2019 to include all communities in Fairfield and New Haven Counties with an emphasis on fostering resilience of regional assets and infrastructure, Transit-Oriented Development (TOD), and key transit corridors which could then be considered resilient corridors. With the GC3 efforts underway in the backdrop, extreme heat was added as a primary consideration, and *Resilient Connecticut* was re-focused to consider multiple impacts of climate change. Resilience opportunity areas were identified through a vulnerability assessment completed in 2020-2021, and seven areas are proceeding to additional study and concept design in 2023. The "2.0" was added to denote the Statewide program expansion using State funds.

Climate Planning Resources Developed by UConn and CIRCA

UConn and CIRCA published the Connecticut Physical Climate Assessment Report in 2019 to help the State and its municipalities plan for the effects of climate change. Additionally, CIRCA developed the sea level rise planning thresholds adopted by the State of Connecticut and required for use in municipal planning and in the design of State-funded projects. Furthermore, CIRCA developed a statewide Climate Change Vulnerability Index tool using ArcGIS, with separate versions measuring flood vulnerability and extreme heat vulnerability. This HMCAP is the first edition of the CRCOG HMP to be developed since these tools were issued.

Extreme Heat

Extreme heat was not included as a hazard in previous editions of the CRCOG HMP. This HMCAP is the first edition of the region's plan to directly include drought as a profiled hazard. Additionally, extreme heat is the central theme of one of the goals of the HMCAP. All municipal annexes include at least one action related to respite from extreme heat.

HMCAP Goals

This edition of the CRCOG HMCAP includes new region-wide municipal goal statements that are aligned with *Resilient Connecticut* and the efforts of the GC3.

The nine region-wide municipal goals from the previous 2019 plan are listed below.

- Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure: Mitigation actions that address this goal are intended to protect or adapt structures and infrastructures from the physical impacts of hazards. Actions might include floodproofing structures, elevating structures above flood elevations, constructing fire breaks, or assessing wind-load capacities of critical facilities.
- Goal 2: Ensure municipal codes and regulations support hazard mitigation: Mitigation actions that address this goal focus on strengthening the regulatory frameworks of communities to avoid the creation or exacerbation of hazardous conditions. Actions might include requiring buildings be elevated above the flood elevation or requiring new developments have multiple modes of egress.
- Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies: Mitigation actions that address this goal focus on education and training of municipal or regional staff, first responders, and elected officials.
- Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure: Mitigation actions that address this goal focus on utilizing the beneficial functions of natural systems and features. Actions might include wetland protection, low impact development, and use of green infrastructure similar to recent actions in the City of Hartford.
- Goal 5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies: Mitigation actions that address this goal focus on maintaining critical services through hazard events. Actions might include burying power lines, developing microgrids, or protecting a wastewater treatment plant.
- Goal 6: Improve public outreach, education, and warning systems: Mitigation actions that address this goal focus on educating and alerting the public. Actions may include sending informational mailers, providing information on the municipal website, or implementing a reverse 9-1-1 system.
- Goal 7: Improve the emergency response capabilities of the region and its communities: Mitigation actions that address this goal focus on developing a community's ability to respond to a hazard event. Actions may include upgrading shelters or the Emergency Operations Center, reviewing evacuation routes, or improving the ability of emergency responders to communicate with one another during events.
- Goal 8: Ensure community character and social equity are addressed in mitigation activities: Mitigation actions that address this goal focus on protecting features of a community that may otherwise be overlooked when considering only the most critical features. Actions may include those that protect historic, cultural, and recreational resources or those that specifically address low-moderate income or underserved populations.

- Goal 9: Minimize the economic impact of hazard damages: Mitigation actions that address this goal focus on limiting economic impacts of damages that do occur regardless of actions taken to mitigate the physical impacts of the damages themselves. Actions may include educating landowners about flood insurance, joining CRS, improving the community CRS score, or setting up recovery funding mechanisms.

This HMCAP advocates for, and supports, new goal statements that are aligned with *Resilient Connecticut* and the efforts of the GC3. The five new goals developed for this HMCAP were developed with cooperation from CIRCA in the *Resilient Connecticut* planning process, and are:

1. Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.
2. Address risks associated with extreme heat events, especially as they interact with other hazards.
3. Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.
4. Reduce losses from other hazards.
5. 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.

Additional detail is provided later in the executive summary as well as in Section IV, including a table that cross-references the five new goals to the previous nine goals, demonstrating that the intent of each of the prior goals was preserved during the shift to new goals.

Hazards Impacting the Capitol Region

The Capitol Region is vulnerable to numerous natural hazards, with flooding, tropical and winter storms, and high wind events being the natural hazards that most frequently occur with enough severity to cause loss of life or property. Many of the hazards faced by the Capitol Region are likely to be exacerbated by climate change, posing increasing risk to lives and property. To evaluate the impacts of these hazards on our region, we looked at historical accounts of major storms and other events; examined flood insurance claims data and public assistance provided after federally declared disasters; reviewed multiple sources of loss estimates, analyzed demographic data and physical features; and used HAZUS, a computer model, to estimate losses due to flooding, hurricanes, and earthquakes.

The hazards included in the planning process in 2023-24 included all of those profiled and analyzed 5 years earlier, with the addition of extreme heat. For this Plan Update, hazards were organized by climate driver as shown in Table 4, to better convey how climate change might exacerbate each hazard.

Table 4. Hazards Organized by Climate Driver

Climate Driver	Hazards Included in Plan Update
Extreme Storms	Hurricanes and tropical storms
	Tornadoes and high wind events
	Severe winter storms
Sea Level Rise	Connecticut River tidal range
Changing Precipitation	Riverine and pluvial floods
	Droughts
	Dam overtopping or failure
Rising Temperatures	Extreme heat
	Wildfires
Earthquakes (not affected by climate change, but included in the plan as always)	Earthquakes

Average Annualized Loss (AAL) estimates for the CRCOG region are summarized in Table 5 below. Average Annualized Loss (AAL) figures are useful tools for comparison of the risks faced from different hazards with different likelihoods of occurring in a given time period. National Centers for Environmental Information (NCEI) data, from the last 20 years, was categorized by hazard and averaged based on the proportion of population within each town in the CRCOG Region. National Flood Insurance Program (NFIP) losses were calculated based on the 50-year span of the program. FEMA Public Assistance (PA) data from the past 11 years was categorized based on hazard and used to compute AAL. United States Department of Agriculture (USDA) from the past 10 years was calculated to get AAL for drought. Expected Annual Loss data from the National Risk Index (NRI) was downloaded and categorized to get AAL for the below hazards. Dam failure data was taken from the 2019-2024 CRCOG Hazard Mitigation Plan (HMP) plan since no new dam failures have occurred in the past five years. The 2019 HMP Dam failures were sourced in turn from the 2014 Connecticut Natural Hazard Mitigation Plan Update, with dam failure data supplemented by the National Performance of Dams Program and the Connecticut Department of Energy & Environmental Protection.

Table 5. Average Annualized Loss Estimates By Hazard

Hazard	Source	Average Annualized Losses (AAL)
Hurricanes/Tropical storms	NCEI	$2,508,790
	NRI	$39,018,299
	FEMA PA	$733,703
Tornados/High Winds	NCEI	$939,245
	NRI	$9,065,692
Winter Storms	NCEI	$744,050
	NRI	$1,159,569
	FEMA PA	$655,889
Flood	NCEI	$760,450
	NRI	$1,551,942
	NFIP	$248,900
Drought	NRI	$3,422,783
	USDA	$1,272,516
Extreme Heat	NRI	$972,438
Wildfire	NRI	$78,333
Earthquakes	NRI	$2,337,892
Dam Failure	HMP	$10,810

Specific annualized loss estimates from changes to the Connecticut River tidal range due to sea level rise cannot be distinguished from the general flooding estimates. Details regarding these loss estimates are provided in Section III and each municipal annex of this plan.

Properties, people, historic resources, and critical facilities in the region are exposed to natural hazards affected by climate change (i.e., severe storms, 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 6.

Table 6. CRCOG Regional Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Historic Assets		At-Risk Critical Facilities	
	Value	Number	Value	Number	Value	Number
Hurricanes & Tropical Storms	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Tornadoes & Other Severe Weather	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Severe Winter Storms	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Tidal Connecticut River Flooding	$71,769,901	184	$6,675,948	16	$715,402	2

Hazard	At-Risk Parcels		At-Risk Historic Assets		At-Risk Critical Facilities	
	Value	Number	Value	Number	Value	Number
Flood (1% Annual Chance)	$7,507,499,059	24,622	$285,903,095	909	$25,818,761	81
Drought	$21,123,646,871	74,676	$169,818,430	615	$14,337,206	52
Dam Failure	$3,624,203,173	11,136	$196,844,008	554	$9,196,488	29
Extreme Heat	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Wildfires	$49,585,807,175	163,813	$1,056,129,475	3,270	$66,240,267	226
Earthquake	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373

The following is a brief summary of the natural hazards affecting the region and our communities.

Hurricanes and Tropical Storms

The Atlantic hurricane season extends from June 1 through November 30 each year. While the Capitol Region is spared the coastal storm surges associated with hurricanes, it is not immune from damaging winds and rain. According to the state's Hazard Mitigation Plan, a Category 3 hurricane has a calculated return period of 63 to 120 years along the coastline of Connecticut, and hurricanes in general have calculated return period ranges from 17-24 years for Connecticut.

In August 2011, Hurricane Irene, which was downgraded to a tropical storm before hitting Connecticut, caused widespread damage to the region and state. Irene was responsible for three deaths associated with flooding and downed wires from falling trees. According to *The Hartford Courant*, insurance companies paid out $235 million on more than 60,000 claims in Connecticut related to damage from Irene. However, this figure does not include hundreds of millions more in uncovered expenses and cleanup costs for Connecticut's largest electric utility at the time, Connecticut Light and Power (now Eversource). At the height of the storm, some 754,000 residents were without power. Capitol Region cities and towns were widely affected by downed trees, flooding, and power outages as a result of Irene. Many residents and businesses were without power for over a week. According to the Connecticut Division of Emergency Management and Homeland Security (DEMHS), municipalities, and other local and private nonprofit agencies incurred expenses of over $3.18 million due to Irene. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

More recently, Tropical Storm Isaias passed through Connecticut on August 4, 2020, leading to significant rain as well as substantial wind damage. The 2023 *State Natural Hazard Mitigation Plan Update* notes that wind gusts of up to 70 mph led to severe tree and powerline damage, resulting in over 632,000 power outages. In the Capitol Region, municipalities reported widespread power outages that lasted over a week in some areas. Multiple summer storms occurred in 2021, including Tropical Storm Henri, which reached Connecticut on August 21, 2021. The 2023 *State Natural Hazard Mitigation Plan Update* notes that the worst flash flooding associated with Henri occurred in northeast Connecticut, and the highest rainfall totals over the two-day period ranged from 5 to 6 inches in Hartford and Tolland Counties. In the Capitol Region, municipalities reported some infrastructure damage, including road washouts, as a result of this summer of storms.

Tornadoes and Other Severe Weather

Connecticut averages approximately three tornadoes every 2 years; however, in the first week and a half of July 2013 four tornadoes hit the state including three that touched down in the Capitol Region. Hartford and Litchfield Counties are at the highest risk for tornadoes within the state based on historical patterns and locations of their occurrence. Between 1950 and 2003, Hartford County experienced 14 tornadoes, and Tolland County experienced 10. Between 2006 and 2018, Connecticut experienced 23 tornadoes. Three of these were in Hartford County and two in Tolland County. The Capitol Region experienced three tornadoes in 2013. Four tornadoes severely impacted Connecticut during one storm in May 2018 although none were located in the Capitol Region. On October 2, 2018, an EF1 tornado touched down in New Canaan, and an EF-0 was reported in the Capitol Region in Mansfield.

Typically, tornadoes occur between April and October. High winds and microbursts (strong straight-line downburst winds) can also inflict damage to property and result in injuries.

One of the country's most destructive tornadoes touched down in Windsor Locks and Windsor on October 3, 1979. The F4 tornado had winds in excess of 200 miles per hour (mph) and tore an 11-mile path from Windsor to Suffield. The tornado killed 3 people, injured 500, and caused an estimated $250 million ($776,385,000 in 2011 dollars) in damage, in part because it struck the New England Air Museum, destroying several planes and hangars.

Severe Winter Storms

Connecticut is subject to blizzards, ice storms, and nor'easters - storms characterized by strong, possibly damaging northeasterly winds. According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, Hartford and Tolland Counties receive, on average, 2.5 to over 4 feet of snowfall each year, although snowfall amounts vary widely from year to year and can vary dramatically across the region in any given storm. Severe winter storms can result in damage to buildings and infrastructure, loss of life, and disruptions to regional transportation and communication systems. Half of all federal disaster declarations for Connecticut since 1954 have followed major winter or snowstorms. Federal assistance is frequently used to offset the snow/ice removal costs that the state and municipalities incur. For example, a federal emergency was declared for the February 11-12, 2006, snowstorm in several counties in Connecticut (including Hartford and Tolland) to help share the costs of snow removal. In 2011, FEMA obligated over $74 million in Public Assistance funds to the State of Connecticut to reimburse state agencies, local governments, and eligible private nonprofit organizations for costs associated with the January 11-12, 2011, snowstorm and Storm Alfred in October. The frequency, intensity, and timing of winter storms dramatically impacts snow removal budgets. Storm Alfred was particularly costly for municipalities because of the heavy debris loads resulting from the high number of fully leafed trees downed in this storm. Municipalities also incur higher labor costs for snow removal on weekends and holidays. More recent winter storms include Winter Storms Nemo (2013), Juno (2015), Anna (2016), and the Blizzard of January 29, 2022, which brought heavy snowfall to the state.

Floods

Flooding can occur as a result of other natural hazards such as heavy precipitation, hurricanes, winter storms, snow melt, ice jams, or dam failures. The Capitol Region's numerous rivers and streams, as well as its urbanized areas, make floods and flash floods a regular risk. Individuals and local governments face significant economic loss, risks to public safety, and degraded waterways from flooding. There is not a "flood season" per se in Connecticut; however, waterways are normally higher during spring and

are thus especially vulnerable to flooding from intense precipitation. Significant flooding can also occur as a result of hurricanes and tropical storms. Historic and widespread floods occurred in 1936, 1938, 1955, and 1982.

An analysis of claims filed under the National Flood Insurance Program (NFIP) in the Capitol Region demonstrates the potential for losses due to flooding. Since the program's inception in 1968, 1,989 claims resulting in payments of nearly $12.5 million have been filed in the Capitol Region as of July 2023. East Hartford has had the highest number of overall flood loss claims, followed by Glastonbury, West Hartford, New Britain, and Windsor. West Hartford and Farmington have also had the highest overall flood loss payments.

Of these claims, 486 were repetitive loss claims (i.e., more than one claim over $1,000 has been filed for flood damages to an insured building over a 10-year period). Approximately 153 properties have experienced repetitive losses in the Capitol Region. These losses have resulted in payments of approximately $5.5 million. West Hartford has the highest number of repetitive flood claims, followed by New Britain, Simsbury, and Southington. West Hartford, Farmington, and Newington have had the highest repetitive flood loss payments.

Significant areas of the Capitol Region are vulnerable to flooding. About 8.5%, or 56,827 acres, of the Capitol Region is located in floodplains. Over half of this land is zoned residential. Without restrictions on development in floodplains, lives and property are at risk.

Tidal Connecticut River Flooding

The CRCOG region is entirely inland, and therefore flooding is typically the result of moderate precipitation over several days or intense precipitation over a short period. However, because the Connecticut River is tidally influenced, sea level rise could eventually impact the water surface elevations along the Connecticut River, which in turn could affect its floodplains and potentially other low-lying areas along the river in the lower CRCOG region. The specific communities adjacent to the tidally influenced stretch of the Connecticut River include Hartford, East Hartford, Wethersfield, Glastonbury, and Rocky Hill. Specific loss estimates from changes to the Connecticut River tidal range due to sea level rise cannot be distinguished from the general flooding estimates at this time, but may be possible in future plan updates.

Drought

Droughts periodically occur in Connecticut and can have serious consequences. While a drought does not pose immediate threats to life and property, it can have severe economic, environmental and social consequences. A lack of precipitation can affect not only agricultural production but also tourism, water utilities, residential wells, businesses, and more. Connecticut experienced notable droughts in 1957, 1964-67, 1980-81, 2002, 2012, 2013, 2015-17, 2020, and 2022. According to the National Oceanic & Atmospheric Association (NOAA) Storm Events Database, rivers and streams were most affected as most ran at record low levels during the spring runoff season. The main impact of this meteorological drought was periods of very high fire danger.

The most recent severe drought warning for Connecticut was issued in 2022, affecting 87% of the state and causing significant agricultural losses. As the state's Natural Hazard Mitigation Plan notes, predicting the future occurrences of drought within any given time period is difficult.

Dam Failure

Dams provide vital benefits to our region such as water supply, power generation, flood control, and recreation, but in the event of failure, they can pose a threat to lives and property. Dam failure can happen for a number of reasons including as a result of natural disasters such as structural failure due to earthquakes or overtopping due to heavy precipitation. Dams in Connecticut are regulated by the Department of Energy & Environmental Protection (DEEP).

According to the DEEP, there are hundreds of dams in the Capitol Region. The majority of these are either Class A (low hazard) or Class AA (negligible hazard); failure of a Class A dam would lead to minimal economic loss and may cause damage to agricultural land or unpaved roadways while failure of a Class AA dam would cause negligible loss or damage. Dams of concern for hazard mitigation are those in classes BB, B, and C. In the Capitol Region, 49 dams are Class C, or high hazard, dams. Failure of a Class C dam would result in probable loss of life, major damage to habitable structures, damage to major highways, and great economic loss. There are 46 Class B, or significant hazard, dams in the Region. Failure in these dams would result in similar but less severe damage. Finally, there are 135 Class BB, or moderate hazard, dams in the region. Failure of one of these dams would result in damage to normally unoccupied structures or local roadways or would cause moderate economic loss; no loss of life would be expected. The 2023 *Connecticut Natural Hazard Mitigation Plan Update* estimates there are nearly 67,500 people in Hartford County and nearly 5,000 people in Tolland County within the mapped dam inundation areas of high and significant hazard dams. The Capitol Region includes most of, although not all, the municipalities in Hartford and Tolland Counties, thus the regional population exposed to this risk is likely less than 7.5 percent.

Extreme Heat

According to the Fourth National Climate Assessment, the average temperature has increased by 1.2 degrees Fahrenheit between 1986 and 2016. Additionally, temperature records from the past twenty years show the number of high temperature records exceeding the number of low temperature records, in addition to an extended frost-free season over the years. It is projected that over the next few decades that annual temperature across the United States will increase by about 2.2 degrees Fahrenheit, with an increase between 2.3 and 6.7 degrees under low emission scenarios and 5.4 and 11.0 degrees under high emission scenarios by late century.

Particularly in the northeast, temperatures tend to be slightly higher due to the abundance of concrete and asphalt, and relative lack of vegetation. This in turn increases the urban heat island effect. During heat waves and extreme heat events, these highly impervious areas that have an increased urban heat island effect experience higher nightly temperatures than surrounding, more vegetated areas. Increased temperatures can translate to increased heat stress, poor air quality, greater risk of wildfires, and increased vulnerability due to health, occupation, and lack of air conditioning. Rising temperatures will also increase demand on electric supply as heat wave frequency increases and so does the demand for energy and air conditioning. The greatest impact of rising temperatures is likely to be associated with human health. Air quality will likely degrade as temperatures rise, and climate change is expected to increase levels of ground-level ozone. Increased temperatures are expected to lead to an increase in heat related death, illness, emergency department visits, and hospitalizations.

Forest and Wildland Fires

Forest or wildland fires can cause not only long-term damage to vegetation and ecosystems but also damage to developments, especially as residential development has increased in woodland areas. In the last 25 years, a few forest fires have occurred in the Capitol Region including a brush fire in April 1999 in Vernon, which burned about 40 acres and came within 100 feet of homes in a nearby neighborhood, and a fire in April 2005, which burned 8 acres along the Farmington River in Avon. The scale of these fires is much less than those experienced in the western and midwestern United States; nonetheless, forest fires here pose a risk to lives and property, especially at the urban/woodland interface.

Earthquake

Connecticut has a moderate risk of earthquakes based on the frequency of their occurrence, not the intensity of individual earthquakes. According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, 59 earthquake epicenters have been reported in Connecticut since 1973. The Capitol Region experienced 18 between 1837 and 2023. Of those where the magnitude was known, all were under magnitude 4.0. A strong earthquake centered in central Connecticut and thought to be 3.8 magnitude occurred on August 9, 1840.

Magnitude 3.0 to 3.9 earthquakes are often felt by people up to 100 miles away from the epicenter but rarely cause damage. Magnitude 4.0 to 4.9 earthquakes cause shaking of objects indoors but generally cause none to slight damage. Magnitude 5.0 to 5.9 earthquakes can cause moderate to major damage to poorly constructed buildings but none to slight damage to other buildings. Connecticut incorporated building codes for seismic activity into the state building code in 1992. There were no requirements prior to that. So, while the risk for a very damaging earthquake is relatively low in the region, some structures may be impacted by less intense earthquakes depending on the soil and integrity of the structure.

The location of the epicenter holds great significance for the damages that could be expected. A moderately strong earthquake centered near a more populated, built-up area would be expected to result in considerably more damage than one located in a more remote area. Based on our history and geology, the Capitol Region's vulnerability to damaging earthquakes is low. The damages we are likely to face here from earthquakes are much lower than in other parts of the nation and world.

Mitigation Strategy

To address the impacts of these natural hazards, the planning committee and local and regional staff reexamined the goals, objectives, and strategic mitigation activities proposed in the 2019 Plan as well as assessed our experiences with natural disasters of the last 5 years and considered input from the public and other stakeholders in order to develop a blueprint for better protecting our region over the next 5 years. Each mitigation action was prioritized, and responsible agencies, potential funding sources, and time frames for implementing the projects were identified. What follows is a brief outline of the regional and local strategies proposed

Region-wide Municipal Goals, Objectives, and Mitigation Actions

During the development of the 2014 edition of this plan, the municipalities in the Capitol Region collectively identified over 400 mitigation strategies to include in the plan. These 400+ mitigation actions

were organized among municipal goals and objectives that largely originated in the 2008 edition of the plan and were carried forward to the 2014 edition of the plan with revisions as directed by the local planning teams. Many of the goals and objectives were similarly worded but contained slight differences, which created a situation where goals and objectives were redundant.

To promote uniformity throughout the update process in 2018-2019 and ensure that communities selected appropriate mitigation actions in light of the new initiatives and challenges described during meetings held in 2017-2018, CRCOG worked with its communities to develop a standard list of municipal goals from which each community would identify those that are locally relevant. Nine municipal hazard mitigation goals were identified and used to inform each community's respective hazard mitigation strategies and actions. The nine region-wide municipal goals in the 2019 plan are listed below.

- Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure: Mitigation actions that address this goal are intended to protect or adapt structures and infrastructures from the physical impacts of hazards. Actions might include floodproofing structures, elevating structures above flood elevations, constructing fire breaks, or assessing wind-load capacities of critical facilities.
- Goal 2: Ensure municipal codes and regulations support hazard mitigation: Mitigation actions that address this goal focus on strengthening the regulatory frameworks of communities to avoid the creation or exacerbation of hazardous conditions. Actions might include requiring buildings be elevated above the flood elevation or requiring new developments have multiple modes of egress.
- Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies: Mitigation actions that address this goal focus on education and training of municipal or regional staff, first responders, and elected officials.
- Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure: Mitigation actions that address this goal focus on utilizing the beneficial functions of natural systems and features. Actions might include wetland protection, low impact development, and use of green infrastructure similar to recent actions in the City of Hartford.
- Goal 5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies: Mitigation actions that address this goal focus on maintaining critical services through hazard events. Actions might include burying power lines, developing microgrids, or protecting a wastewater treatment plant.
- Goal 6: Improve public outreach, education, and warning systems: Mitigation actions that address this goal focus on educating and alerting the public. Actions may include sending informational mailers, providing information on the municipal website, or implementing a reverse 9-1-1 system.
- Goal 7: Improve the emergency response capabilities of the region and its communities: Mitigation actions that address this goal focus on developing a community's ability to respond to a hazard event. Actions may include upgrading shelters or the Emergency Operations Center, reviewing evacuation routes, or improving the ability of emergency responders to communicate with one another during events.

- Goal 8: Ensure community character and social equity are addressed in mitigation activities: Mitigation actions that address this goal focus on protecting features of a community that may otherwise be overlooked when considering only the most critical features. Actions may include those that protect historic, cultural, and recreational resources or those that specifically address low-moderate income or underserved populations.
- Goal 9: Minimize the economic impact of hazard damages: Mitigation actions that address this goal focus on limiting economic impacts of damages that do occur regardless of actions taken to mitigate the physical impacts of the damages themselves. Actions may include educating landowners about flood insurance, joining CRS, improving the community CRS score, or setting up recovery funding mechanisms.

This HMCAP advocates for, and supports, new goal statements that are aligned with *Resilient Connecticut* and the efforts of the GC3. The five new goals developed for this HMCAP were developed with cooperation from CIRCA in the *Resilient Connecticut* planning process, and are:

1. Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.
2. Address risks associated with extreme heat events, especially as they interact with other hazards.
3. Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.
4. Reduce losses from other hazards.
5. 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.

The previous nine goals are cross-referenced to the five new goals in the table below, demonstrating that the intent of each of the prior goals was preserved during the shift to new goals.

Table 7. Matrix of New Hazard Mitigation and Climate Adaptation Goals Compared to Previous Goals

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure.	Critical facilities are an important subset of buildings and infrastructure.	Extreme heat is a hazard that may impact some buildings and infrastructure. Reducing heat exposure may help reduce losses to buildings and infrastructure.	Floods and erosion are hazards that will impact some buildings and infrastructure. Reducing flood and erosion risks will help reduce losses to buildings and infrastructure.	Hazards such as winter storms and severe wind events will impact some buildings and infrastructure. Reducing risks will help reduce losses to buildings and infrastructure.	Infrastructure includes roads and the utilities within roadways. Resilient corridor identification and development will help protect infrastructure.
Goal 2: Ensure municipal codes and regulations support hazard mitigation.	Codes and regulations are employed when developing or upgrading critical facilities.	Codes and regulations may help reduce the impacts of extreme heat.	Codes and regulations will help reduce the impacts of flood and erosion.	Codes and regulations will help reduce the impacts of hazards such as severe wind events and heavy snow.	---
Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Discussions about shelters and cooling centers will be helpful in advancing institutional awareness and community planning.	New discussions about extreme heat can be used in advancing institutional awareness and local planning.	New discussions about intense flooding can be used in advancing institutional awareness and local planning.	New discussions about droughts and other hazards can be used in advancing institutional awareness and local planning.	The concept of fostering resilient corridors may be helpful in advancing institutional awareness and local planning.
Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	--	Some actions that help reduce extreme heat are aligned with green infrastructure natural resource restoration.	Flood risk reduction efforts may include setting aside open space and acquiring properties to remove structures, as well as the use of green infrastructure.	Natural and green infrastructure can help manage droughts and other hazards.	--
Goal 5: Improve the resilience of local and	Critical facilities are an important subset of infrastructure.	Extreme heat is a hazard that may impact some utilities and infrastructure.	Floods and erosion are hazards that will impact some utilities and	Hazards such as winter storms and severe wind events will impact some	Infrastructure includes roads and the utilities within roadways. Resilient corridor

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.		Reducing heat exposure may help reduce losses to utilities and infrastructure.	infrastructure. Reducing flood and erosion risks will help reduce losses to utilities and infrastructure.	utilities and infrastructure. Reducing risks will help reduce losses to utilities and infrastructure.	identification and development will help protect utilities and infrastructure.
Goal 6: Improve public outreach, education, and warning systems.	Shelter and cooling center awareness is a key part of public education, especially given that not all cooling centers are equally accessible; and some shelters are in adjacent towns	Extreme heat is emerging as a severe public health threat, and public education is critical for reducing injuries and deaths.	More than ever, flood risk communication is needed to ensure that private and public investments are reducing risks; and that people understand how to be safe during flood events.	An all-hazards approach to public education fosters community responses to wildfires, droughts, and severe storms.	Helping community members understand why investment is directed at resilient corridors will help them make choices about preparing for floods and other events.
Goal 7: Improve the emergency response capabilities of the region and its communities.	Making critical facilities such as shelters and cooling centers more resilient will directly benefit emergency response capabilities.	Reducing the impacts of extreme heat may reduce the need to respond during extreme heat events.	Reducing the impacts of floods may reduce the need to respond during flood events.	Reducing the impacts of hazards such as severe winter storms and wind events may reduce the need to respond during these events.	Resilient corridors will directly benefit emergency response capabilities.
Goal 8: Ensure community character and social equity are addressed in mitigation activities.	Critical facilities such as shelters and cooling centers are necessary to support social equity. Actions about transportation and facility operations will help ensure equity in usage is achieved.	Extreme heat often highlights the inequities in extreme heat management. Actions that reduce heat exposure such as trees, and actions that increase heat management such as cooling centers, can help achieve equity while also benefiting community character.	Flood damage often highlights the inequities in floodplain management. Actions that reduce flood risk such as providing more resilient housing opportunities and setting aside floodplains for conservation can help achieve equity while also benefiting community character.	Losses from other hazards (e.g., power outages) often highlight social inequities. Actions that reduce risks can help achieve equity while also benefiting community character.	Resilient corridor concepts can help advance social equity by fostering deliberate investment in specific corridors rather than responding to unplanned development pressures or requests from specific neighborhoods to invest in roads that are not appropriate for an enhanced level of investment.

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
Goal 9: Minimize the economic impact of hazard damages.	Making critical facilities such as shelters and cooling centers more resilient will reduce costs associated with repairs after hazard events.	Reducing the causes of extreme heat exposure may reduce the costs to manage extreme heat (e.g., air conditioning).	Reducing the impacts of floods has a direct economic benefit to property owners and the community.	Reducing the impacts of severe wind, winter storms, and other hazards has a direct economic benefit to property owners and the community.	Resilient corridor concepts can be used to foster development in resilient areas, which has an economic benefit to residents.

Each of the 38 municipalities in the Capitol Region also reassessed its goals, objectives, and strategic mitigation actions from the 2019 Plan and developed a new strategic course of action for the upcoming 5 years. While many are unique to the individual communities, there are commonalities among the actions proposed, and most communities have proposed a range of activities including public education and awareness; natural resource protection; plans, studies, and regulatory actions; structural projects and modifications to buildings, facilities, and infrastructure; as well as measures to improve preparedness and emergency response.

Plan Implementation and Maintenance

Upon approval of the Plan Update by FEMA, each municipality's governing body as well as CRCOG's Policy Board will need to formally adopt the Plan Update.

Implementation of the strategies contained within this plan will depend largely on the availability of resources. Each municipality and CRCOG will have to consider the costs, availability of funding, and impacts of each strategy individually. The CRCOG Policy Development & Planning Department will be responsible for regional strategies and coordination with CRCOG Public Safety staff.

For more information on natural hazard mitigation planning, please visit CRCOG's website – https://crcog.org/natural-hazards-mitigation-planning/

Municipal Annexes

Details on the hazard risks and vulnerabilities, mitigation capabilities, and planned mitigation strategies and actions of each municipality in the Capitol Region are included in the Municipal Annexes section of this document. That section is formatted to be viewed as a separate document, but is not intended as a stand-alone planning document.

Appendices

Appendix A: Local planning meeting materials

Appendix B: Regional workshop materials

Appendix C: Utility and lifeline meeting materials

Appendix D: Public meeting materials

Appendix E: Internet based survey results

Appendix F: Copies of communications related to planning process

Appendix G: Draft plan presentation materials

Appendix H: Templates for annual emails to jurisdictions and organizations that serve socially vulnerable populations

Appendix I: Worksheet to document plan updates and amendments

Appendix J: Action monitoring form

Appendix K: CIRCA climate change fact sheets

Appendix L: DCRF fact sheet

Appendix M: Active mitigation strategies and actions: 2024-2029

Appendix N: Planning process for the 2019 CRCOG HMP Update

Appendix O: HAZUS results

Appendix P: Adoption resolutions

Tables

Maps

Figures

Section I: Introduction and Overview of the Region

Introduction

The Capitol Region Council of Governments (CRCOG) received Federal Emergency Management Agency (FEMA) funds through the Connecticut Department of Emergency Services and Public Protection (DESPP) to develop a Natural Hazard Mitigation Plan Update for the 38 municipalities comprising the region:

Town of Andover	Town of East Windsor	Town of Marlborough	Town of Suffield
Town of Avon	Town of Ellington	City of New Britain	Town of Tolland
Town of Berlin	Town of Enfield	Town of Newington	Town of Vernon
Town of Bloomfield	Town of Farmington	Town of Plainville	Town of West Hartford
Town of Bolton	Town of Glastonbury	Town of Rocky Hill	Town of Wethersfield
Town of Canton	Town of Granby	Town of Simsbury	Town of Willington
Town of Columbia	City of Hartford	Town of Somers	Town of Windsor
Town of Coventry	Town of Hebron	Town of South Windsor	Town of Windsor Locks
Town of East Granby	Town of Manchester	Town of Southington	
Town of East Hartford	Town of Mansfield	Town of Stafford	

CRCOG staff and municipal officials from each community contributed to this planning project. The Connecticut Institute for Resilience and Climate Adaptation (CIRCA) prepared this plan update, building upon the existing Capitol Region Natural Hazard Mitigation Plan of 2019 prepared by Milone and MacBroom, Inc. CRCOG is working with CIRCA to identify unmet climate-related needs related to flooding and extreme heat through participation in the *Resilient Connecticut* program, with a duration of about 18 months from April 2023 through September 2024. CRCOG therefore elected to align the *Resilient Connecticut* planning process with this update of the region's Hazard Mitigation Plan. This alignment has resulted in development of a combined Hazard Mitigation and Climate Adaptation Plan ("HMCAP"). The alignment of the planning efforts, and the adoption of this combined Hazard Mitigation and Climate Adaptation Plan, will help position local hazard mitigation, climate adaptation, and resilience efforts for the State's "resilience project pipeline."

Plan

This plan update builds on the existing Capitol Region Natural Hazard Mitigation Plan of 2019.

This introductory section contains a brief overview of the plan's purpose and an introduction to the region and its current conditions. It describes who we are and what we have at stake. Section II describes the planning process undertaken by CRCOG and its member municipalities to complete this plan. Section III profiles and evaluates the natural hazards that affect the Capitol Region. Section IV assesses regional and local capabilities, summarizes mitigation actions, and describes the regional mitigation goals and strategies in more detail. Section V describes the process for adopting, implementing, monitoring, and updating the plan. Section VI documents the sources we used. The Municipal Annexes are shared as a separate document, which describes each participating community, their vulnerabilities to natural hazards, and their mitigation strategies. Finally, the appendices provide

further details on our planning process, critical facilities, historic and cultural resources, and loss estimates.

Authority

The Federal Disaster Mitigation Act of 2000 (DMA 2000) amended Section 322, "Mitigation Planning" and other sections of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to promote natural hazard mitigation planning. DMA 2000 requires local governments to have an approved Natural Hazard Mitigation Plan to be eligible to receive Hazard Mitigation Grant Program project funding. Once approved by FEMA and adopted locally, this regional plan will fulfill that requirement.

Purpose

The purpose of this plan is to identify natural hazards and climate change impacts likely to affect the Capitol Region and its nearly one million residents, assess vulnerabilities to these hazards, and set forth mitigation strategies that will reduce the loss of life and property, economic disruptions, and the cost of post-disaster recovery for the region's communities. Unlike other emergency plans already adopted for the region, this Hazard Mitigation and Climate Adaptation Plan focuses on reducing or eliminating losses from natural hazards and climate change impacts. The Capitol Region's communities recognize their responsibility to protect the health, safety, and welfare of their citizens and will strive to implement the mitigation strategies they propose. However, while this plan provides a blueprint for local and regional efforts to reduce or eliminate risk to life and property from natural hazards, it does not constitute a mandate, specification, or regulation.

The hazards included in this Plan Update include all of those profiled and analyzed in the previous Plan Update of 2019, with the addition of extreme heat. For this Plan Update, hazards were organized by climate driver as follows:

Table 8. Hazards Organized by Climate Driver

Climate Driver	Hazards Included in Plan Update
Extreme Storms	Hurricanes and tropical storms
	Tornadoes and high wind events
	Severe winter storms
Sea Level Rise	Connecticut River tidal range
Changing Precipitation	Riverine and pluvial floods
	Droughts
	Dam overtopping or failure
Rising Temperatures	Extreme heat
	Wildfires
Earthquakes (not affected by climate change, but included in the plan as always)	Earthquakes

Mitigation goals and strategies were developed at both the regional and local levels. CRCOG, in addition to local and other partners, are responsible for implementation of the regional goals contained in this plan. Each participating municipality identified its own mitigation goals and strategies and assumes responsibility for implementation of those measures.

Connecticut's Capitol Region

Geography and Climate

The Connecticut River valley bisects the Capitol Region from north to south. The western and eastern edges of the region contain more steep slopes and narrower tributary river valleys than the relatively flat, central valley (see the topography map at the end of this section). The region's climate, like the state's, is dominated by a relatively even distribution of precipitation across four seasons, a significant range in temperatures both seasonally and daily, and significant variability in weather over brief time spans as well as across years. Generally, the state has a moderate climate with maximum temperatures ranging from the teens and single digits during the winter months to highs in the 80s and 90s during the summer months. Median annual precipitation ranges from 42 – 52 inches, although this can vary widely, and the amount of precipitation may be changing as the climate changes. Snowfall averages between 30 inches along the coastline to 50 inches in the northwest hills, with wide variation across the hills and valleys of the CRCOG region, and again, with wide variation from year to year. The topography of the region is depicted in Map 1.

Population

Connecticut's Capitol Region encompasses the City of Hartford, Connecticut's capitol, and the 37 surrounding urban, suburban, and rural communities. It is a region rich in history as well as human and natural resources. Portions of the Farmington and Connecticut Rivers traverse the region, in addition to several regional river complexes, including the Hockanum, Park, Quinnipiac, Scantic, and Willimantic. The region contains urbanized and heavily developed areas as well as low-density suburbs and rural enclaves.

The total regional population according to the 2020 U.S. Census is 976,248. This is a 0.23 % increase from the 2010 population of 973,960. As Table 9 indicates, population density across the region varies dramatically, from a low of 166 people per square mile in Willington to a high of 6,688 people per square mile in Hartford.

Table 9. Capitol Region 2020 Population and Density

Municipality	Land Area (sq. mi.)	Census 2020 Population	Density (per sq. mi.)
Andover	15.7	3,151	201
Avon	23.6	18,932	802
Berlin	27.0	20,175	747
Bloomfield	26.3	21,535	819
Bolton	14.7	4,858	330
Canton	25.0	10,124	405
Columbia	22.0	5,272	240
Coventry	38.2	12,235	320
East Granby	17.7	5,214	295
East Hartford	18.7	51,045	2,730
East Windsor	26.8	11,190	418

Municipality	Land Area (sq. mi.)	Census 2020 Population	Density (per sq. mi.)
Ellington	34.6	16,426	475
Enfield	34.2	42,141	1,232
Farmington	28.8	26,712	928
Glastonbury	52.2	35,159	674
Granby	40.8	10,903	267
Hartford	18.1	121,054	6,688
Hebron	37.3	9,098	244
Manchester	27.7	59,713	2,156
Mansfield	45.6	25,892	568
Marlborough	23.5	6,133	261
New Britain	13.5	74,135	5,491
Newington	13.1	30,536	2,331
Plainville	9.8	17,525	1,788
Rocky Hill	13.8	20,845	1,511
Simsbury	34.3	24,517	715
Somers	28.5	10,255	360
South Windsor	28.7	26,918	938
Southington	36.6	43,501	1,189
Stafford	58.8	11,472	195
Suffield	42.9	15,752	367
Tolland	40.3	14,563	361
Vernon	18.1	30,215	1,669
West Hartford	22.3	64,083	2,874
Wethersfield	13.1	27,298	2,084
Willington	33.5	5,566	166
Windsor	31.0	29,492	951
Windsor Locks	9.4	12,613	1,342
Totals	**1,046**	**976,248**	

According to a demographic presentation to the CRCOG Policy Board on September 27, 2023, between 2010 and 2020 the region's Hispanic population increased 21% from 137,266 to 165,603. Percentage increases were also observed in Black, Asian, multi-racial, and "other" populations within the region, while the White population decreased 14% over the decade.

There was a 3.4% increase in the housing supply from 2010 to 2020 in the CRCOG region, more than the 2.8% increase observed across the entire state of Connecticut.

Socially Vulnerable Populations

Certain populations throughout the CRCOG region are more vulnerable to the impacts of natural hazard events and climate change than others. Factors increasing this vulnerability could include age, socioeconomic status, minority status, and health or disabilities.

There are multiple tools used within the state of Connecticut for identifying communities facing disproportionate environmental burdens, including exposure to pollution, impacts of climate change, and vulnerability to natural hazard events. The state list of Distressed Municipalities identifies the towns that are most economically distressed, taking into account factors such as per capita income, percentage of the population in poverty, unemployment, education, old housing stock, and more. The Connecticut Environmental Justice Screening Tool (CT EJ Screen) is a new tool developed by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) and the Connecticut Department of Energy and Environmental Protection (DEEP), which gives each census tract in the state of Connecticut an environmental justice index score based on how it compares to all other census tracts in the state in terms of pollution exposure, health sensitivity, and social vulnerability. More information about the CT EJ Screen can be found here: https://connecticut-environmental-justice.circa.uconn.edu/ A map of the region displaying CT EJ Screen Environmental Justice Index Scores is shown in Map 1.

Separate from the new EJ mapping, CIRCA developed a tool to aid in understanding extreme heat and flood vulnerabilities for communities across the state. This tool, known as the CCVI, is comprised of dozens of factors that contribute to a community's sensitivity, exposure, adaptive capacity, and ultimately the overall vulnerability. Many of the demographic factors used for EJ mapping are used for the sensitivity and adaptive capacity scores in the CCVI. In fact, in some communities, these factors dominate the CCVI calculation (which is based on ranking methodologies found in climate science) and the flood and heat vulnerabilities have a similar profile as the EJ mapping. Individual flood and heat CCVI maps can be found in each annex document.

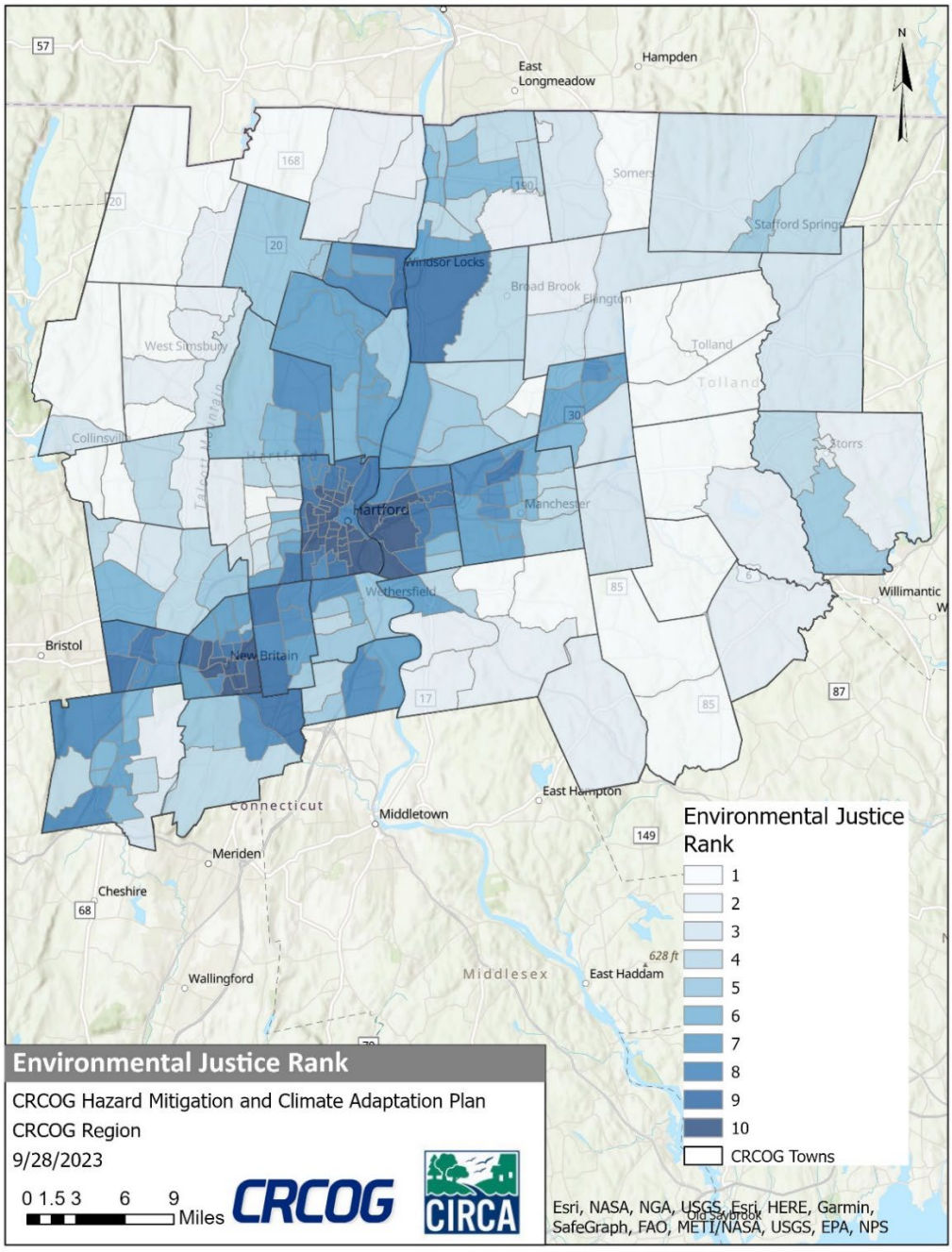
The public engagement component of the planning process included tools to reach socially vulnerable and EJ populations in an equitable manner. Additional levels of outreach were conducted for the four Distressed Municipalities located within the CRCOG region, as well as the towns that contain census tracts ranked 8 or above on the CT EJ Screen, which indicates the top 20% of the most impacted census tracts in the state. An additional municipality was added to this list based on guidance from CIRCA staff. The resulting list of municipalities for targeted outreach is below:

- Hartford
- East Hartford
- New Britain
- Enfield
- Windsor Locks
- East Windsor
- Manchester
- West Hartford
- Newington
- Plainville
- Berlin
- Vernon

For these towns, CIRCA staff identified local community organizations, broader nonprofit organizations with local presences in specific towns, and/or community foundations with grant programs targeted at specific towns. For each town, up to five organizations were identified and contacted via direct email. CIRCA staff shared a Story Map, an online survey, and invitations to both virtual and in-person public meetings with the organizations identified for each town, and asked the organizations to share the materials with their social media, websites, and email networks. Additionally, a flyer in Spanish was prepared and shared, including at an in-person Frog Hollow NRZ community event where Hartford residents were already gathering.

While it is impossible to know how many socially vulnerable people viewed social media or press releases, people who participated in the survey live in at least three EJ communities based on the locations they entered (Manchester, Hartford, and Plainville), making up more than half of the total survey respondents. The public meeting in Hartford (which was hybrid, with both in-person and virtual options for joining) was located along a major bus route near bus hubs, and another virtual public meeting was also held to allow people to join regardless of location.

Notwithstanding the efforts already undertaken, CRCOG believes that continued engagement directed at socially vulnerable, traditionally underserved populations will help enhance the plan. Working with CIRCA, CRCOG developed a list of organizations that are best equipped to reach socially vulnerable, traditionally underserved populations in the region. Appendix H includes the list, along with specific messages that will be annually distributed to these organizations for physical posting and their social media.



Map 1. Connecticut Environmental Justice Scores for the CRCOG region.
Higher scores / darker areas indicate higher pollution burdens and sensitive populations.

Land Use

Like most inland areas in New England, the Capitol Region historically developed along its major rivers. That early settlement pattern is still evident in contemporary land uses, with more urbanized areas concentrated along the Connecticut, Farmington, and Hockanum Rivers. Less dense development and

more significant forested and open space lands exist on the western and eastern edges of the region. Map 2 of this section displays land cover across the region in 2020. As is evident from the map, more development has occurred in a rather diffuse pattern, away from the traditional urban core. This map was derived from the Center for Land Use Education and Research (CLEAR) at the University of Connecticut. Town-level land cover change maps for the same time period are available on CLEAR's website. These maps can help towns assess the vulnerability of new developments to natural hazard risks. The Capitol Region's current Plan of Conservation and Development's Land Use Policy Map is displayed on page 15 of this section (Map 3). The regional POCD was being updated at the same time as this HMCAP Plan Update and will be in effect from 2024-2034. The Land Use Policy Map represents the generalized land use plan for the region and the 30 municipalities that were members of CRCOG at the time the plan was prepared. It reflects existing and proposed regional priority areas of development and preservation and shows municipal focus areas for development and conservation.

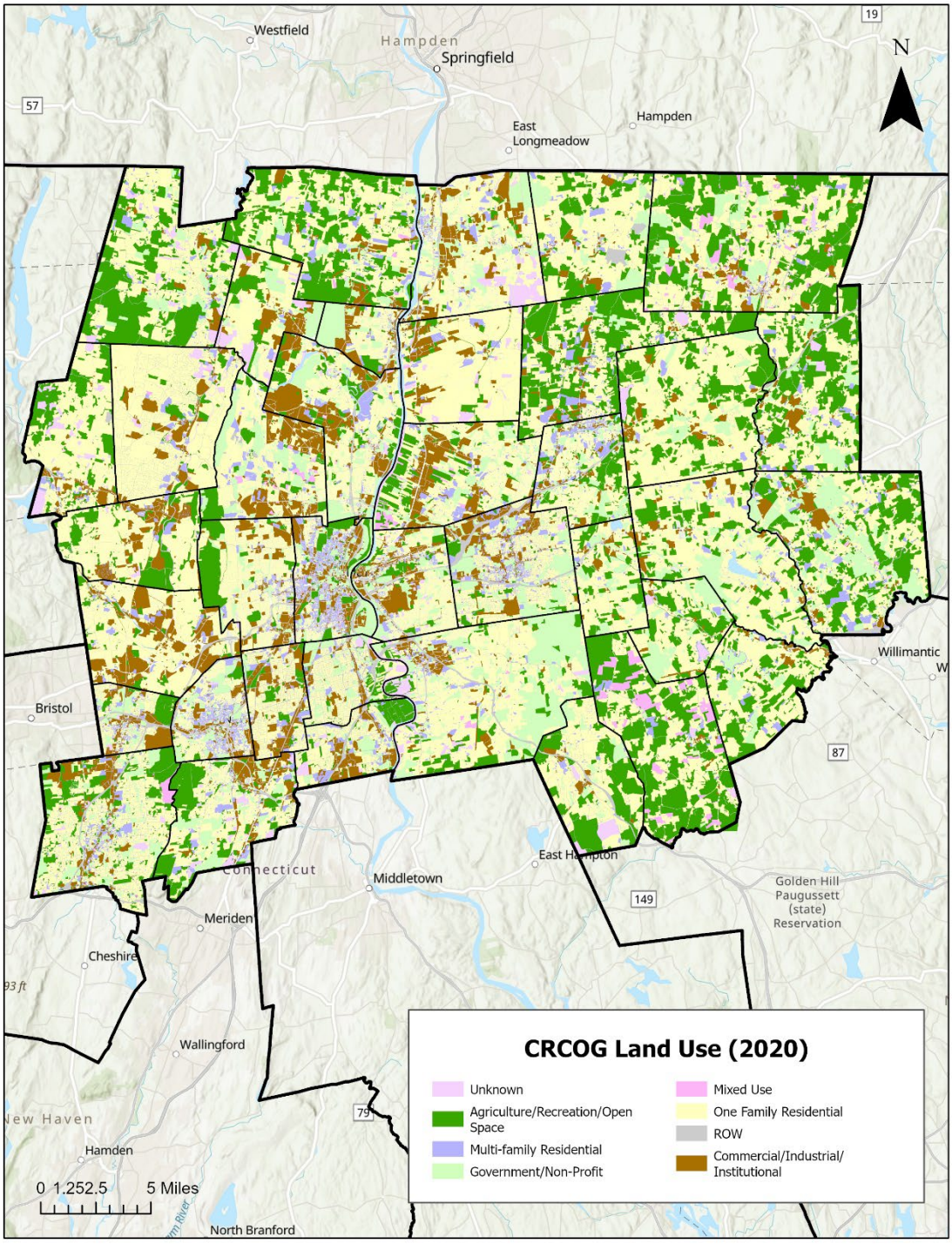
The Capitol Region hosts significant commercial, industrial, and public properties ranging from the regional employment centers and state office buildings in Hartford, New Britain, Enfield, Suffield, Rocky Hill, Wethersfield, and Newington to Rentschler Field in East Hartford, Bradley International Airport in Windsor Locks, the commercial/industrial Day Hill Road area in Windsor, and the major retail developments in West Hartford, Manchester, and South Windsor. According to 2021 equalized net grand list data, the region contains $ 144.9 billion in taxable real and personal property (see Table 10 below). The previous Hazard Mitigation Plan reported a total of $108.9 billion in taxable real and personal property.

Table 10. 2021 Grand List Data by Town

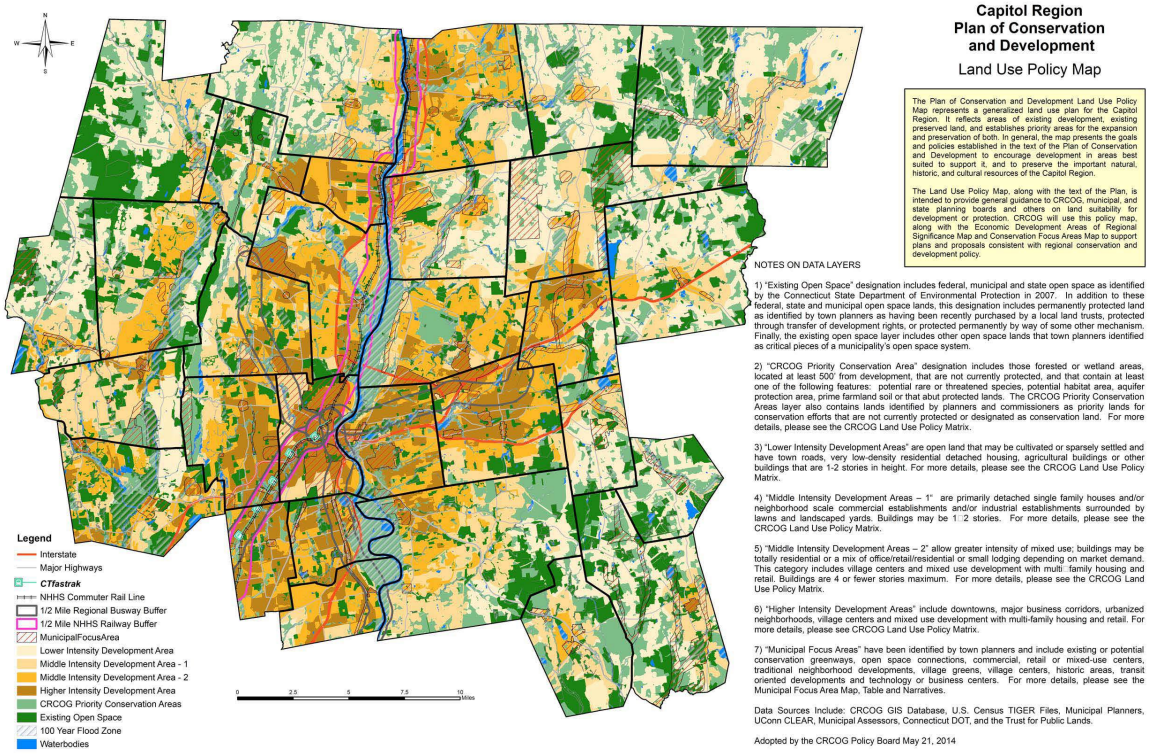
Town Name	2021 Total Real Property Equalized	2021 Total Personal Property Equalized	2021 Total Equalized
Andover	$ 373,350,474	$ 69,955,770	$ 443,306,244
Avon	$ 4,199,039,012	$ 498,905,320	$ 4,697,944,332
Berlin	$ 3,469,184,179	$ 766,242,347	$ 4,235,426,526
Bloomfield	$ 3,387,888,433	$ 814,067,213	$ 4,201,955,646
Bolton	$ 722,063,886	$ 100,025,889	$ 822,089,775
Canton	$ 1,679,786,708	$ 264,442,934	$ 1,944,229,642
Columbia	$ 706,563,498	$ 127,569,187	$ 834,132,685
Coventry	$ 1,733,328,640	$ 259,477,179	$ 1,992,805,819
East Granby	$ 858,829,256	$ 226,867,423	$ 1,085,696,679
East Hartford	$ 3,993,795,516	$ 997,778,367	$ 4,991,573,883
East Windsor	$ 1,667,098,042	$ 303,933,776	$ 1,971,031,818
Ellington	$ 2,371,377,851	$ 392,559,771	$ 2,763,937,622
Enfield	$ 4,272,518,585	$ 980,990,109	$ 5,253,508,694
Farmington	$ 6,044,878,920	$ 784,293,053	$ 6,829,171,973
Glastonbury	$ 7,227,283,057	$ 895,616,077	$ 8,122,899,134
Granby	$ 1,777,520,980	$ 231,543,817	$ 2,009,064,797
Hartford	$ 4,934,490,815	$ 1,903,406,157	$ 6,837,896,972
Hebron	$ 1,132,260,419	$ 183,933,757	$ 1,316,194,176
Manchester	$ 5,736,012,230	$ 1,238,247,857	$ 6,974,260,087
Mansfield	$ 1,948,462,374	$ 298,999,386	$ 2,247,461,760

Town Name	2021 Total Real Property Equalized	2021 Total Personal Property Equalized	2021 Total Equalized
Marlborough	$ 992,364,136	$ 124,856,781	$ 1,117,220,917
New Britain	$ 5,047,355,200	$ 882,338,671	$ 5,929,693,871
Newington	$ 4,563,456,588	$ 706,766,249	$ 5,270,222,837
Plainville	$ 1,911,397,761	$ 435,360,300	$ 2,346,758,061
Rocky Hill	$ 3,646,967,546	$ 571,975,900	$ 4,218,943,446
Simsbury	$ 4,485,778,897	$ 613,606,121	$ 5,099,385,018
Somers	$ 1,430,697,302	$ 263,018,114	$ 1,693,715,416
Southington	$ 7,049,951,147	$ 1,171,997,696	$ 8,221,948,843
South Windsor	$ 4,636,932,025	$ 925,050,791	$ 5,561,982,816
Stafford	$ 1,360,399,734	$ 240,439,986	$ 1,600,839,720
Suffield	$ 2,478,736,312	$ 373,497,161	$ 2,852,233,473
Tolland	$ 2,063,509,640	$ 316,383,510	$ 2,379,893,150
Vernon	$ 2,685,824,373	$ 498,242,730	$ 3,184,067,103
West Hartford	$ 10,911,277,493	$ 1,173,139,527	$ 12,084,417,020
Wethersfield	$ 3,888,081,556	$ 492,200,431	$ 4,380,281,987
Willington	$ 724,853,377	$ 126,784,113	$ 851,637,490
Windsor	$ 4,950,178,263	$ 1,073,714,780	$ 6,023,893,043
Windsor Locks	$ 1,920,599,978	$ 627,453,957	$ 2,548,053,935
Total	**$ 122,984,094,203**	**$ 21,955,682,209**	**$ 144,939,776,410**

Not all properties are equally vulnerable to all natural hazards as location and building materials influence vulnerability; nevertheless, the region risks substantial financial losses from catastrophic natural hazards affecting not only property but also business and government operations.



Map 2. Capitol Region Land Cover - 2020



Map 3. Capitol Region Plan of Conservation and Development Land Use Policy Map

Full size version available here: https://crcog.org/wp-content/uploads/2016/07/Appendix_01_map_Land_Use_Policy_06092014.pdf

Development Trends

The above discussion about property value, housing supply, and population change provides a somewhat uniform picture of development trends in the Capitol Region. While there was limited growth in single-family housing, many Capitol Region communities saw growth in multifamily units. Some of the increases in multifamily housing units are striking, with large apartment complexes completed in Bloomfield, Farmington, Granby, Mansfield, Newington, Tolland, and Vernon since the previous edition of this plan was approved in 2019. Industrial development also occurred in the region, particularly through the construction of warehouses in Enfield, Windsor, and East Windsor.

To provide a narrative characterization of development trends in the Capitol Region, each municipality was provided an opportunity during the planning process to comment on development within its borders. Some of the more significant developments noted by communities include the following:

Table 11. Notable Developments or Redevelopments

Municipality	Notable Developments or Redevelopments
Andover	One Dollar General was built at the intersection of Lake Road and Rt 6. This is not in the flood zone, but could be potentially cut off from most of the town in the event

Municipality	Notable Developments or Redevelopments
	of a flood emergency. This is not a critical facility. Not much other development to report.
Avon	Some multi-family developments have been planned or are in-progress, such as Avon Mill off Waterville Road/Route 10. Some development has occurred in the industrial park area. No new subdivisions are proposed or underway.
Berlin	Several mixed-use and apartment complexes have been recently added along the Berlin Turnpike and by the CTrail/Amtrak train station.
Bloomfield	A lot of apartment development as well as some industrial development. There has been a large influx of apartments in the past 5-6 years, in the downtown area (such as Jolley Drive), and the town is still getting applications for new development.
Bolton	No significant development in Bolton since 2019.
Canton	Multiple large residential complexes have been constructed, including on Rt 44/179 at 5 Cherry Brook Road and on Rt 44 near Daynard. Additional complexes are in development or discussion on Old Canton Road, Lawton Road, and Dowd's Corner.
Columbia	No new development along the Hop River, which is the main vulnerable area in the town. Development elsewhere is primarily limited to single residences from time to time.
Coventry	The route 44 corridor hosts small-scale, slowly paced incremental development. The town hosts a new Anaerobic digestor that has used some of the farmland but will support continued farm use.
East Granby	Town staff reported that they have not seen much development in recent years. Applications for multi-family development in the Village center have been submitted, but no development has yet occurred at the time of writing.
East Hartford	Redevelopment of the Silver Lane Plaza, which overlaps with a small portion of the Willow Brook flood zone, is likely in the near future. The state building code regulations for floodproofing and elevation will be followed here as they should be in all regulated FEMA flood zones.
East Windsor	Watermill Crossing, a new assisted living 55+ apartment building, has been constructed. A new warehouse has been constructed on Rt 5, outside of the flood zone.
Ellington	Some commercial development has continued on Rt 83, which is the main commercial corridor. Three new subdivisions with 10-12 lots each. Oakridge Dairy, the largest dairy in the state, has just commissioned a digester that is already online and operating. The town has purchased 11 acres for low-income senior housing on 59 Maple Street.
Enfield	Major development with warehouse distribution centers. One 480,000 sq ft warehouse has been constructed on 113 North Maple Street. One 800,000 warehouse will be starting construction on 35 Bacon Road. A third warehouse of about 500,000 sq ft has been approved at 0 King Street. Most of the existing shopping mall will eventually be redeveloped.
Farmington	Multiple new apartment complexes, mostly along Rt 4 (new buildings) or Fienemann Rd (a former hotel). None of these are believed in areas of flood risk.

Municipality	Notable Developments or Redevelopments
Glastonbury	Several large multi-family developments are upcoming, including apartments at the intersection of Main and Hebron Avenue, a town-house development on Feldspar, a development with a mix of apartments and townhouses on Nye Road, and a 74-unit development on Pratt Street. There is a potential hotel project development north of the town center off Glastonbury Boulevard
Granby	The town has had a lot of recent residential development, including 235 apartments north of the center of town in a 3-story building. None of the new development is located in a vulnerable area.
Hartford	The old stormwater infrastructure system in the city faces pressures from climate-related weather events; as a result, MDC will not allow new sewer and water connections, which limits new development. Instead, redevelopment has continued to be a significant focus in Hartford.
Hebron	No significant development or redevelopment reported by town staff. Modest commercial developments will periodically be advanced in the town center.
Manchester	Ongoing development and redevelopment town-wide, but town staff report none in floodplains.
Mansfield	Development projects listed on the following Story Map, totaling about 1,400 units in the Four Corners Area: https://storymaps.arcgis.com/stories/89b1735a27444d54a409d9e04b99a51c
Marlborough	The town recently approved two apartment buildings with 92-units total. These are not in areas that flood. The town has not had any development in the floodplains.
New Britain	There is a lot of development happening in downtown New Britain, but municipal staff don't believe any of these developments are in high-risk areas. Developments include affordable housing, multi-story and mixed-use buildings (residential/commercial), throughout the downtown area.
Newington	Approximately 1,000 residential units have been approved in the last few years (many of these have not yet been constructed). These are primarily multi-family developments along Berlin Turnpike and Cedar Street. None of these are located in flood plains. Some single-family development too, including two recent subdivisions.
Plainville	The town is concentrating on redevelopment to the extent that it can, to minimize the impact to existing green or undeveloped areas. However, parcels of open space in private hands could be developed. In these cases, the town requires low-impact-development (LID) standards to be applied. One recent development included a series of rain gardens and a larger detention area.
Rocky Hill	There has been a moderate amount of development in the past five years and there will be more coming in the next three years. Most of the development in the past five years has been residential and will continue to be residential.
Simsbury	Route 10 on the South Side of town has new development, but it is outside of the floodplain. This development consists of apartments and an assisted living center. The new development on 36 Iron Horse Boulevard has one property that is in the floodplain, but the first floor is raised 3 feet above the floodplain.

Municipality	Notable Developments or Redevelopments
Somers	Redevelopment of the old mill site in Somerville to 80-100 room apartments: The mill was originally partly in the river but after the mill was removed, the FEMA map was revised. The proposal is for residential units but the units will be outside the FEMA flood zone because of the map revision and the position of the building relative to the river. There is also a 55+ community being built on Eleanor Rd, 30 acres of new greenhouses (Growers Direct Farms), and an expanded farm (Tobacco Barns).
South Windsor	The town does not allow new development in the FEMA floodplain, and are not aware of any particularly vulnerable developments. Commercial development continues along Route 5.
Southington	One re-development is pending downtown near the river, which has already been reviewed for floodplain storage. This is primarily commercial with a mixed-use component. Formerly called Greenway Commons, although the footprint of the re-development will be smaller and will include 200 apartments and retail. A lot of adaptive re-use of older buildings continues to occur in the town. The upper part of West Street Corridor is undergoing some development interest, possibly due to the proximity of ESPN. The town might adjust zoning regulations to allow for responsible development here.
Stafford	Stafford has a two-phase senior housing complex in progress, with the first complex already built and the second one in progress. These are two 73-unit complexes that are next to each other, not in a flood zone. One complex, on Woodland Springs Dr, was completed in 2019. The second phase of the project is underway at 55 Woodland Springs. There are also sporadic individual housing going up throughout town. No major subdivisions are proposed or under development.
Suffield	Most of what the town sees is single-family residential development. Not a lot of new commercial development is occurring. In the industrial zone, one new building has been constructed in the last few years. Overall, the town sees light, sporadic development.
Tolland	Two major developments in process: 1) 240 multi-family units behind Big Y grocery store off Rt 195, which is adjacent to the Tolland Marsh but uphill and not in a flood zone; 2) 83-unit development on Rt 195.
Vernon	There has been a significant amount of development and re-development in Vernon in the last five years. The main economic corridor is the Route 83 / Welles Road / Main Street area referenced in Action #2 of Vernon's table of actions. There has been a significant amount of private development in this area. Apartments and commercial development (from the 200 block to the 800 block on Route 83). Some open space has been acquired and developed but this development has included steps for flood mitigation, including the grading of the parcels to allow water flow back to the river.
West Hartford	The new apartment complex at the former convent at the Southwest corner of Park and Prospect was completed in 2023 and is now open. It was under construction during the 2021 storms described in this plan, which impacted that property and

Municipality	Notable Developments or Redevelopments
	the adjacent stream. Redevelopment of the former UConn campus will be a significant project for the Town in the next decade, and this development will be adjacent to (but not located in) the floodplain associated with the North Branch of Trout Brook.
Wethersfield	Generally, redevelopment is happening within the commercial corridors along Silas Dean Highway and Berlin Turnpike. Not much development in the residential areas. The Borden Development (1160 and 1178 Silas Dean Highway) is a mixed-use residential development in the floodplain, and had to include compensatory flood measures. Overall, the Town requires analysis with compensatory mitigation for development or redevelopment in FEMA flood zones.
Willington	There are no new subdivisions going in at the present time. The Dollar General on Rt 74 and Love's Truck Stop are new since the last HMP.
Windsor	There have been a lot of warehouses development in town, mostly at the airport, along I-91, and in the western part of town, plus a warehouse on Baker Hollow Road. Town has had some applications for redevelopment. Specifically, 144 Broad St which was an old strip mall being repurposed for apartments in the middle of town near the train station. Two apartment developments are taking place. No new structures can be added to 100-year floodplains according to the town ordinance.
Windsor Locks	CT Rail and Amtrak both run commuter trains through Windsor Locks (between Springfield and New Haven). Freight trains also come through. A second high-speed rail line and a new transportation center are being developed. A developer has submitted a concept plan and MOU for 80-100 units with first floor retail on Main Street.

In summary, based on meetings with local planning teams, the most common form of development in the CRCOG communities is multi-family residential development, with some commercial and industrial development also reported (particularly in the form of warehouse developments). The communities of Bolton, Columbia, East Granby, Hartford, Hebron, and Manchester have experienced a somewhat lesser level of development and redevelopment. Two CRCOG communities (East Hartford and Wethersfield) reported redevelopment at least partially in a flood zone, and noted that these projects included compensatory flood measures.

Capitol Region communities are aware of the need to strictly regulate development in areas of risk. Each municipality enforces floodplain development regulations as noted in Section IV. Overall, development and redevelopment in the CRCOG region is not increasing flood risks. Adherence to building codes likewise reduces the risks associated with other hazards profiled in this plan.

In addition to the development listed above, the State of Connecticut and the Capitol Region anticipate that transit-oriented development (TOD) will be spurred by the June 2018 launch of the Hartford line of CT*rail*, the new commuter rail between New Haven and Springfield. Existing railroad stations in Berlin, Hartford, Windsor, and Windsor Locks and potential new stations in Newington, West Hartford, and Enfield may lead to TOD development in those communities. The CT*fastrak* busway has already spurred some development along its stations in New Britain, Newington, and West Hartford.

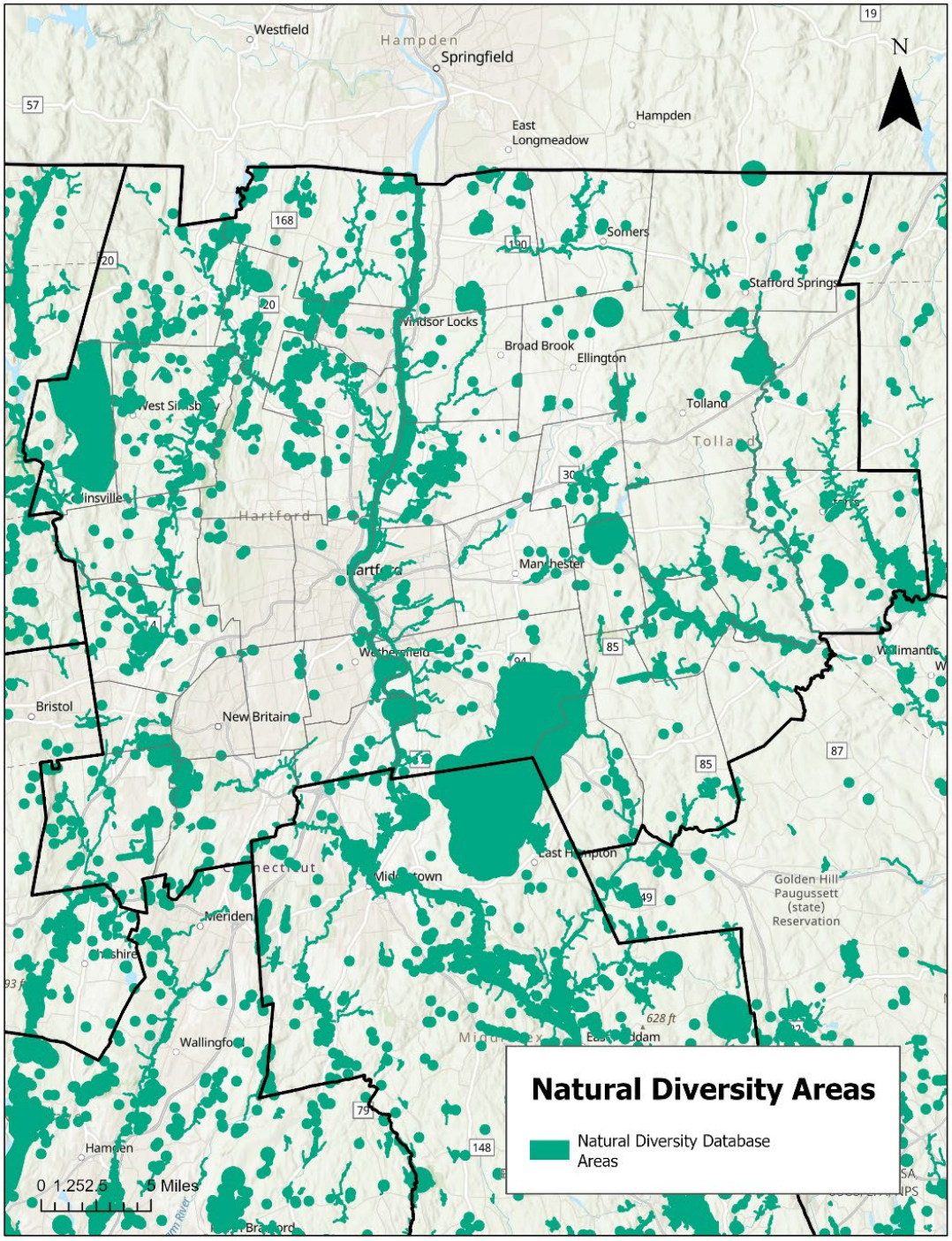
Cultural and Natural Assets of the Region

The Capitol Region is rich in natural, historic, and cultural assets. Efforts have been taken by many to recognize, preserve, and protect these assets. These assets should be considered in our mitigation planning whether in efforts to further protect the assets from the impacts of natural disasters or to minimize potential adverse impacts that may affect these assets.

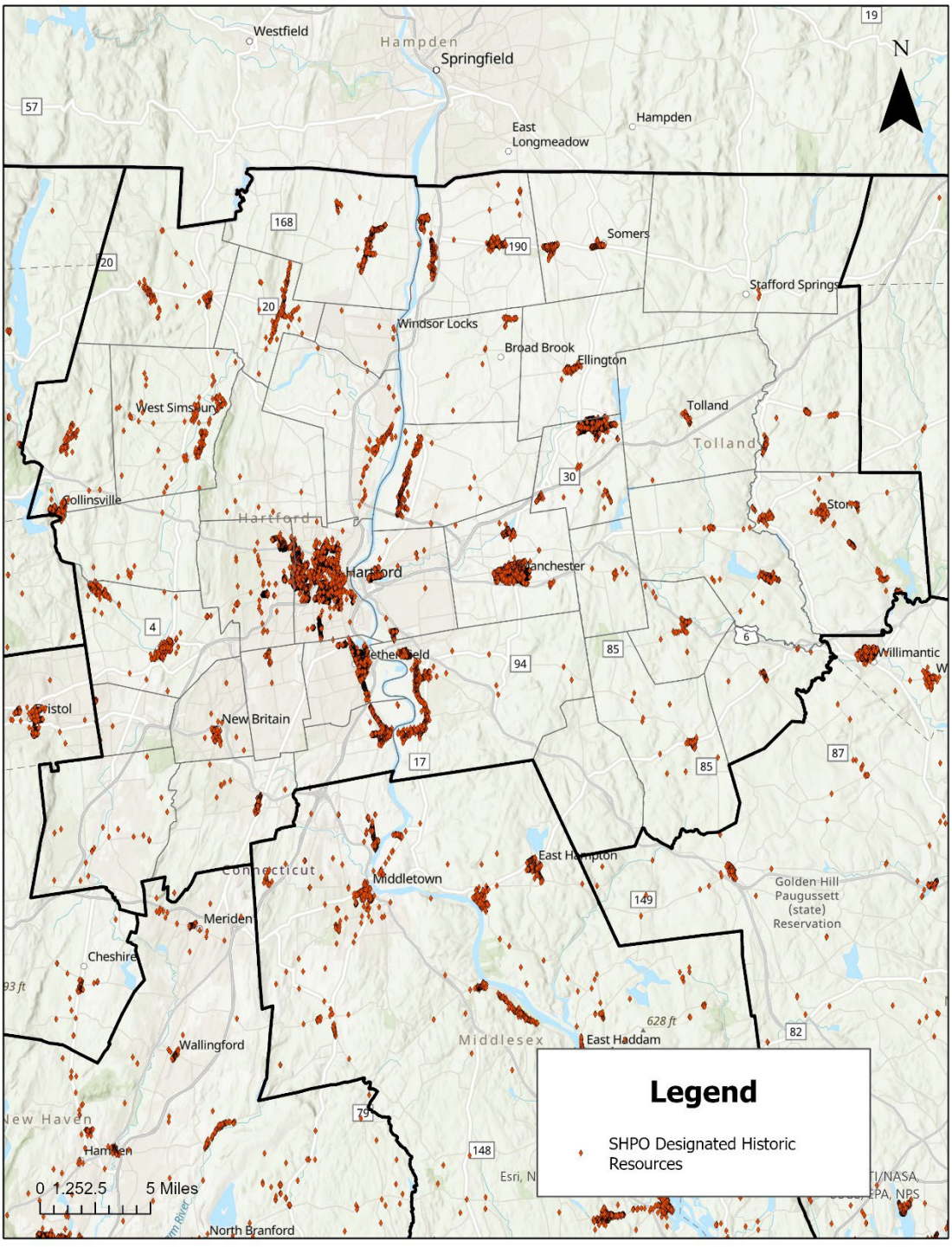
The Connecticut Department of Energy & Environmental Protection (DEEP) maintains a database of plant and animal species that are endangered, threatened, or of special concern. The list is lengthy and can be seen on DEEP's website[1]. In the Capitol Region, some of the species listed include the Barn Owl, Red-headed Woodpecker, Timber Rattlesnake, Wood Turtle, Short-nose Sturgeon, Ground Beetle, Sedge, Yellow Lady's-slipper, Red Pine, and Prickly Pear. Map 4 displays the approximate locations endangered, threatened, and special concern species and significant natural communities in the Capitol Region. These locations are taken from DEEP's Natural Diversity Data Base (NDDB) Maps. These maps are intended to be a pre-screening tool to identify potential impacts to state-listed species. The DEEP should be consulted regarding any mitigation projects that may be considered in these areas.

In 2022, SHPO released an up-to-date GIS inventory of historic resource sites within Connecticut. Map 5 displays this spatial inventory for the CRCOG region. These historic sites are significant to the culture of the region, and historic preservation is an ongoing goal of multiple CRCOG communities.

Risks to historic and cultural resources are discussed in Section III and IV of this plan.



Map 4. General Locations of Endangered and Threatened Species in the Capitol Region



Map 5. SHPO Inventory of Historic Resources in the Capitol Region

Section II: Planning Process

Planning Process for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

The planning process for the 2019 Capitol Region Natural Hazard Mitigation Plan Update is described in Appendix N.

The planning process for the subject Plan Update began in 2023 when the Capitol Region Council of Governments (CRCOG) received Federal Emergency Management Agency (FEMA) funds through the Connecticut Department of Emergency Services and Public Protection (DESPP) to develop a Natural Hazard Mitigation Plan (HMP) Update for the 38 municipalities comprising the region. The Plan Update was developed in collaboration with the region's 38 municipalities, DESPP/DEMHS, and the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). CIRCA was contracted by CRCOG to provide technical support, coordinate efforts to involve officials from each town, and prepare this Plan Update, building upon the existing Capitol Region Natural Hazard Mitigation Plan of 2019 prepared by Milone and MacBroom, Inc. Local planning team members, regional stakeholders, utilities and lifeline providers, and environmental justice communities were all provided opportunities to provide input throughout the development of the Plan Update, as described in more detail in below.

Documentation that supports this narrative description can be found in the Appendices as follows:

- Appendix A – Typical *PowerPoint* slides used for local planning meetings followed by 38 sets of meeting notes (one set for each community)
- Appendix B – Presentation materials and other documentation associated with the two region-wide planning team meetings in July and October 2023
- Appendix C – Presentation materials and meeting notes associated with meetings with regional utilities from July – December 2023
- Appendix D – Materials associated with the two public information meetings held in October 2023
- Appendix E – Internet-based survey results
- Appendix F: Copies of communications related to planning process
- Appendix G – Draft plan presentation materials, including slides for public meeting as well as press release to announce public comment period and public meeting

The planning process for the multi-jurisdiction hazard mitigation plan update commenced in April 2023 and ended in December 2024, spanning a period of 9 months. For this 4th edition of the plan, CRCOG elected to link the planning process to a parallel planning process administered by 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
- Direct incorporation of new Environmental Justice (EJ) mapping developed by CIRCA in 2022-2023
- Positioning of the 38 municipalities for new funding sources in Connecticut such as the new DEEP DCRF
- Consistency with the 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.

Hazards Identification for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

The hazards included in the planning process in 2023-24 included all of those profiled and analyzed 5 years earlier, with the addition of extreme heat. For this Plan Update, hazards were organized by climate driver as follows:

Table 12. Hazards Organized by Climate Driver

Climate Driver	Hazards Included in Plan Update
Extreme Storms	Hurricanes and tropical storms
	Tornadoes and high wind events
	Severe winter storms
Sea Level Rise	Connecticut River tidal range
Changing Precipitation	Riverine and pluvial floods
	Droughts
	Dam overtopping or failure
Rising Temperatures	Extreme heat
	Wildfires
Earthquakes (not affected by climate change, but included in the plan as always)	Earthquakes

Data Collection and Analysis/Risk Assessment for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

CIRCA collected and analyzed the hazards and loss data for participating municipalities to reduce duplication of efforts and to provide a common ground for evaluating mitigation strategies. The data came from a wide variety of sources including FEMA, DEEP, the National Weather Service, National Centers for Environmental Information, United States Department of Agriculture, regional newspapers, the United States Geological Survey, United States Census Bureau, municipalities, and CRCOG's internal geographic information system as well as other resources. The data were used to evaluate natural disasters in terms of frequency, magnitude, areas of impact, and economic loss. The collected data were analyzed using ESRI *ArcGIS Pro* and FEMA's *HAZUS* software. Municipal and regional Plans of

Conservation and Development, municipal zoning and floodplain regulations, municipal budget and capital improvement program documents, and flood management studies were also reviewed during the course of the update. New resources include the Climate Change Vulnerability Index developed by CIRCA and the Connecticut Environmental Justice Screening Tool developed by CIRCA and DEEP.

Municipal Plans Review/Update for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

As the hazards analyses were undertaken, CIRCA led meetings with municipal officials to initiate updates to individual city and town plans. Local planning team meetings commenced in May 2023 and primarily ended in August 2023, although one meeting was held in November 2023 due to municipal staff availability. Meeting dates for each local planning team are listed in Table 13 below. Meeting notes were prepared to document the meetings and the status of prior mitigation actions. Additional follow-up by email communication was conducted by CIRCA as needed to answer questions that could not be addressed in local planning meetings. Meeting notes are provided in Appendix A. Local planning team meetings were held in each of the 38 municipalities and included local staff from a variety of departments including administration, planning, emergency management, police, fire, public health, public works, and engineering. In some towns, citizens and elected officials also participated.

Table 13. Summary of Local Planning Meeting Dates

Town	Meeting Date
Andover	6/22/2023
Avon	7/18/2023
Berlin	11/6/2023
Bloomfield	8/7/2023
Bolton	5/25/2023
Canton	6/23/2023
Columbia	6/21/2023
Coventry	6/29/2023
East Granby	8/29/2023
East Hartford	8/17/2023
East Windsor	5/30/2023
Ellington	6/22/2023
Enfield	7/10/2023
Farmington	6/7/2023
Glastonbury	6/15/2023
Granby	5/22/2023
Hartford	6/12/2023
Hebron	6/20/2023
Manchester	6/13/2023
Mansfield	5/25/2023
Marlborough	6/14/2023

Town	Meeting Date
New Britain	8/23/2023
Newington	8/9/2023
Plainville	6/15/2023
Rocky Hill	6/30/2023
Simsbury	6/26/2023
Somers	6/12/2023
South Windsor	6/26/2023
Southington	8/4/2023
Stafford	6/28/2023
Suffield	6/29/2023
Tolland	6/27/2023
Vernon	8/16/2023
West Hartford	6/16/2023
Wethersfield	6/28/2023
Willington	6/5/2023
Windsor	6/27/2023
Windsor Locks	5/22/2023

Following these municipal meetings, CIRCA worked with municipally designated staff contacts to incorporate the updates prepared by the municipalities. Prior to sending the Plan Update for FEMA approval, each municipality's staff was asked to review their respective annexes and make any desired changes to reflect corrections or status updates since the date of their local meetings; these changes are reflected in the final municipal annexes.

Strategy Analysis and Prioritization for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

To review prior goals, objectives, and actions and strategize about new mitigation initiatives, CRCOG and CIRCA sought input from the local planning coordinators at workshops held on July 24, 2023 and October 3, 2023. The meetings were attended by municipal officials from most of the Capitol Region communities. CIRCA presented and described mitigation success stories and a number of proposed mitigation initiatives and reported on additional strategies/actions based on our findings and discussions with local officials at the individual municipal meetings. Attendees voted on their preferred areas of focus and mitigation strategies, informing the selection of mitigation actions shared across the region and this plan's emphasis on cooling center and critical facility resilience, drought resilience, water supply resilience, agriculture, stormwater infrastructure, dams, stream crossings, vulnerable populations, and forestry management.

Specific Opportunities for Stakeholder and Public Participation for 2024 Natural Hazard Mitigation and Climate Adaptation Plan Update

Following the local planning meetings, a variety of means were used to conduct targeted outreach to local and regional stakeholders, utilities/lifelines, and environmental justice communities and

disproportionately vulnerable communities, in addition to multiple approaches for informing the public of the planning process and gaining public input on hazards, areas and issues of concern, and mitigation measures. These specific outreach efforts are described below.

Workshops for the Local Coordinators:

Two regional workshops were held with the Chief Elected Officials, local coordinators, and other community staff.

The first workshop, the "Vulnerability and Risk Assessment" workshop, was held on July 24, 2023. The workshop was held virtually using the WebEx platform. The theme of the workshop was to present risk assessment findings and gather input. There were three presenters from CIRCA who touched on ten different topics:

- Purpose and Need for Hazard Mitigation Plan
- What's New – Why are we Expanding the Plan into a HMCAP?
- Deployment of the *Resilient Connecticut* program
- Other directives
- Vulnerabilities and Risks
- What Did We Hear from You During the Local Planning Meetings?
- Organization of Hazards in HMCAP
- Hazard Loss Estimates
- Discussion
- Next Steps

A total of 36 participants from the region joined the hour-long workshop. CIRCA staff provided background information to the audience on the HMCAP and insight into the Resilient Connecticut program and the significance of the joint effort taking place for the HMCAP. The focus then shifted to reviewing the findings of the local meetings conducted in May, June, and July with each community. As this point in the workshop, attendees were able to participate in a Jeopardy game that ultimately made them revisit their "top climate change vulnerability" or challenge (Figure 1). Members from each community were asked to select a category and item under that category to reveal a description of a specific concern discussed during at least one local planning meeting, and then were asked to identify which specific town faced that concern. Ultimately the discussion results either reinforced some communities' top challenge, or made others consider some of their other vulnerabilities and risks.

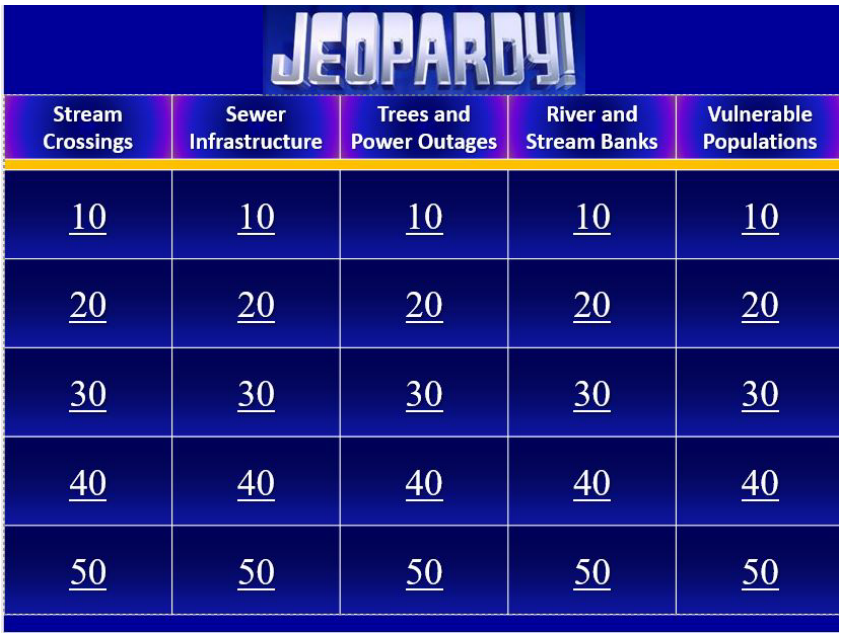


Figure 1. Jeopardy game included in workshop for local planning coordinators.

Preliminary findings from the vulnerability and risk assessment were then presented. This included NFIP statistics, repetitive loss statistics, FEMA Public Assistance (PA) losses, NOAA National Centers for Environmental Information (NCEI) losses, USDA loss estimates, and HAZUS loss estimates. Finally, CIRCA staff presented a little more detail on some of the specific climate-driven risks in the region, and how these are related to the Resilient Connecticut progress.

Participants were given the opportunity to ask questions after being reminded of the ESRI Story Map for the project, that there were public meetings in the near future, and that there was going to be another workshop in the fall.

The second workshop, which was the "Hazard Mitigation and Climate Adaptation Actions" workshop, was held on October 3, 2023. The theme of the workshop was to present State, regional, and shared hazard mitigation and climate adaptation strategies and actions. The workshop was held virtually on the Microsoft Teams platform, and the agenda included

- A final brief reminder about the alignment of the Hazard Mitigation and Climate Adaptation Plan and "Resilient Connecticut"
- Updates on the planning meetings with the municipal teams (if needed) and from the August public meetings
- Summary of the major climate-driven and hazard mitigation needs in the Capital Region of Connecticut
- Adaptation and hazard mitigation strategies of Federal, State, and regional interest that we will "shop from" for example:
    - Critical facilities resilience
    - Cooling centers for extreme heat respite
    - Water supply issues (water supply watersheds, harmful algal blooms, water quality challenges, etc.)

    - Wastewater/sewer infrastructure such as WWTPs/WPCFs and pumping stations
    - Stream Crossings
    - Others
- Next steps

The workshop had a total of 30 participants, in addition to the three from the CIRCA team. To start, the team gave a similar overview of the HMCAP and Resilient Connecticut as the first workshop. Next, the consultants gave an overview of what the climate concerns were throughout the region according to the local community meetings, provided an updated on the public outreach and engagement efforts, and presented main points from additional stakeholder engagement. Next, participants were briefed on the status of some of the 2019 HMP actions that were drafted from State and regional efforts.

The bulk of the workshop was spent on a "shopping exercise" that was developed to gauge where communities stood on various hazard mitigation and climate adaptation actions pertaining to different assets and hazards. Participants used Microsoft Teams polling tools to vote on three to five sample actions under nine categories, all varying in degree of implementation and goals. The categories included:

- Cooling center and critical facility resilience
- Drought resilience
- Water supply needs
- Agriculture
- Stormwater infrastructure
- Dams
- Stream crossings
- Vulnerable populations
- Forestry management

This exercise helped the team to understand the community's priorities and perspectives on staffing and implementation capabilities.

Finally, the workshop was closed out with the next steps, and the floor was opened for discussion and questions. Workshop materials including PowerPoint slides can be found in Appendix B.

General Public Engagement:

Story Map and Online Survey: CIRCA developed an online ESRI Story Map describing the hazard mitigation and climate adaptation planning process, the 2024 Plan Update, and the specific hazards included in the Plan Update for the CRCOG region (Figure 2).

Figure 2. Story Map for the CRCOG HMCAP 2024 Update

This Story Map included a web-based survey asking a series of questions designed to gather input about how residents of the CRCOG region experience natural hazards and climate change impacts. This public survey was open to the public from July 2023 to November 2023. The link to the Story Map and survey was distributed to all community local coordinators for local promotion, included in the press release, promoted to specific stakeholders and environmental justice and disproportionately vulnerable communities (described below), and included in the monthly CIRCA Resilience Round-up newsletter (Figure X). The 26-question survey was designed to allow residents to provide input on natural hazard events, past impacts, and preparedness; climate change considerations were also incorporated.

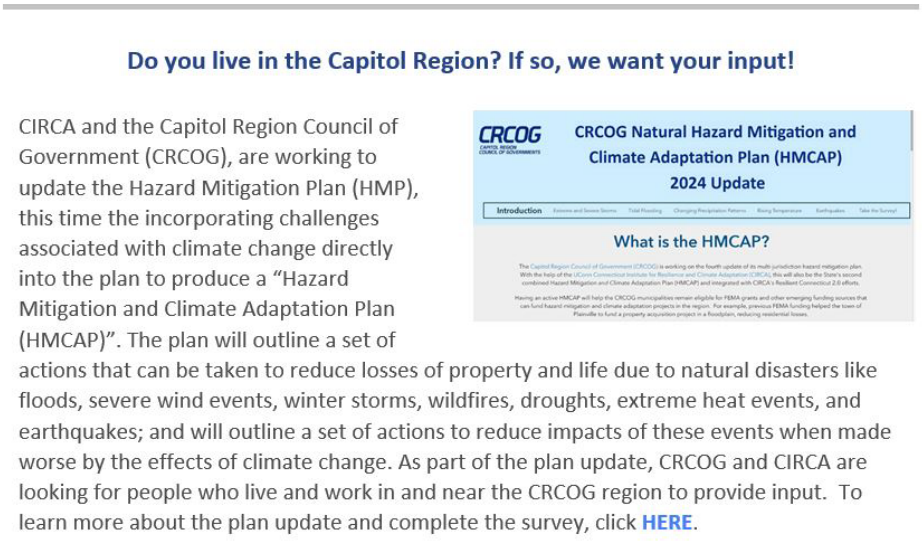


Figure 3. Outreach to publicize the HMCAP public survey.

The first section of the survey allowed respondents to voluntarily provide a little demographic information such as which community they live or work in, how long they have done so in the region, and whether they rent or own their properties. In total there were 21 respondents from 9 different communities (Figure 4, Map 6). Most respondents also shared where they work or live more specifically. Locations include:

- Wintonbury and Blue Hills
- Wheelock Rd
- South Glastonbury off Foote Road
- Southeast Willington
- Shuttle Meadow and North Side border with Farmington
- Public Health Department

- Naubuc Avenue
- Martin
- Main Street
- Lakefront property on Lower Bolton Lake
- Hollywood
- East Glastonbury
- Buckley School (northeast)
- Buckland area
- Bowers school area
- Bowers
- Birch Mountain

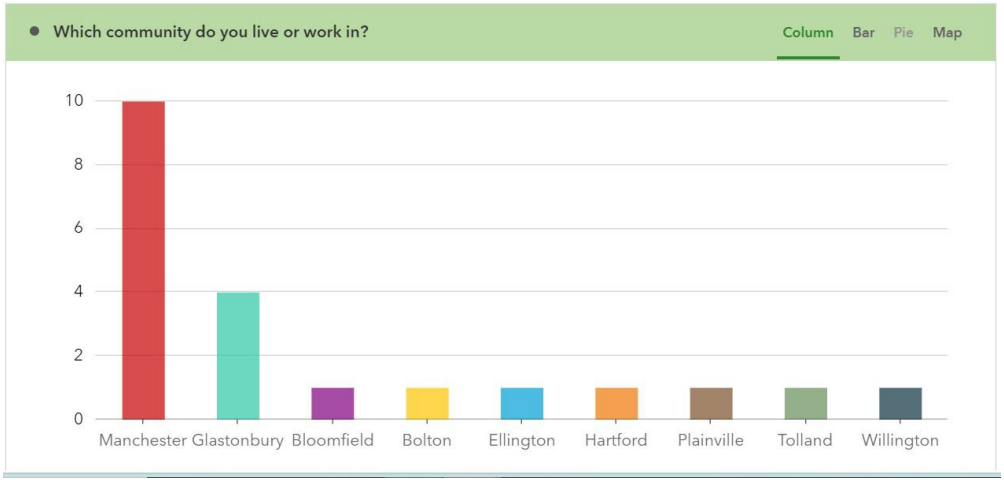
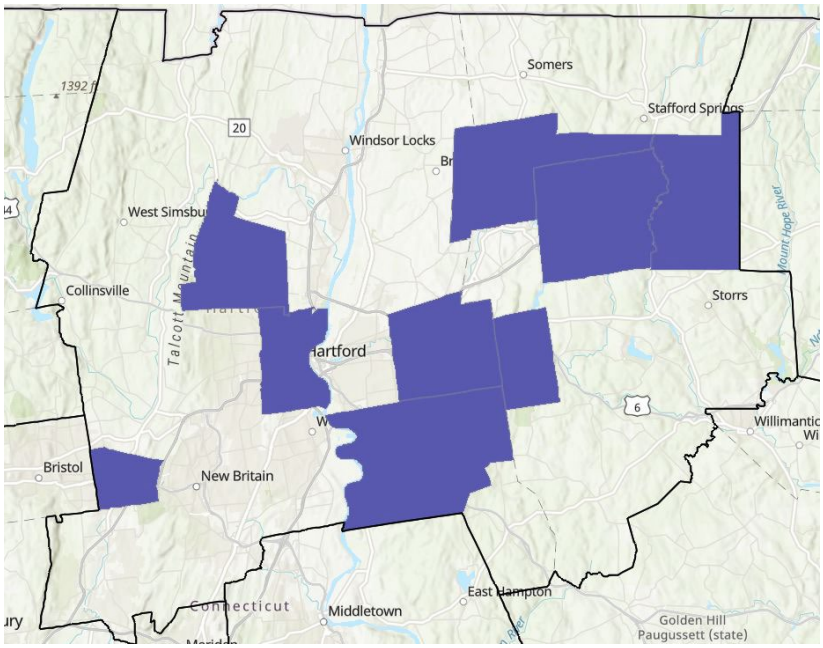


Figure 4. Responses to survey question regarding respondent location.



Map 6. Survey respondent locations.

Thirteen of the respondents have lived or worked in the region for ten or more years, with one respondent being in the area less than a year, four between one to five years, and the last two between six and nine years. Eighteen of the twenty-one individuals report owning their property, while two reported renting and one skipped the question. Respondents were also asked how natural hazards have impacted their properties in the past. Some of the responses included wind damage; tree damage; road washouts due to heavy rain; flooding of roads, yards, parking lots, and basements; power outages lasting more than a week, and loss of access/egress. Specific storm events referenced by respondents included rainstorms in August 2021, wind and tree damage in August 2020, tree damage and power outages due to an early snowstorm in October 2011, downed trees blocking egress in 2020, and heavy rain in 2023. One respondent reported: "This past year every heavy rain has caused extreme flooding in our yard and we have had to spend more than $14,000 to fix drainage issues and still have them even after fixes."

The following section of the survey focused on natural hazards events and their experiences. In Question 7, respondents were asked to simply identify which of the 9 hazards identified have they experienced or not experienced in the past. At least half of those who answered have experienced a tropical storm, tornado/wind event, severe winter storm, river flooding, drought, and an extreme heat event. None of the respondents have directly experienced a dam failure or earthquake in the CRCOG region. Respondents were given the opportunity to include more details about the flooding they have experienced. Responses included the following:

- We suspect our flooding is caused by Quinnipiac River flooding during heavy rains.
- The outflow from Lower Bolton Lake (known as Bolton Pond Brook) flooded from hurricane Isaias a few years ago wiping out a bridge on Mark Anthony Lane cutting vehicular traffic to several homes.
- The flooding of the diked area behind Seabury cut us off from use of the trails for about ten days on several occasions (some for less time)
- Hockanum River in Charter Oak Park street collapse on Ambassador Drive due to flooding of Lydall Brook
- Hockanum river flooding near the Hilliard Mills and Cheney Tech on to the street
- Ambassador Drive, Manchester, was washed out in August 2021 rainstorm by a local stream. Road closed for 8 months. A private road condo entry (Cliffside Drive at Lydall St) was also closed about a year caused by a washout in the same storm event.
- Wheelock Rd. - ground oversaturated with heavy rains
- Hudson Street flooding in basement
- Heavy rain events in late winter with ice on ground that caused basement flooding
- Bushnell on the park apartments basement parking lot flooded and cracks seen in ceiling
- Along Fenton River and Willimantic River
- Our neighborhood has storm sewers that are always filled with water and constantly running water.

Question 11 asked respondents to identify whether they felt these events have increased, decreased, or have not changed in frequency or intensity in the past ten years. At least half of those that responded felt that tornado/high winds, hurricanes/tropical storms, riverine flooding, extreme heat, and wildfires

have increased in the past ten years. More than a third of respondents felt that severe winter storms have decreased in the past ten years. Several respondents felt that some events have not changed.

The following question, Question 12, then asked respondents to identify which of the same hazards appear to be worsened by climate change. Approximately 80% of respondents felt that hurricanes and tropical storms appear to be worsened by climate change, with eleven respondents reporting the same for tornadoes and severe wind, riverine flooding, drought, and extreme heat (Figure 5).

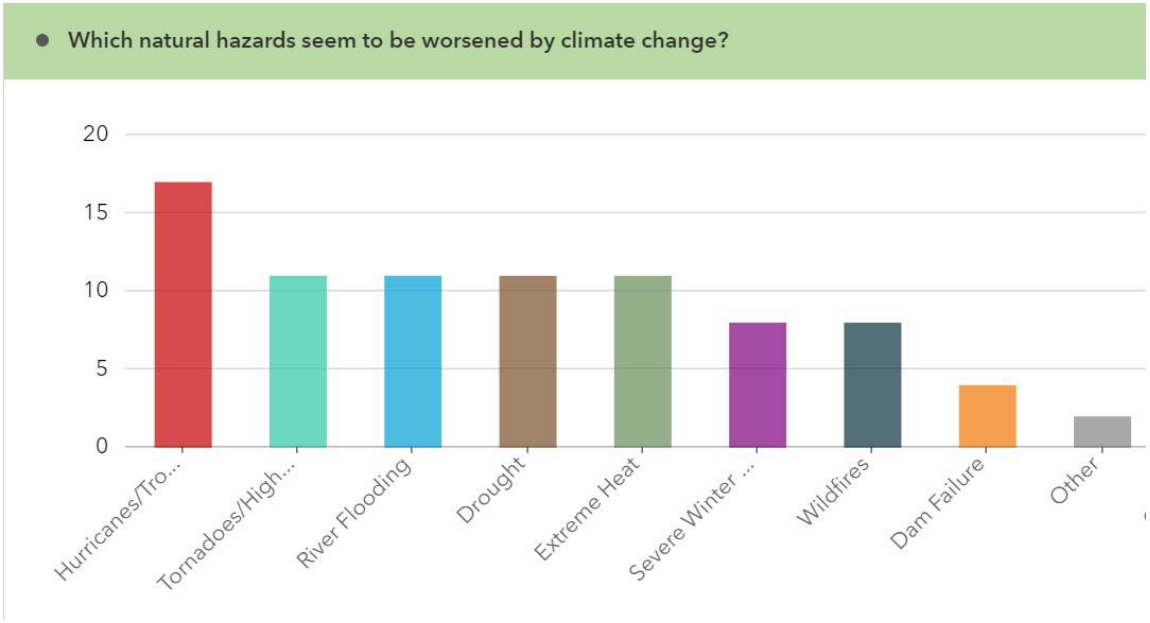


Figure 5. Responses to survey question regarding hazards worsened by climate change.

The next section focused on past impacts. Question 13 asked about how the 2021 storms impacted their home/property/place of employment, whether it was wind impacting the property or roadways, loss of power, of flooding at the property or impeding access and egress (Figure 6). More than half of respondents reported wind affecting roads and power lines, with additional responses indicating that wind also led to power outages and damage to their homes, properties, or places of employment. Only one respondent reported flooding affecting a home, property, or place of employment, but five respondents indicated that flooding impacted roads or utilities.

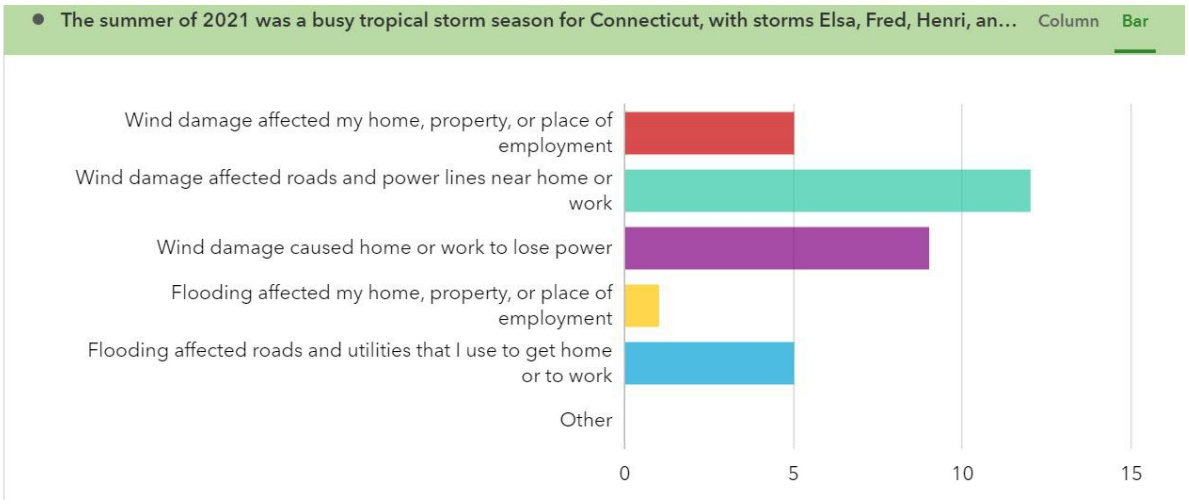


Figure 6. Responses to survey question regarding impacts from storms in Summer 2021.

To better gauge how heat events have impacted respondents, Question 14 then asked which resources were available to them for respite or relief from extreme heat (Figure 7). Nearly all respondents agreed their house with air conditioning was an option, with many more also indicating options for respite at a local cooling center, a retail or restaurant establishment, their place of employment, or recreational area with shade, water access, or a public pool.

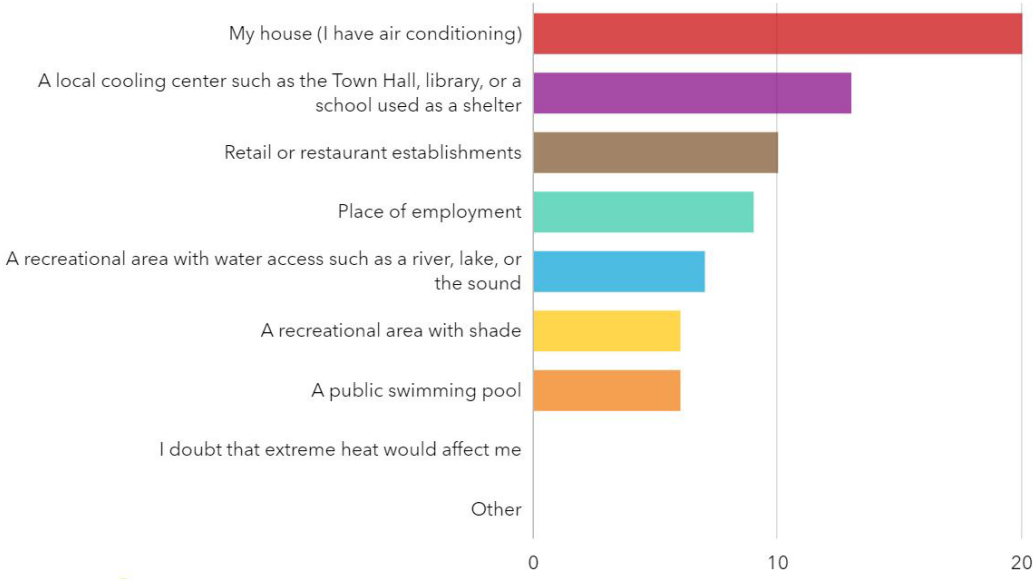


Figure 7. Responses to survey question regarding options for respite from extreme heat.

Question 15 asked the respondents how future droughts could affect them as these events are predicted to become flashier with rapid onset (Figure 8). Approximately half of respondents felt that the public water system that serves their home or place of work will enact water use restrictions. In addition, more than a third of respondents were also concerned with the impacts to local produce availability. Other respondents felt their private well could be impacted, their fire suppression could be

impacted, or their agricultural or business operations could be impacted by drought. Two respondents felt drought will likely not affect them.

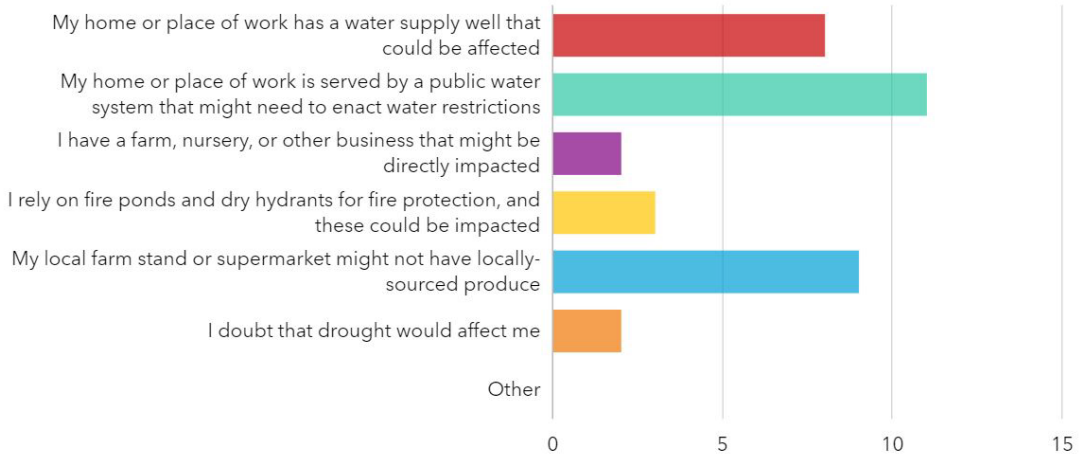


Figure 8. Responses to survey question regarding potential drought impacts.

Section four of the survey focused on both personal and community preparedness. The first question in this section, Question 16, asked respondents to first tell us how concerned they were with each of the identified hazards (Table 14). Respondents expressed the most concern about drought and extreme heat, with seven respondents indicating that they were "extremely concerned" about both of these hazards. Respondents also indicated they are concerned about severe winter storms, hurricanes/tropical storms, tornadoes/high winds, and river flooding. Most are not concerned about dam failure or earthquakes.

Table 14. Number of responses expressing degrees of concern related to hazard risk.

	Not Concerned	Somewhat Concerned	Concerned	Extremely Concerned
Hurricanes/Tropical Storms	5	5	6	5
Tornadoes/High Winds	4	7	6	3
Severe Winter Storms	6	3	9	3
River Flooding	5	6	6	2
Dam Failure	11	3	3	1
Drought	2	7	3	7
Extreme Heat	2	6	5	7
Wildfires	7	6	4	2
Earthquakes	11	5	2	0

Next, respondents were asked in Question 17 to identify their level of preparedness for each of the hazards (Table 15). A small percentage of respondents felt "very prepared" for each hazard except drought, although respondents were much more likely to choose "somewhat prepared" or "sufficiently prepared" for most of the hazards. Dam failure, wildfires, and earthquake received the most votes for

"not prepared", although as noted elsewhere in this plan the overall risk of these hazards to the CRCOG region is relatively low. Multiple individuals were unsure of how to prepare for wildfires and dam failures.

Table 15. Number of responses expressing degrees of preparedness for hazards.

	Not Prepared	Somewhat Prepared	Sufficiently Prepared	Well Prepared	Very Prepared	Unsure How to Prepare
Hurricanes/Tropical Storms	1	8	4	3	2	3
Tornadoes/High Winds	2	9	5	1	1	3
Severe Winter Storms	1	8	2	5	3	2
River Flooding	5	4	5	0	2	3
Dam Failure	8	3	1	0	2	4
Drought	5	7	7	1	0	1
Extreme Heat	0	7	6	5	3	0
Wildfires	9	4	1	0	1	4
Earthquakes	7	4	1	0	1	5

Question 18 asked how prepared the respondents felt they were to cope in the event of a power, natural gas, or other utility outage, while Question 19 asked how prepared they felt their community was to delivery emergency notifications (Table 16). Approximately half of the respondents felt they were only somewhat prepared for each of these questions. Approximately 25% indicated that they were well prepared or very well prepared to cope in the event of a power or other utility outage, while approximately 33% indicated that their municipality was well prepared or very prepared to delivery emergency notifications.

Table 16. Number of responses expressing degrees of community preparedness for power/utility outages and delivery of emergency notifications.

	Not Prepared	Somewhat Prepared	Sufficiently Prepared	Well Prepared	Very Prepared
Power / Utility Outage	2	10	3	4	1
Delivering Emergency Notifications	3	10	1	4	3

Question 20 then asked respondents to provide more detail on why they felt they, or their community, were prepared or unprepared for a utility outage or to deliver emergency information. Some of the responses included:

- We've never needed community response to such an event, so I do not know how well they would do.
- well-informed, generator, provisions, CERT
- We have a generator. Community has CERT team.

- We can power our house from our hybrid car through a 1000 watt inverter and some emergency outlets we installed. Cooking is more of a problem since we switched from a gas to induction stove. Without solar panels and battery storage, home electrification will make us more vulnerable to electric grid outages. Town has generators at important buildings but I think that businesses that provide essential services are not able to operate in grid outages. It would be good to develop microgrids at small local strip malls with food and medicine stores, urgent care centers, gas stations, propane suppliers, etc with solar and battery power supply. I think that our digital phone network that requires distributed grid power to operate is much less robust than the old phone system powered by central offices with battery backup.
- Town notifications allow communication to citizens
- The three Bolton Lakes are maintained by three dams (two in Vernon and one in Bolton). Each dam is equipped with a drawdown capability. This drawdown capability was originally considered useful for flood control. However, the CT DEEP has consistently denied the use of this drawdown capability except for seasonal winter lake lowering. This policy is unreasonable in the face of current heavy rain events which have and will cause property damage.
- My residence is powered by generators. We have reasonable warning system and protocols to follow. However I think those in charge may be unrealistic about the frequency and severity of dire situations in coming years.
- Manchester delivers emergency notifications effectively by email. But I am unaware of other avenues for such notifications, and many people do not receive the emails. If email didn't work or I didn't have my phone, I don't know how notifications would be received.
- I am unsure because we do not have emergency drills or instructions from our landlord. The household is pretty unprepared it seems. The place of work is sufficiently prepared in comparison.
- Have a generator and support system with family and friends
- have a generator, do not have a lot of fuel stockpile generator is good to have heat but not good for air conditioning not aware of town communications
- Hasn’t been communicated well to my knowledge. They did communicate places for relief from extreme heat.
- Great communication with residents
- generator, bottled water reserves.
- Community shelters, battery-powered radio and portable lights
- At home: generator, fireplace and stocked wood, camping equipment and propane, water purification equipment, prepare when possible by filling water in tubs for flushing/bathing. Town: Local gas station has generator, town has high school shelter, fire department provides tap water, good town notification system.

Respondents were then asked in Question 21 (Figure 9) which communication methods they think are most effective in helping to withstand natural hazards. Nearly all respondents felt that email communication and television are the most effective. Approximately half also felt that radio and social media are effective. Other resources such as public awareness events, brochures, outdoor advertisements, and public meetings were useful to about 10 to 30% of the respondents.

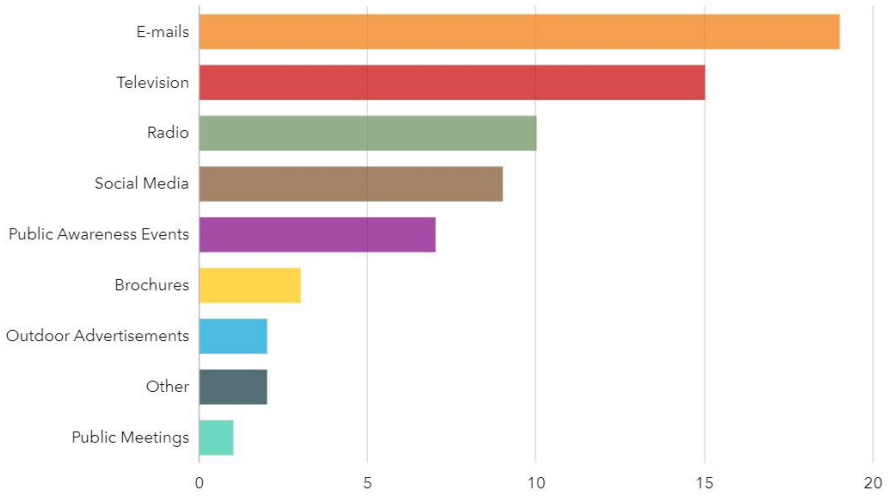


Figure 9. Responses to survey question regarding effectiveness of different communication methods.

Question 22 then asked how they had received emergency information in the past. More than half have received information from the internet or the phone, approximately half from television, 38% via social media, and 9% said other outlets. Question 23 asked if respondents have signed up for emergency alerts in their community; two-thirds have signed up for alerts, while one-third have not. The final set of questions, Question 24 and 25, asked if the respondent knew where their local shelter and local cooling center is in their community; only 48% of respondents know where their local shelter is, while 52% do not. In contrast, 76% of respondents know where their local cooling center is, while the remaining 24% do not.

Lastly, Question 26 asked respondents to provide any additional comments or concerns about natural hazards. Responses included:

- There needs to be state laws requiring water conservation efforts earlier, before reservoirs and aquifers are too low. Also, burn bans for home fire-pit use and increased penalties and restrictions for home fireworks. Financial assistance for CT's small farmers who suffer crop loss is needed.
- I wish my town would take more steps to ensure that new buildings are sustainable and efficient, and I wish gov't would offer more incentives to residents and nonprofits to prepare for the chaos that is nearing.
- I think apartment buildings should have surprise audits by the government agencies to check their efforts towards making residents aware of emergency services and drills. Every new resident must be made to undergo tests to study mandatory safety precautions.
- I repeat for emphasis: The three Bolton Lakes are maintained by three dams (two in Vernon and one in Bolton). Each dam is equipped with a drawdown capability. This drawdown capability was originally considered useful for flood control. However, the CT DEEP has consistently denied the use of this drawdown capability except for seasonal winter lake lowering. This policy is unreasonable in the face current heavy rain events which have and will cause property damage.

Public Meetings: CIRCA and CRCOG held two public meetings to solicit feedback from residents and other stakeholders. These meetings were advertised to local coordinators from all CRCOG municipalities and through targeted outreach to environmental justice and disproportionately vulnerable communities (described below). A flyer advertising these meetings was also developed by CIRCA and circulated to CRCOG for sharing with member municipalities and their residents (Figure 10).

The first hybrid in-person and virtual public meeting was held on October 10, 2023 at the CRCOG headquarters in Hartford, Connecticut, a location that is accessible by public transportation. There were three members from the CIRCA team, one COG representative, and two attendees from the public at this meeting. CIIRCA staff presented on what the HMCAP is, what some of the natural hazards and climate impacts are that the region is facing, the types of mitigation actions and strategies their communities may identify, and some of the ways the public can provide input. Throughout the presentation, the audience was also polled using Mentimeter on natural hazards and climate change. At the conclusion of the present the floor was open for questions and comments. Flooding and extreme heat were the most commonly mentioned concerns from the audience.

The second virtual public meeting was held on October 12, 2023. Mentimeter was again used to record answers to questions that were asked during the polling segment of the meeting. There were three members from the CIRCA team, one COG representative, and three attendees from the public at this meeting. The consultant gave the same presentation as the previous meeting, and at the end the floor was opened for questions and comments. Like the first meeting, flooding and extreme heat were the most commonly mentioned concerns from the audience.

Below are the questions and comments posed by the members of the public at these public meetings.

- Concerns mentioned by the public include:
    - “Flooding and basement backups” (x2)
    - “Longer power outages”
    - “Flooding” (x6)
    - “Flash flooding”
    - “Flooded roads”
    - “Snow and summer flooding”
    - “Flooding due to high-intensity storms”
    - “Roads”
    - “Culverts”
    - “Earthquakes”
    - “Increasing rain”
    - “Drought” (x2)
    - “Extreme heat” (x5)
    - “Extreme heat and humidity” (x2)
    - “Air pollution, esp. from methane”
    - One participant verbally described her concerns that climate adaptation and resilience efforts in the state and the region were dispersed and piecemeal, focusing on either smaller-scale projects or projects that addressed only one type of concern.

    - One participant, who serves as the senior coordinator in her town, verbally expressed her concern about communicating with elderly people during hazard situations.
- Suggestions put forward by the public include:
    - “Maintain culverts”
    - “Increase culvert size”
    - “More education”
    - “Open cooling centers”
    - “If not universal a/c, extend hours of cooling centers. Night is the most dangerous time for not being able to cool down.”
    - “Explore and categorize methods of increasing resiliency for town buildings that offer emergency services.”
    - “Improve emergency services in town and review structural buildings”
    - “Study problem areas and seek grants to address repairs/upgrades”
    - “Town council updates”
    - “We have announcements on cell phones when emergency and good information but know we can do much better informing those elderly people”
    - “Could be some changes made to building codes for new/rehabbed projects.”
    - “Reduce trash”
    - “Try to eliminate plastics; public ed for solar AND batteries.”
    - “Be sure "everyone" has access to A/C”
    - One participant verbally expressed that she would like to see more comprehensive efforts in places like the Park River, which cover a larger geographic area and attempt to tackle more challenges at the same time. This participant also stated her belief that fostering expanded ecosystem services and benefits would be necessary to truly address and adapt to climate change.
    - One participant verbally expressed that more coordination among communities would help advance climate action (mitigation and adaptation). She noted that several towns in the region appeared to have climate action plans, but implementation has lagged.
    - One participant from Andover acknowledged that this town has been working to improve communications systems with updates to the website, but the resident would like to see more communication with the elderly community specifically and especially during hazards.
- Additional comments and questions include:
    - “Have we noticed that the tidal range of the CT River is moving northward or into new feeding rivers?”
    - “What [sic] are working to conserve and revive the riparian zone North Branch of the Park River so as to increased [sic] connectivity.”
    - “No there my community does not have the resources (funding)”
    - “My community has the resources to reduce losses from natural hazards” (x2)
    - “My community has the resources to address the negative impacts of climate change” (x2)
    - “I know where to find information about risks from natural hazards and climate change” (x2)
    - “I do know where to find information about the risks”

- "We have been working to conserve and revive the floodplains and woodland slopes along the North Branch Park River in Hartford"
- One participant cited figures about how much of the Park River watershed was in Bloomfield, engaging another participant in a discussion about the importance of participation among Bloomfield staff, commission, and committees in the resilience efforts for the Park River. These participants agreed to discuss this further outside the meeting.
- One participant shared information about an upcoming conference to advance coordination among towns, and both CIRCA and CRCOG expressed interest in participating or attending. This is an opportunity for continued engagement.

A full display of the PowerPoint presentation for the public meetings can be found in Appendix D.

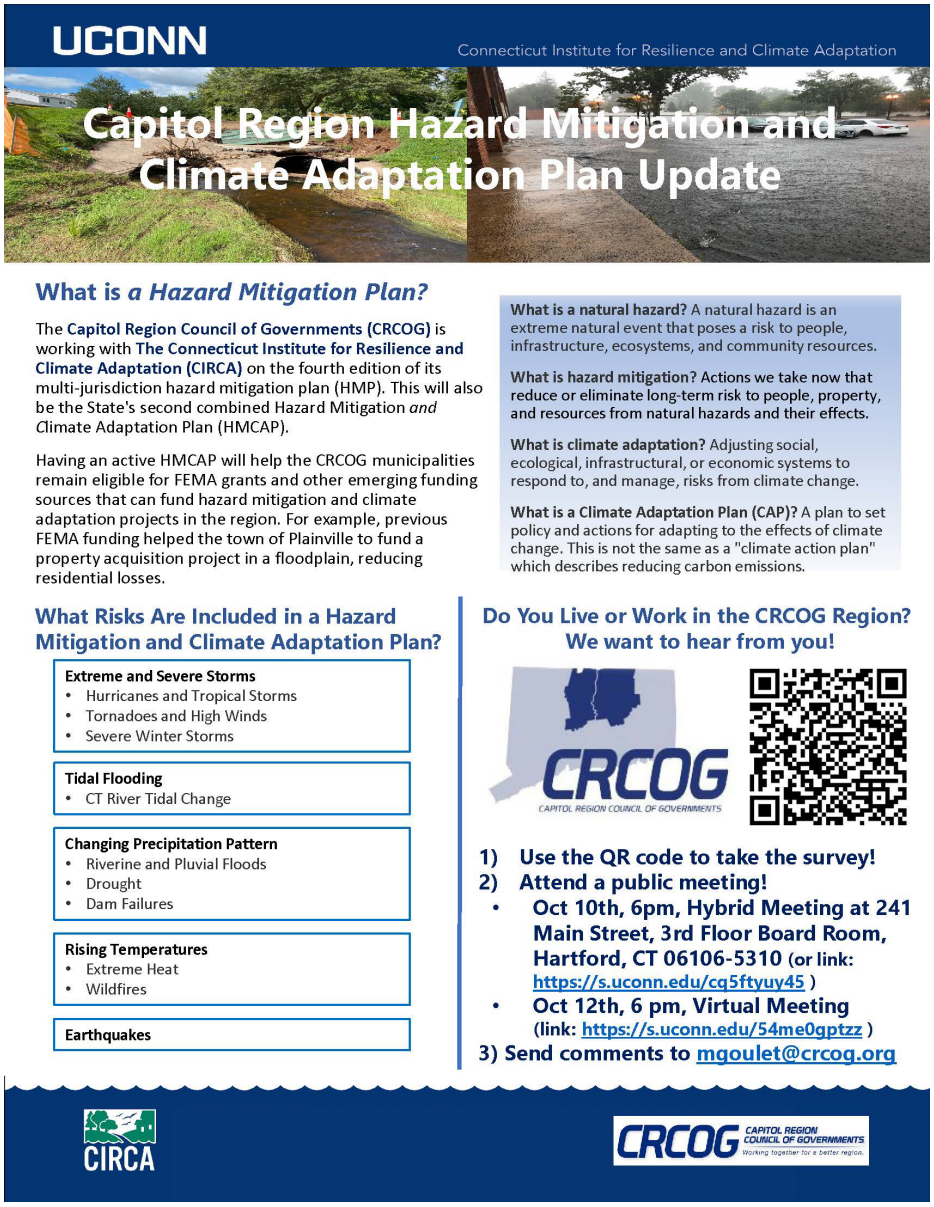


Figure 10. Outreach flyer for HMCAP public input opportunities.

Website: CRCOG's web page related to the Natural Hazard Mitigation and Climate Adaptation Plan was updated throughout the planning process. Translations of CRCOG's web pages are available in over 70 languages. Additional links to the Natural Hazard Mitigation Plan page were also added from other web pages on CRCOG's site. The draft for public review was posted in January 2024.

Targeted Stakeholder Engagement:

Letters were distributed to the regional planning agencies in Connecticut and Massachusetts that surround the CRCOG region. These letters described the HMCAP and invited comments and participation. CRCOG provided CIRCA with a master list of municipal and regional stakeholders with connections to environmental planning, including conservation commissions, wetland commissions, municipal committees for Sustainable Connecticut, farmers markets and farm commissions, water pollution control staff, land trusts, waste and recycling committees, clean energy tasks forces, tree wardens, and open space committees. CIRCA contacted each of these groups and shared a link to the HMCAP Story Map and online survey.

Targeted Engagement of Utilities and Lifelines:

CIRCA reached out to and met with multiple utilities that serve more than one community in the CRCOG region. During these meetings with utilities, CIRCA staff provided an overview of the HMCAP process and timeline and asked for input on any utility projects or concerns relevant to natural hazards mitigation and climate adaptation planning. The relevant utility services are listed below:

- Sanitary sewer: The Metropolitan District (MDC) serves its member towns, and the Colchester-Hebron-East Hampton sewer system serves one CRCOG town (Hebron). Other sanitary sewer service providers are municipally based and operated, and these were discussed as needed during local planning team meetings in the respective municipalities.
- Public water systems: MDC serves its member towns, Aquarion Water Company serves a number of towns, and Connecticut Water Company serves numerous CRCOG towns. Hazardville Water Company serves Enfield and Somers. Other large public water service providers are municipally based and operated (i.e., Manchester and New Britain), and these were discussed as needed during local planning team meetings in the respective municipalities.
- Electricity: Eversource is the sole electricity provider in the CRCOG region.
- Natural gas: Avangrid and Eversource provide natural gas via distribution systems in the CRCOG region.

CIRCA staff met with staff members from Windham Water Works on July 14, 2023. Windham Water Works is a water utility in eastern Connecticut whose service area includes parts of the Town of Mansfield in the CRCOG region. Meeting notes are attached in Appendix C.

CRCOG and CIRCA met with MDC on September 13, 2023. MDC is a non-profit municipal corporation providing water and sewer services to eight member municipalities and drinking water services to four additional non-member municipalities, all within the CRCOG region. During the meeting, CIRCA explained the importance of coordination with the municipalities served by the MDC public water system and the MDC sewer system. MDC has additional responsibilities in the City of Hartford relative to drainage, which were also discussed during the meeting. CIRCA explained that the 2019 edition of the

CRCOG plan called for developing a list of MDC critical facilities in the timeframe 2019-2024, and requested that MDC develop such a list for each municipality annex. Meeting notes are attached in Appendix C.

CIRCA reached out to Connecticut Water Company and Hazardville Water Company on September 29, 2023, but did not receive a response.

CIRCA reached out to the Town of Hebron on September 29, 2023 to determine if a separate meeting with the regional sewer system was needed, given that sewer system concerns were addressed during the local planning team meeting in Hebron. Hebron municipal staff confirmed that a separate meeting was not needed, but noted that Hebron has a standing application to DEEP for Clean Water funding to conduct a study in the Amston Lake area related to inflow and infiltration concerns, and may also find similar concerns in other areas of town.

CIRCA met with Eversource on October 5, 2023. Eversource is a power utility that provides electricity throughout the CRCOG region. During the meeting, Eversource staff expressed concerns regarding flood vulnerability of electric substations, Area Work Center locations, and regulator gas stations. Meeting notes are attached in Appendix C.

CIRCA met with Aquarion Water Company on October 17, 2023. Aquarion is a public water supply company whose service area includes many towns in the CRCOG region. During this meeting, Aquarion staff reported that they have not yet experienced any heat or flood related disruptions to service, but a Plainville wellfield is located on a street that has previously been closed due to flooding. Meeting notes are attached in Appendix C.

CIRCA met with Avangrid on December 4, 2023. Avangrid is an energy company providing natural gas throughout the CRCOG region. During this meeting, Avangrid staff reported that their natural gas infrastructure is relatively resilient to hazards and the company is able to respond to concerns on a case-by-case basis. Multiple gate stations and district regulators throughout the CRCOG region are essential to providing consistent energy service with no outages. Avangrid's facility in Rocky Hill has had no previous reported flooding concerns, but Avangrid staff note that flooding here is always a possibility that they should keep in mind. Meeting notes are attached in Appendix C.

Targeted Engagement of Environmental Justice and Disproportionately Vulnerable Communities:

There are multiple tools used within the state of Connecticut for identifying communities facing disproportionate environmental burdens, including exposure to pollution, impacts of climate change, and vulnerability to natural hazard events. The state list of Distressed Municipalities identifies the towns that are most economically distressed, taking into account factors such as per capita income, percentage of the population in poverty, unemployment, education, old housing stock, and more. The Connecticut Environmental Justice Screening Tool (CT EJ Screen) is a tool developed by the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) and the Connecticut Department of Energy and Environmental Protection (DEEP), which gives each census tract in the state of Connecticut an environmental justice index score based on how it compares to all other census tracts in the state in

terms of pollution exposure, health sensitivity, and social vulnerability. More information about the CT EJ Screen can be found here: https://connecticut-environmental-justice.circa.uconn.edu/

Special outreach was conducted for the four Distressed Municipalities located within the CRCOG region, as well as the towns that contain census tracts ranked 8 or above on the CT EJ Screen, which indicates the top 20% of the most impacted census tracts in the state. An additional municipality was added to this list based on guidance from CIRCA staff. The resulting list of municipalities for targeted outreach is below:

- Hartford
- East Hartford
- New Britain
- Enfield
- Windsor Locks
- East Windsor
- Manchester
- West Hartford
- Newington
- Plainville
- Berlin
- Vernon

For these towns, CIRCA staff identified local community organizations, broader nonprofit organizations with local presences in specific towns, and/or community foundations with grant programs targeted at specific towns. For each town, 1 – 5 organizations were identified and contacted via email. CIRCA staff shared a Story Map, an online survey, and invitations to both virtual and in-person public meetings with the organizations identified for each town, and asked the organizations to share the materials with their social media, websites, and email networks. Additionally, a flyer in Spanish was prepared and shared, including at an in-person Frog Hollow NRZ community event where Hartford residents were already gathering.

Reports and Presentations to Local Officials

CIRCA attended multiple meetings of the CRCOG Policy Board meeting, including on April 26, 2023, May 24, 2023, and December 20, 2023 to publicize the upcoming local coordination meetings and then provide an update once the meetings had started. CIRCA also attended the CRCOG Planning and Development forum on May 17, 2023, as well as the CRCOG Municipal Services meeting on June 20, 2023 to provide a brief update of the planning process and next steps. Policy Board and Municipal Services Committee meetings are public meetings with meeting notices, agendas, and minutes published on CRCOG's website.

In summary, the key meeting dates memorializing the above planning process are as follows:

1. CRCOG Policy Board meeting – 4/26/23
2. CRCOG Planning and Development forum – 5/17/2023

3. Local Planning Team meetings – 5/22/23 through 8/29/23
4. CRCOG Policy Board Meeting – 5/24/23
5. CRCOG Municipal Services Meeting – 6/20/2023
6. Windham Water Works – 7/14/23
7. Workshop #1 for Local Coordinators and Planning Teams – 7/25/23
8. Metropolitan District – 9/13/23
9. Workshop #2 for Local Coordinators and Planning Teams – 10/3/23
10. Eversource – 10/5/23
11. Public Meeting #1 – 10/10/23
12. Public Meeting #2 – 10/12/23
13. Aquarion Water Company – 10/17/23
14. CRCOG Policy Board Meeting – 12/20/2023

A summary of municipal participation can be found in Table 17.

Table 17. Municipal Participation Summary Table

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Andover						6/22/2023	Eric Anderson	Eric Anderson	
Avon	Tom Armstrong	Brandon Robertson	Hiram Peck		Grace Tiezzi	7/18/2023	Bruce Appell, Grace Tiezzi, Hiram W Peck		
Berlin		Chris Edge		Chris Edge		11/6/2023			
Bloomfield		Jon Colman		Jon Colman		8/7/2023		Jon Colman, Justin LaFountain	Jon Colman
Bolton	Tom Manning	Jim Rupert		Jim Rupert		5/25/2023	Patrice Carson		Jim Rupert
Canton			Neil Pade		Bob Skinner	6/23/2023	Christopher Arciero		
Columbia		Mark Walter	John Guzkowski	Mark Walter	Mark Walter	6/21/2023	Beth Lunt	Elizabeth Lunt	Mark Walter
Coventry		Lisa Thomas, John Elsesser				6/29/2023			Jim Drumm
East Granby						8/29/2023			
East Hartford	Hank Pawlowski		Carlene Shaw			8/17/2023	Doug Wilson	Lewis Tamaccio	
East Windsor		Jason Bowsza		Jason Bowsza		5/30/2023	Ruthanne Calabrese	Ruthanne Calabrese	Jason Bowsza
Ellington			Lisa Houlihan	Lori Spielman	Lori Spielman, Tom Modzelewski	6/22/2023	John Rainaldi, John Colonese, Tom Modzelewski, Walter Lee	Lisa Houlihan	Lori Spielman and Matthew Reed

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Enfield		Ellen Zoppo-Sassu		Ellen Zoppo-Sassu		7/10/2023		Lauren Whitten	
Farmington	Matt Hutvagner		Garrett Daigle and Shannon Rutherford			6/7/2023			Joseph Capodiferro
Glastonbury	Corey Turner	Jonathan Luiz	Shelley Caltagiro	Larry Niland	Jonathan Luiz	6/15/2023	Gary Haynes	Gary Haynes, Jonathan Luiz	
Granby						5/22/2023	Abby Kenyon		
Hartford		Raúl De Jesús		Randall Davis		6/12/2023 and 8/30/2023			Raúl De Jesús and Randall Davis
Hebron		Andrew Tierney				6/20/2023	Matthew Bordeaux	Matthew Bordeaux	
Manchester	Bonnie Potocki	Stephen Stephanou			Kasia Purciella, Kimberly Lord	6/13/2023	Emma Peterson	David Laiuppa, Emma Peterson	Stephen Stephanou
Mansfield		Ryan Aylesworth				5/25/2023		Adam Libros	Ryan Aylesworth
Marlborough						6/14/2023	Amy Traversa	Peter Hughes	David Porter
New Britain		Erin Stewart	Jacob Colbath	Erin Stewart		8/23/2023		Mark Moriarty	Erin Stewart
Newington				David Nagel		8/9/2023	Paul Dickson	Paul Dickson	
Plainville		Mike Paulhus		Mike Paulhus		6/15/2023	Mark DeVoe	Mark DeVoe	Mike Paulhus
Rocky Hill		Lisa Marotta		Lisa Marotta, Ray Carpentino		6/30/2023		Michael Garrahy	

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
Simsbury		Wendy Makstutis		Wendy Makstutis	Tom Fitzgerald	6/26/2023	Michael Berry		Wendy Makstutis
Somers				Robert Schmidt		6/12/2023	Todd Rolland	Todd Rolland	
South Windsor	Bart Pacekonis					6/26/2023	Glenn Reynolds, Marco Mucciacciaro, Walter Summers, Vincent Stetson	Marco Mucciacciaro	Marco Mucciacciaro
Southington		Mark Sciota			David Nourse	8/4/2023			Mark Sciota
Stafford						6/28/2023			
Suffield				Colin Moll		6/29/2023		Bill Hawkins	William Morrison
Tolland		Steve Jones	David Corcoran	Steve Jones	Megan Massa	6/27/2023	David Corcoran	David Cororan	Katie Stargardter
Vernon						8/16/2023		Michael J. Purcaro	
West Hartford		Shari Cantor, Rick Ledwith		Rick Ledwith		6/16/2023	Duane Martin, Robert McCue	R Austin, Duane Martin	Shari Cantor
Wethersfield	Rich Roberts	Fred Presly		Fred Presly	Fred Presly	6/28/2023			
Willington		Erika Wiecenski		Erika Wiecenski		6/6/2023			Peter Tankaka
Windsor		Peter Souza	Patrick McMahon	Peter Souza		6/27/2023	Paul Goldberg, Peter Souza ,	Suzanne Choate	

Municipalities	CRCOG Regional Planning Commission (November 17th 2022)	CRCOG Policy Board Meeting on April 26th 2023 (also for Resilient CT 2.0)	CRCOG Planning and Development forum on May 17th, 2023	Kickoff presentation CRCOG Policy Board on May 24th, 2023 (also for Resilient CT)	Municipal Services meeting on June 20th, 2023	Local Planning Team Meetings	Local Coordinators Workshop on July 24th	Local Coordinators Workshop on Oct 3rd	CRCOG Policy Board Meeting on December 20th 2023 (also for Resilient CT 2.0)
							Suzanne Choate		
Windsor Locks	Peggy Sayers					5/22/2023	Jen Valentino		
CRCOG	Christopher Henchey, Jacob Knowlton, Caitlin Palmer, Kyle Shiel				Kimberly Bona, Maureen Goulet, Matt Hart, Elizabeth Sanderson, Pauline Yoder		Kyle Shiel, Maureen Goulet, Caitlin Palmer	Emily Bigl, Maureen Goulet, Caitlin Palmer	Kimberly Bona, Maureen Goulet, Matt Hart, Elizabeth Sanderson, Pauline Yoder, Kyle Sheil, Cheryl Assis, Elizabeth Sanderson, Laura Rosenbluth, Cara Radzins, Heidi Samokar, Lily Schneider, Roger Krahm, Rob Aloise

Review of the Draft Plan Update and Public Comment Period

Drafts of the municipal annexes were shared with the local planning coordinators of all 38 CRCOG municipalities on December 12th, 2023, with a deadline for edits and put set for January 12th, 2024. Suggested edits were received from 36 towns and incorporated into the municipal annexes' text and tables.

Availability of the public draft of the plan update was announced on January 17th, 2024 simultaneously with notification of a public meeting about the draft plan to be held on January 22nd and a public comment period lasting from January 22nd until February 16th. The plan documents were posted on the CRCOG Hazard Mitigation Planning webpage. Press releases were emailed to the stakeholder list provided by CRCOG, the EJ organization outreach list utilized during the planning process, and the local planning coordinators for each municipality. Press releases were also shared with local and regional news outlets *The Patch, Hartford Courant, North Central News*, and *The Journal Inquirer*. An announcement was also published in CIRCA's email newsletter *Resilience Roundup*, which reaches 1,350 recipients. Links to the draft plan and the dates of the public comment window were provided in all announcements.

The public meeting was held virtually on January 22nd, 2024 at 6 pm.

The following public comments were received:

- "Collectively in the past we have not done a good job of planning for the emergency needs of the elderly, handicapped, and critical health care patients. The latter includes patients on oxygen. In short, people that can not fend for themselves. I would urge that this group of people with special needs be appropriately considered in this process." (Tolland resident)

Several aspects of the planning process did take this concern into account, even before this public comment was received. Municipalities were asked about local vulnerable populations during the local planning meetings, and any reported concerns were reflected in the municipal annexes and action tables. Actions related to increasing the resiliency of critical facilities such as senior centers and increasing access to cooling centers for residents without vehicles were also included in the action tables of many municipalities. The town of Tolland also chose to address their resident's concern by adding the following sentence to the "Capabilities" section of the town annex: "The Town maintains a list of vulnerable persons that is updated annually. Additionally, the Public Safety Director coordinates with Eversource to ensure that our lists are coordinated."

Revisions to the Mansfield, Farmington, and Hartford critical facilities lists were also provided during this period by the Emergency Management Program Specialist at the University of Connecticut (UConn), which has campuses in each of these municipalities. These revisions ensured that facilities on UConn campuses were captured in the critical facilities lists for their respective municipalities. The Emergency Management Program Specialist at UConn also suggested some edits to the Mansfield annex text, which were incorporated into the draft after approval by the town.

Coordination with Neighboring Communities and Other State Efforts

Coordination with Neighboring Communities

Opportunities for input from neighboring communities and other regional bodies were provided throughout the update process. Letters were distributed to the regional planning agencies in Connecticut and Massachusetts that surround the CRCOG region. These letters described the HMCAP and invited comments and participation; the text of this letter is included in Appendix F.

These letters were emailed to:

- Northeastern CT Council of Governments
- Southeastern CT Council of Governments
- Lower Connecticut River Valley Council of Governments
- South Central Regional Council of Governments
- Naugatuck Valley Council of Governments
- Northwest Hills Council of Governments
- Pioneer Valley Planning Commission (PVPC), MA
- Town of Southwick, MA
- Town of Monson, MA

Several State and Regional planning efforts have been considered and incorporated into the HMCAP where appropriate. Those that have been incorporated are described below.

Connecticut Natural Hazard Mitigation Plan:

The Connecticut Natural Hazard Mitigation Plan Update was developed in parallel to the Capitol Region Natural Hazard Mitigation Plan, albeit several months ahead in sequence. The parallel efforts allowed CIRCA to participate in the update of the Connecticut Natural Hazard Mitigation Plan and bring information from one process to the other. DEMHS, DEEP, and other state agency personnel attending the workshops for the Connecticut Natural Hazard Mitigation Plan Update were made aware that the Capitol Region Natural Hazard Mitigation Plan was being updated.

Resilient Connecticut, Governor's Council on Climate Change, and DEEP Climate Resilience Fund:

Resilient Connecticut is CIRCA's chief climate adaptation and resiliency planning program. As noted above, the *Resilient Connecticut* program is described on CIRCA's web site at https://resilientconnecticut.uconn.edu/ and the expansion of the program into the Capitol Region of Connecticut is described at https://circa.uconn.edu/2022/02/23/resilient-connecticut-expands-statewide/. The planning process was piloted in Fairfield County and New Haven County in 2020-2021, relying on four COGs for community engagement. The ultimate goals of the *Resilient Connecticut* program are to develop vulnerability assessments that would not otherwise be completed (i.e., the flood and heat CCVI tools) and to identify and advance complex projects that address unmet needs. These complex projects fundamentally address types of flooding (whether coastal or riverine or related to stormwater) but some of them also address extreme heat vulnerabilities. Because two of the COGs in the pilot area (WestCOG and NVCOG) were developing hazard mitigation plan updates at the same time, the timing was not ideal for incorporating *Resilient Connecticut* outcomes into the hazard mitigation plan actions. Instead, the municipalities were provided with generic actions such as "Continue to

collaborate with CIRCA about *Resilient Connecticut*." Unfortunately, this proved challenging for the municipalities to manage.

This experience contributed to some of the changes in the *Resilient Connecticut* program. With the expansion into the Capitol Region and other parts of Connecticut, the planning process was likewise expanded, and it now relies on direct engagement with the COGs and with the member municipalities. The CCVI was completed for the Capitol Region of Connecticut in January 2023. However, identification of climate adaptation and resilience "opportunity areas" will occur while this plan is under review by FEMA. Notwithstanding the challenge related to timing, the direct participation of municipalities and tribal planning teams in the HMCAP/*Resilient Connecticut* planning process has avoided the need to include generic actions such as "Continue to collaborate with CIRCA about *Resilient Connecticut*." **Instead, CIRCA's *Resilient Connecticut* program is listed as a funding source for approximately 30 individual actions.** This will help position potential projects for the *Resilient Connecticut* program to advance through CIRCA-funded studies and concept designs.

This coordination with *Resilient Connecticut* and incorporation of climate adaptation into the Plan Update also aligns the Plan with the state Governor's Council on Climate Change (whose responsibility was expanded to include climate adaptation and resilience through Governor Lamont's Executive Order 21-3), and the Connecticut Department of Energy and Environmental Protection's new Climate Resilience Fund (DCRF), a grant program intended to help Connecticut communities initiate the planning and developing of projects to help communities become more resilient to the effects of climate change. The first DCRF round was launched in Fall 2022. Four municipalities within the CRCOG region received grants under the first round of the DCRF, as did CRCOG itself.

Environmental Justice

The Connecticut Department of Energy and Environmental Protection (DEEP) and CIRCA recently partnered to develop a Connecticut Environmental Justice Screening Tool (CT EJScreen), which was released to the public in August 2023. This tool was developed in response to recommendations from the Equity and Environmental Justice Working Group associated with the Governor's Council on Climate Change. More information about this project and access to the online web viewer is available here: https://connecticut-environmental-justice.circa.uconn.edu/

CT EJScreen has been incorporated into this Plan update through the inclusion of town-specific maps displaying the Environmental Justice Index Scores for each census tract of each municipality within the CRCOG region.

Environmental justice was also incorporated into the analysis of mitigation actions alongside STAPLEE and PERSISTS scoring. Each action was also provided with a statement about its nexus to EJ populations. The choices are:

- "Yes," located in EJ tract:
    - "Yes," if located in a state-identified Distressed Municipality or in a census tract with a CT EJScreen Environmental Justice Index Score of 8 or higher, indicating that the community is in the top 20% impacted within the state.
- Benefits an EJ tract (i.e., a nearby shelter)
- Serves EJ census tracts (i.e., a sewer pumping station)
- No – does not serve, does not benefit, and is not located in an EJ tract or distressed municipality

These statements can be used by decisionmakers to help allocate grant funds for studies and projects.

Historic Resources Resiliency

Recognizing that historic and cultural resources are increasingly at risk to natural hazards and climate change, the State Historic Preservation Office (SHPO) executed a resiliency planning study for historic and cultural resources from 2016 through 2018. Working with the State's Councils of Government and municipalities throughout the planning process, numerous examples were identified where historic and cultural resources were specifically at risk now, could be at risk in the future, and could help generate consensus for resiliency actions. Historic resources are difficult to floodproof, elevate, or relocate without potential loss of their historicity. Therefore, a thorough understanding of the site-specific options for each set of historic resources is necessary prior to disasters that could damage these resources, in order to avoid damage during recovery. A best practice guide for planning techniques to make historic resources more resilient was distributed in 2017. This guide can be used by all jurisdictions in Connecticut when undertaking development of hazard mitigation plans.

The most commonly repeated action regarding historical resource resiliency in the previous Plan update was "Coordinate with CT SHPO to conduct historic resource surveys, focusing on areas within natural hazard risk zones (such as flood or wildfire hazard zones and areas near steep slopes), to support identification of vulnerable historic properties and preparation of resiliency plans across the state. This action leverages existing resources and best practices for protection of historic and cultural resources through an ongoing statewide initiative by CT SHPO." Most of the CRCOG towns did not complete this action due to staffing and time constraints. In 2022, SHPO released an up-to-date GIS inventory of historic resource sites within Connecticut, which achieves part of the intent of this previous action. Therefore, this action has been carried forward with revisions for those communities that remain concerned about historic and cultural resources at risk, with the revisions including setting the intention to obtain and review the new SHPO inventory to guide the identification of vulnerable historic resources.

Critical Facilities Resiliency

Critical facilities have always been important in hazard mitigation planning, but their importance was highlighted through the rollout of the BRIC program (with the "lifelines" concept) and through the State's GC3 planning process. Therefore, all communities participating in this plan have been provided with actions related to critical facilities. This is not a change from previous editions of this plan. However, rather than focusing on standby power, concepts related to accessibility and transit/transportation have been added to the actions.

Cooling Centers for Extreme Heat Respite

Cooling centers have not been addressed in previous editions of this plan. Their importance was highlighted through the rollout of the BRIC program (with the "lifelines" concept) and through the State's Governor's Council on Climate Change planning process. Therefore, all communities participating in this plan have been provided with actions related to cooling centers and/or respite from extreme heat. This is a major change from previous editions of this plan. New actions address the

existence of cooling centers as well as their accessibility and transit/transportation needed to reach cooling centers.

Water Supply and Drought

Three major planning initiatives were completed in 2018. They were the:

- State Water Plan (https://portal.ct.gov/Water/Water-Planning-Council/State-Water-Plan) completed through consultant services secured by the Connecticut Water Planning Council.
- Coordinated Water System Plans for the Western, Central, and Eastern Connecticut Water Supply Management Areas (https://portal.ct.gov/DPH/Drinking-Water/WUCC/Water-Utility-Coordinating-Committee) completed through consultant services secured by the CT DPH, with the WUCCs as the plan developers. The WUCCs consist of all water utilities and the State's COGs.
- Drinking Water Vulnerability Assessment and Resiliency Plan (DWVARP) (https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/05/DWVARP_Public.pdf) completed through consultant services secured by the CT DPH, with CIRCA serving as the chief consultant.

The third plan listed above (the DWVARP) was developed, in part, specifically to ensure that the goals of the State Water Plan and Coordinated Water Supply Plans would not be lost in the State's advancement of climate adaptation and resiliency. With the completion of these major planning efforts and the addition of extreme heat as a hazard in this edition of the plan, opportunities were available to leverage community needs related to water supply. Some of the water supply issues addressed in this plan include flooding in water supply watersheds, harmful algal blooms, water quality challenges, and extension of water systems to address private wells harmed by flashy droughts.

Stormwater Authorities/Stormwater Utilities

The State of Connecticut passed legislation in 2021 that makes it easier for municipalities to form stormwater authorities and implement stormwater utilities. Specifically, the Connecticut legislature passed Substitute House Bill 6441, authorizing the creation of municipal stormwater authorities pursuant to Section 22a-498 of the Connecticut General Statutes. This bill allows any Connecticut multiplicity to establish a stormwater authority, which assesses and collects scaled user fees from property owners, for the purpose of maintaining. One central Connecticut municipality (New Britain) formed a stormwater utility after this legislation took effect and has been utilizing the utility to generate revenues for projects that have addressed chronic flooding challenges in New Britain.

CRCOG has been awarded a grant to study the feasibility of stormwater utilities within its member municipalities, but the grant will not be executed until after approval of this HMCAP.

Dams

Connecticut's dam safety program was significantly strengthened in 2014-2015 with adoption of new regulations and development of templates and forms for dam inspections and dam Emergency Action Plans (EAPs) or Emergency Operations Plans (EOPs). Nevertheless, local communities continue to

experience some concern about the condition of dams in their borders and upstream. In lieu of repeating previous actions such as “obtaining copies of EOPs/EAPs” and “including dam failure inundation areas in the Reverse 911 or Alert CT database” (which have been largely completed), new actions were developed for specific dam-related concerns raised by local planning teams and chief elected officials.

Climate Pollution Reduction Grant Coordination

CRCOG received a grant from EPA under the Climate Pollution Reduction Grant Program in August 2023 and kicked off the planning process for development of the Priority Climate Action Plan (PCAP) in November 2023. The PCAP was developed from December 2023 through January 2024, with a draft available in January 2024. The PCAP will be in place within the timeframe of this HMCAP adoption in mid-2024. The EPA’s Climate Pollution Reduction Grant Program specifically excludes the funding of climate adaptation projects, but it the PCAP planning process does not discourage the appropriate planning for strategies that provide co-benefits in climate mitigation and adaptation. During some of the planning meetings for the PCAP (for example, the meeting for municipal committees and commissions on November 27, 2023), some of the municipal contacts asked about coordination between the HMCAP and the PCAP. Many of the strategies related to urban forestry may provide benefits related to climate mitigation and extreme heat adaptation.

Section III: Hazard Evaluation

The Capitol Region is vulnerable to the numerous natural hazards described in this section. While flooding, tropical and winter storms, and high wind events are the natural hazards that most frequently occur with enough severity to cause loss of life or property, this plan covers all of the natural hazards that have the potential to cause damage anywhere in the region.

Hazards and Climate Drivers Considered

The 2023 *Connecticut Natural Hazard Mitigation Plan Update* includes a risk assessment of dam failure, drought, earthquake, extreme cold, extreme heat, flooding, sea level rise, thunderstorm, tornado, tropical cyclone, wildland fire, and winter weather. The hazards we evaluated in the Capitol Region, organized by climate driver to better convey how climate change might exacerbate these hazards, are the following:

Table 18. Hazards Organized by Climate Driver

Climate Driver	Hazards Included in Plan Update
Extreme Storms	Hurricanes and tropical storms
	Tornadoes and high wind events
	Severe winter storms
Sea Level Rise	Connecticut River tidal range
Changing Precipitation	Riverine and pluvial floods
	Droughts
	Dam overtopping or failure
Rising Temperatures	Extreme heat
	Wildfires
Earthquakes (not affected by climate change, but included in the plan as always)	Earthquakes

The selection of these hazards stayed consistent with the CRCOG 2019 Plan Update, with the addition of extreme heat to reflect recent state and regional concern about this hazard. Other natural hazards that can impact the region include ice jams and solar flares. While not specifically evaluated in this plan, the impacts of such hazards can be mitigated by some of the measures identified to deal with the ten natural hazards evaluated in this plan update.

Climate Change

It has been observed that global climate change is occurring more rapidly than that of the historic natural variations throughout earth's history. Observations include average global temperature increases, sea level rise, shifting precipitation trends, ocean acidification, and changes in severe storm occurrences. These observed changes are predominantly attributed to human activities such as emission of greenhouse gases from fossil fuel combustion, deforestation, and extensive land-use changes. Many of these climate changes have severe, direct impacts on natural hazards.

On average, the annual temperature across the U.S. has increased by 1.8 degrees Fahrenheit when looking at the entire period of record (1895-2016). Accelerated warming patterns between 1979 and 2016 have been observed with satellite and surface data, and paleoclimate records show that some of the recent decades have been the warmest in the past 1,500 years, according to the Fourth National Climate Assessment. It is expected that annual average temperatures will increase by about 2.5 degrees Fahrenheit by the end of the century regardless of future emissions.

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.

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, in addition to 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. 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 (2024-2029).

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.

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, according to the Fourth National Climate Assessment. 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 towns or for specific populations, more severe storm damages and impacts, or an increase in flooding occurrences.

Sources for information related to climate change impacts used in this Plan Update include the Fourth National Climate Assessment Report, the Connecticut Physical Climate Assessment Report, the 2023 Connecticut Natural Hazard Mitigation Plan Update, and other resources maintained by CIRCA. In addition, the Fifth National Climate Assessment was released at the end of 2023, and its findings are generally consistent with those described above.

Climate Drivers and Natural Hazards

As global warming increases, and the climate changes as a result of anthropogenic and natural reasons, these various reasons drive certain types of climatic events to shift in frequency, intensity, and location.

Extreme and severe storms such as hurricanes, summer storms and tornadoes, and winter storms, are all expected to shift in intensity and frequency to varying degrees. As the climate warms and ocean temperatures rise, and atmospheric circulation patterns change, weather patterns change, and these warmer conditions provide “fuel” for more intense tropical events. Extreme storms can also exacerbate coastal flooding and shoreline change events, particularly as a result of **sea level rise.** Rising sea levels, caused by warming waters and melting ice sheets, can increase the frequency and intensity of coastal

flooding storm surge, and erosion of shoreline change. Severe storms can also experience **changing precipitation patterns**. Annual precipitation amounts have increased across the northern and eastern United States in since the beginning of the last century. These changes are projected to continue, with the most notable shifts during winter and spring months. In addition to more precipitation, drought conditions are also expected to increase due to longer periods of time between heavy rainstorms and a reduction in surface soil moisture due to warmer temperatures. As temperatures increase, **extreme temperature** events will also become more frequent. Global temperatures across the United States have increased by 1.2 degrees over the past few decades. These small increases have lead to an increase in heat wave events, ultimately increasing public health challenges, decreasing air quality, and promoting dry, drought conditions. These dry conditions are also conducive to wildfires. Over the past few decades, wildfire occurrences have increased in frequency in western areas of the United States.

As these storms and hazards shift in intensity and frequency as a result of climate change, so will the vulnerability and susceptibility throughout the CRCOG region. One critical component of hazard mitigation and climate adaptation is to prepare for future, larger storms, above and beyond what is typically experienced in a community.

In general, changes in flooding, storms, and extreme heat events tend to be the most concerning for many of the CRCOG communities. All CRCOG jurisdictions have specific concerns related flooding, storms, heat, and other climate driven hazards such as drought. In order to succinctly identify these top community concerns, a summary table of the top three climate challenges reported by each community is included in the Hazards Summary section.

Federal Disaster Declarations

Understanding the natural hazards we are likely to face is crucial for our ability to prepare for and respond to disasters. Researching historic data on major storms and other natural disasters can be helpful in this analysis. Knowing where and when natural disasters have occurred in the past is important to our understanding of our risks. To assess the risks we face from natural disasters, we can evaluate past occurrences of major disasters, looking at the losses to life and property incurred by our communities, state, residents, and businesses. The following pages contain descriptions of major storm events and their impact on the Capitol Region.

Some natural disasters such as stream and river flooding affect specific areas and their damages, although significant, may be localized. Other natural disasters such as hurricanes and blizzards can impact the whole region and beyond. Such widespread natural disasters can overwhelm state and local resources and the Governor may seek assistance from the federal government. Table 19 below lists the federal Emergency ("EM") and Disaster declarations ("DR") for Connecticut since 1954:

Table 19. Connecticut Federally Declared Disasters Since 1954

Disaster Number	Year	Incident Period	Disaster Type	Counties	CRCOG Region?
DR-4629	2021	September 1-2	Remnants of Hurricane Ida	Litchfield, Fairfield, New Haven, Middlesex, and New London	No

Disaster Number	Year	Incident Period	Disaster Type	Counties	CRCOG Region?
EM-3564	2021	August 21-24	Hurricane Henri	All	Yes
DR-4580 & EM-3535	2020	August 4	Tropical Storm Isaias	All	Yes
DR-4500 & EM-3439	2020	January 20, 2020 - May 11, 2023	COVID-19 Pandemic	All	Yes
DR-4410	2018	September 25-26	Severe Storms and Flooding	Middlesex and New London	No
DR-4385	2018	May 15	Severe Storms, Tornadoes, and Straight-line Winds	Fairfield, New Haven	No
DR-4213	2015	January 26-29	Severe Winter Storm and Snowstorm	New Haven, New London, Tolland, and Windham	Yes (part)
DR-4106 & EM-3361	2013	February 8-11	Severe Winter Storm and Snowstorm	All	Yes
DR-4087 & EM-3353	2012	October 27-November 8	Hurricane Sandy	Litchfield, Fairfield, New Haven, Middlesex, New London, Windham, and Tolland	Yes (part)
DR-4046 & EM-3342	2011	October 29-30	Severe Storm	Litchfield, Fairfield, New Haven, Middlesex, Windham, Tolland, and Hartford	Yes
DR-4023 & EM-3331	2011	August 27-September 1	Tropical Storm Irene	All	Yes
DR-1958	2011	January 11-12	Snowstorm	Fairfield, Hartford, Litchfield, New Haven, New London, Tolland	Yes
DR-1904	2010	March 12-May 17	Severe Storms and Flooding	Fairfield, Middlesex, New London	No
DR-1700	2007	April 15-27	Severe Storms and Flooding	Fairfield, Hartford, Litchfield, Middlesex, New London, New Haven, Windham	Yes (part)
EM-3266	2006	February 11-12	Snow	Fairfield, Hartford, New Haven, Tolland, Windham	Yes
EM-3200	2005	January 22-23	Snow	All	Yes
DR-1619	2005	October 14-15	Severe Storms and Flooding	Litchfield, New London, Tolland, Windham	Yes (part)
EM-3246	2005	August 29-October 1	Hurricane	All	Yes
EM-3192	2003	December 5-7	Snow	Fairfield, Hartford, Litchfield, New Haven, New London, Tolland, Windham	Yes
EM-3176	2003	February 17-18	Snow	All	Yes

Disaster Number	Year	Incident Period	Disaster Type	Counties	CRCOG Region?
DR-1302	1999	September 16-21	Tropical Storm Floyd	Fairfield, Hartford, Litchfield	Yes (part)
DR-1092	1996	January 7-13	Blizzard	Not listed	
EM-3098	1993	March 13-17	Severe Winds and Blizzard, Snowfall	Not listed	
DR-972	1992	December 10-13	Coastal Flooding, Winter Storm	Not listed	
DR-916	1991	August 19	Hurricane Bob	Not listed	
DR-837	1989	July 10	Severe Storms, Tornadoes	Not listed	
DR-747	1985	September 27	Hurricane Gloria	Not listed	
DR-711	1984	May 27-June 2	Severe Storms, Flooding	Not listed	
DR-661	1982	June 4	Severe Storms, Flooding	Not listed	
DR-608	1979	October 4	Tornado, Severe Storms	Not listed	
EM-3060	1978	February 7	Blizzards and Snowstorms	Not listed	
DR-42	1955	August 19	Hurricane, Torrential Rain, Floods	Not listed	
DR-25	1954	September 17	Hurricane	Not listed	

A federal disaster or emergency declaration for a county opens up the availability of funding reimbursements from the federal government. Such reimbursements may take the form of Public Assistance payments to municipal governments, nonprofit organizations, and state agencies to clean up communities affected by disaster debris and fund the repair, restoration, reconstruction, or replacement of a public facility or infrastructure damaged or destroyed by a disaster. In some cases where private property damage is widespread, FEMA may also offer Individual Assistance payments to individuals and families who have sustained losses due to disasters.

A Public Assistance reimbursement database is maintained by FEMA and is available through the FEMA website. The database contains records of damage reimbursements dating back to August 26, 1998, for municipalities, nonprofit organizations, schools, and state agencies. For Connecticut, the vast majority of losses are related to flooding, wind, or winter storm damage. Total damages from the Public Assistance database are summarized for the region from 2012-2023 in the table below.

Table 20. Public Assistance Reimbursements for the CRCOG Region, 2012-2023

Town	Total FEMA PA for Hurricane and Severe Storm Losses, 2012-2023
Andover	$53,072.58
Avon	$95,408.32
Berlin	$474,082.88
Bloomfield	$85,028.83
Bolton	$183,217.84

Town	Total FEMA PA for Hurricane and Severe Storm Losses, 2012-2023
Canton	$138,101.92
Columbia	$35,116.84
Coventry	$327,666.15
East Granby	$39,608.97
East Hartford	$1,230,024.14
East Windsor	$45,338.31
Ellington	$266,829.60
Enfield	$238,883.66
Farmington	$640,603.04
Glastonbury	$733,814.87
Granby	$77,027.42
Hartford	$3,089,525.34
Hebron	$162,866.85
Manchester	$328,512.19
Mansfield	$265,317.64
Marlborough	$124,144.46
New Britain	$523,960.27
Newington	$537,354.24
Plainville	$266,030.81
Rocky Hill	$484,929.96
Simsbury	$234,129.45
Somers	$154,296.41
South Windsor	$504,411.02
Southington	$346,424.44
Stafford	$197,572.87
Suffield	$186,608.87
Tolland	$538,515.56
Vernon	$358,208.06
West Hartford	$1,051,887.25
Wethersfield	$833,193.11
Willington	$112,926.24
Windsor	$155,619.79
Windsor Locks	$165,254.84
Hartford County, exact location unknown	$9,744.00
Total	$15,295,259.04

The damages above include significant reimbursements to the municipalities of Hartford, East Hartford, West Hartford, Glastonbury, and Wethersfield.

Annualized loss estimates were also prepared based on the Public Assistance data. The damage for each town due to hurricanes/tropical storms and winter storms was summed and divided by the most recent 11 years of available data. The annualized loss for the region from hurricanes and tropical storms is $733,703. The annualized loss due to winter storm damage in the region from these data is $655,889.

Table 21. Annualized loss estimates for hurricanes/tropical storms and winter storms for the CRCOG region.

Hazard	Source	Average Annualized Losses (AAL)
Hurricanes/Tropical storms	FEMA PA	$733,703
Winter Storms	FEMA PA	$655,889

Risk Assessment

In assessing our risks from natural hazards, we need to consider what and who will be affected. Identifying where essential community facilities, such as hospitals, police and fire stations, emergency operations centers, and schools, are located and determining if they are likely to be damaged is necessary for our understanding of our risks. Similarly, knowing where other facilities that are important to our communities, as well as where vulnerable populations, are located is important to our ability to protect them from harm. This plan includes maps for each municipality that show the important community facilities, dams, and floodplains.

While knowing where existing vulnerabilities are, it is also important to limit new or increased vulnerabilities. The communities of the Capitol Region have development controls, such as floodplain and inland wetlands regulations and building codes, in place to regulate or restrict the construction of new structures that could increase their level of vulnerability to the natural hazards. Local communities have strictly limited the amount of new development in hazard prone areas and have required any new development to conform to floodplain requirements in accordance with the NFIP and to inland wetlands regulations in accordance with state requirements. Since the adoption of the original 2008 Plan and the 2014 and 2019 updates, most communities have not permitted new structures in the special flood hazard areas. Those that have allowed structures in these areas have required they be built above the base flood elevation and that compensatory storage be provided as needed. Furthermore, many of the local floodplain and wetland permits issued were for projects that improved stormwater drainage and helped mitigate flooding. Details of any local development since 2019 in hazard prone areas are provided for each community in the Municipal Annexes.

Determining our potential losses from disasters is a daunting task. Comprehensive estimates of the losses each community faces from the various natural hazards are generally not available. The equalized net grand list (Table 10) provides an estimate of the market value of all taxable property in each community and can give an indication of the total value of property exposed to natural disasters of a town-wide or region-wide scope.

Computer modeling is another means of analyzing risks we face from natural disasters. CRCOG used FEMA's HAZUS 6.0 model to evaluate our risks and estimate the losses we might face to life and property. We used HAZUS 6.0 to analyze the risks that the region and each municipality might face from flooding, earthquakes, and hurricanes. HAZUS is a software program that can be used throughout the

United States and provides standard loss estimations and damage assessments based on historical hazard events, Census data, and other federal and nationally based databases. The HAZUS 6.0 model uses 2020 Census data and block boundaries as a baseline for analyzing losses. Because of the limitations of the dated Census and inventory data used in the HAZUS analyses, the loss estimates should at best be considered approximate.

CRCOG also conducted an exposure analysis for each hazard to estimate the number of parcels in each community that are potentially vulnerable to hazard impacts, as well as the number of at-risk parcels with historic resources and the number of at-risk parcels with critical facilities. The results of this exposure analysis are included in each hazard section of this plan.

Climate Driver #1: Extreme and Severe Storms

Changes in atmospheric circulation have resulted in observed shifts of extreme storms. Winter storms have shifted more northward, and future projections show an increase in frequency of these events in the northeastern United States. Human-induced warming is also having impacts on the Atlantic hurricane season. Studies have shown that the tropics have expanded poleward, ultimately expanding the geographic stretch of tropical cyclone tracks. Though it is more challenging to observe and predict the changes to tornadoes and severe thunderstorms due to their shorter time period of occurrence, there have been some indications that a warmer climate could increase the number of days that are conducive to severe storms and tornadoes.

Risk Assessment Terminology

Community assets: The people, structures, facilities, and systems that have value to the community

Extent: The strength or magnitude of the hazard, based on an established scientific scale or measurement system, speed of onset, and duration. Extent defines the characteristics of a hazard regardless of the people and property if affects as opposed to impact (below).

Impact: The consequences or effects of a hazard on the community or its assets

Location: The geographic areas within the planning area that are affected by the hazard

Natural hazard: Source of harm or difficulty created by a meteorological, environmental, or geological event

Probability: The likelihood of the hazard occurring in the future

Risk: The potential for damage, loss, or other impacts created by the interaction of natural hazards with community assets

Risk assessment: Product or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing courses of action, and informing decision making

Vulnerability: Characteristics of community assets that make them susceptible to a given hazard

Definitions from FEMA Local Mitigation

Hurricanes and Tropical Storms (Climate Driver: Extreme and Severe Storms)

Tropical cyclones are a relatively common occurrence in Connecticut and occur every few years producing heavy winds, heavy rainfall, and flooding. Connecticut typically experiences tropical storms as opposed to hurricanes, but strong hurricanes have caused widespread damage to the state, including flooding, and widespread power outages and damages from falling trees and power lines. The 2023 *Connecticut Natural Hazard Mitigation Plan Update* notes that hurricanes have the greatest destructive potential of all natural disasters in Connecticut.

Location

All areas of the Capitol Region communities are susceptible to tropical cyclones. Low-lying areas (such as floodplains) can experience additional impacts of tropical cyclones such as flooding.

Extent

A tropical cyclone is defined by the National Weather Service as a "rotating, organized system of clouds and thunderstorms that originates over tropical or subtropical waters and has a closed low-level circulation." A tropical cyclone is further classified as a tropical depression, tropical storm, hurricane, or major hurricane and is most likely to form from June 1 through November 30 each year in the northern Atlantic Ocean.

The Saffir-Simpson Hurricane Wind Scale (Figure 11) is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures.

Saffir-Simpson Hurricane Wind Scale

	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Damaging winds will produce some damage:** Well-constructed framed homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap, and shallow-rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Very strong, damaging winds will cause widespread damage:** Well-constructed framed homes could sustain major roof and siding damage. Many shallow-rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Dangerous winds will cause extensive damage:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Extremely dangerous winds will cause devastating damage:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

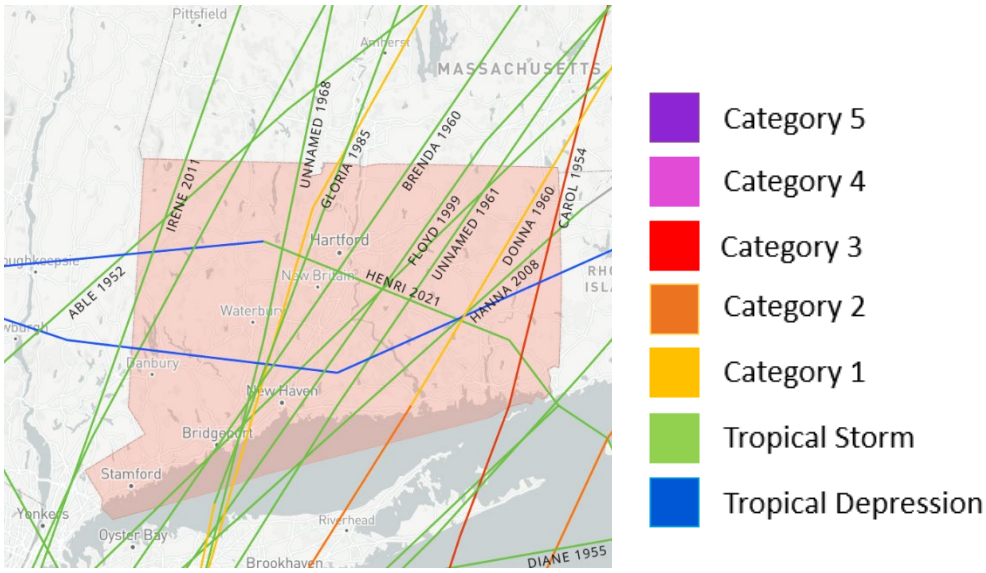
Source: National Hurricane Center, NOAA

Figure 11. Saffir-Simpson Hurricane Wind Scale

Previous Occurrences

The Atlantic hurricane season extends from June 1st through November 30th each year. Hurricanes that hit Connecticut normally form in the tropical waters of the Atlantic, Caribbean, or Gulf of Mexico. This is the time period when environmental conditions are most favorable for a tropical cyclone to develop. The greatest risk of a hurricane impacting New England within this 6-month period is from late August to mid October.

Of the 33 disaster declarations in the state since 1954, 11 have been for hurricane or tropical-cyclone-related damage. However, as illustrated by Map 7, many such storms have tracked through the region in the last 70 years. While the Capitol Region is spared the coastal storm surges associated with hurricanes, it is not immune from damaging winds and rain.



Map 7. Historic Hurricane and Tropical Storm Tracks Across Connecticut (1950 – 2022), from NOAA Historical Hurricane Tracks

The wind and rain brought by historic tropical storms and hurricanes caused flooding, property damage, and power outages and left extensive debris and detritus in their wake. Both the 1938 and 1944 hurricanes that hit Connecticut were Category III hurricanes. The 1938 hurricane is still considered the greatest natural disaster to hit the state as it killed 125 people and caused an estimated $53 million (1938 dollars) in damage across the state. Hurricane Carol in 1954 also caused widespread damage across the state. Remnants of two hurricanes (Connie and Diane) struck Connecticut in the same week in August 1955, causing massive flooding and 70 deaths throughout the state. A Category II hurricane, Gloria, made land fall in Connecticut in 1985, downing and damaging several thousand trees and causing widespread power outages but with little rain or flooding. In 1999, Hurricane Floyd, downgraded to a tropical storm prior to making landfall in Connecticut, resulted in presidential disaster declarations for Fairfield, Hartford, and Litchfield Counties. Numerous less intense hurricanes and tropical storms have affected the region and state, some causing significant damage.

More recently, in August 2011, Hurricane Irene, also downgraded to a tropical storm before hitting Connecticut, caused widespread damage to the region and state. Irene was responsible for three deaths associated with flooding and downed wires from falling trees. According to the *Hartford Courant*, insurance companies paid out $235 million on more than 60,000 claims in Connecticut related to damage from Irene. However, this figure does not include hundreds of millions more in uncovered expenses and cleanup costs for Connecticut's largest electric utility at the time (Connecticut Light and Power). At the height of the storm, some 754,000 residents were without power. Capitol Region cities and towns were widely affected by downed trees, flooding, and power outages as a result of Irene. Many residents and businesses were without power for over a week. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private

nonprofit agencies incurred expenses of over $3.18 million due to Irene. The municipalities and agencies were eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

Flooding in Granby in the Aftermath of Irene

Credit: Ted Glanzer, West Hartford Patch

Downed Wires in Enfield after Hurricane Irene

Credit: Ted Jensen, West Hartford Patch

Hurricane Sandy made landfall on October 29, 2012, causing costly and widespread destruction to coastal communities in Connecticut as well as in numerous other states in the Northeast. Damage due to Sandy was also felt far inland; in Connecticut, all but Hartford County was covered by the Disaster Declaration. In the Capitol Region, communities in Tolland County were designated as eligible for public assistance for funding to repair and rebuild disaster-damaged infrastructure as well as costs for debris removal and emergency protective measures.

Tropical Storm Isaias passed through Connecticut on August 4, 2020, leading to significant rain as well as substantial wind damage. The 2023 *State Natural Hazard Mitigation Plan Update* notes that wind gusts of up to 70 mph led to severe tree and powerline damage, resulting in over 632,000 power outages. In the Capitol Region, municipalities reported widespread power outages that lasted over a week in some areas.

Multiple summer storms occurred in 2021, including Tropical Storm Henri, which reached Connecticut on August 21, 2021. The 2023 *State Natural Hazard Mitigation Plan Update* notes that the worst flash flooding associated with Henri occurred in northeast Connecticut, and the highest rainfall totals over the two-day period ranged from 5 to 6 inches in Hartford and Tolland Counties. In the Capitol Region, municipalities reported some infrastructure damage, including road washouts, as a result of this summer of storms. Hurricane Lee passed offshore of southern New England in September 2023, although impacts in the Capitol Region were limited.

Probability of Future Events

Return periods can be a helpful tool to put risk in perspective. Resident and business leaders should ask themselves, "How many times, over the course of a 30-year mortgage will a Category 1 hurricane hit Connecticut?" This exercise may help frame these storms as an eventuality to be prepared for rather than a risk that can be magically avoided.

NOAA has utilized the National Hurricane Center Risk Analysis Program (HURISK) to determine return periods for various hurricane categories at locations throughout the United States. As noted on the NOAA website, hurricane return periods are the frequency at which a certain intensity or category of hurricane can be expected within 75 nautical miles of a given location. For example, a return period of 20 years for a particular category storm means that on average during the previous 100 years a storm of that category passed within 75 nautical miles of that location five times. Thus, it is expected that similar category storms would pass within that radius an additional five times during the next 100 years.

According to NOAA, a Category 1 hurricane can be expected to make landfall in/near Connecticut once every 17 years. A Category 2 hurricane could be expected to make landfall in/near Connecticut once every 39 years, and a Category 3 hurricane has a calculated return period of 68 to 70 years. According to the state's Hazard Mitigation Plan, a Category 3 hurricane has a calculated return period of 63 to 120 years along the coastline of Connecticut, and hurricanes in general have calculated return period ranges from 17-24 years for Connecticut. Based on this, the occurrence of a major hurricane impacting the state can be expected within the foreseeable future.

The 2023 *Connecticut Natural Hazard Mitigation Plan Update* also notes that some researchers have suggested that the intensity of tropical cyclones has increased over the last 35 years. Most climate simulations agree that a warmer world with warmer waters increases the intensity of tropical storms. Given the past history of major storms and the possibility of increased intensity of tropical storms due to climate change, it is prudent to expect that there will be hurricanes impacting Connecticut in the near future that may be of greater intensity than in the past.

Impacts to Community Assets

The state's Hazard Mitigation Plan states that hurricanes pose the most destructive potential of all natural disasters for Connecticut. They occur relatively frequently and cause structural damage, loss of life, felled trees, flooding, power outages, and other damages. However, hurricanes pose a greater risk for coastal Connecticut than the Capitol Region because of storm surges and associated flooding risks.

Factors that influence vulnerability to tropical cyclones in the Capitol Region include building codes currently in place, local zoning and development patterns, and the age and number of structures located in highly vulnerable areas of the communities. In general, as the residents and businesses of Connecticut become more dependent on the internet and mobile communications, the impact of hurricanes on commerce will continue to increase. A major hurricane has the potential of causing complete disruption of power and communications for up to several weeks, rendering electronic devices and those that rely on utility towers and lines inoperative.

Debris such as signs, roofing material, and small items left outside become flying missiles in hurricanes. Extensive damage to trees, towers, aboveground and underground utility lines (from uprooted trees or failed infrastructure), and fallen poles cause considerable disruption for residents. Streets may be flooded or blocked by fallen branches, poles, or trees, preventing egress. Downed power lines from heavy winds can also start fires during hurricanes with limited rainfall. While moving all utilities underground would prevent wind damage to this infrastructure, this activity is generally too cost-prohibitive for communities.

FEMA Team Meeting in Hartford in Response to Hurricane Irene, 2011, Credit: FEMA

Population

Based on the population and housing growth analysis for the Capitol Region, the population of the region is estimated to continue to increase over the next 5 years. All areas of growth and development increase the region's vulnerability to natural hazards such as hurricanes although new development is expected to mitigate potential damage by meeting the standards of the most recent building code.

Loss Estimates from HAZUS

CIRCA used FEMA's HAZUS 6.0 software to estimate the extent of physical damage and the economic losses to the region and the CRCOG communities if the region experienced a hurricane with a 1% annual chance recurrence interval. The HAZUS hurricane model primarily considers wind damage for inland areas such as the Capitol Region, which is not subject to storm surges. The software assesses physical damage and the associated economic losses. Economic losses associated with the loss of electricity are not considered except as a factor in determining the number of households displaced and/or likely to use public shelters. The model predicts the region could face economic losses of approximately $1.3 billion, including property damage and business interruption loss. Table 22 below displays the economic losses estimated by HAZUS for each municipality in the region.

Table 22. HAZUS Loss Estimates for Hurricane (in thousands of dollars)

Town	Property Damage - Building ($thousands)	Property Damage - Content ($thousands)	Property Damage - Inventory ($thousands)	Business Interruption Loss ($thousands)	Total Loss ($thousands)	People Seeking Shelter
Andover	$ 3,013.40	$ 305.80	$ 1.74	$ 171.06	$ 3,492.00	0
Avon	$ 30,863.99	$ 15,041.38	$ 14.93	$ 896.78	$ 46,817.07	3
Berlin	$ 23,831.23	$ 2,682.27	$ 162.10	$ 2,035.86	$ 28,711.46	5
Bloomfield	$ 15,881.85	$ 1,399.99	$ 97.38	$ 1,169.08	$ 18,548.31	5

Town	Property Damage - Building ($thousands)	Property Damage - Content ($thousands)	Property Damage - Inventory ($thousands)	Business Interruption Loss ($thousands)	Total Loss ($thousands)	People Seeking Shelter
Bolton	$ 4,005.26	$ 396.37	$ 10.77	$ 278.42	$ 4,690.82	1
Canton	$ 10,834.19	$ 4,924.17	$ 10.56	$ 493.31	$ 16,262.23	1
Columbia	$ 5,840.69	$ 644.59	$ 9.71	$ 394.36	$ 6,889.35	1
Coventry	$ 11,215.85	$ 1,109.94	$ 13.91	$ 720.18	$ 1,305.88	3
East Granby	$ 6,354.24	$ 2,645.04	$ 16.26	$ 310.26	$ 9,325.80	0
East Hartford	$ 47,749.33	$ 7,020.49	$ 376.34	$ 5,971.00	$ 61,117.16	34
East Windsor	$ 10,635.12	$ 958.33	$ 71.51	$ 943.70	$ 12,608.67	3
Ellington	$ 17,826.36	$ 1,635.37	$ 36.01	$ 1,293.50	$ 20,791.25	4
Enfield	$ 30,069.50	$ 5,809.66	$ 87.38	$ 2,130.64	$ 38,097.19	10
Farmington	$ 31,358.45	$ 5,463.81	$ 85.26	$ 2,437.83	$ 39,345.36	10
Glastonbury	$ 43,965.60	$ 9,016.17	$ 80.72	$ 2,674.26	$ 55,735.75	12
Granby	$ 11,875.69	$ 5,815.42	$ 6.90	$ 352.65	$ 18,050.67	0
Hartford	$ 124,149.96	$ 16,226.03	$ 326.24	$ 19,765.54	$ 160,467.75	122
Hebron	$ 10,540.15	$ 1,165.67	$ 6.76	$ 556.40	$ 12,268.99	2
Manchester	$ 67,044.33	$ 12,273.71	$ 316.26	$ 9,143.23	$ 88,777.54	37
Mansfield	$ 23,034.95	$ 2,641.78	$ 53.63	$ 5,932.67	$ 31,663.03	9
Marlborough	$ 6,604.52	$ 645.82	$ 5.25	$ 349.71	$ 7,605.31	1
New Britain	$ 72,746.08	$ 9,078.94	$ 219.34	$ 13,135.52	$ 95,179.89	85
Newington	$ 24,168.06	$ 2,676.31	$ 178.72	$ 2,680.15	$ 29,703.24	10
Plainville	$ 17,065.09	$ 2,563.19	$ 103.44	$ 1,402.73	$ 21,134.45	6
Rocky Hill	$ 24,913.36	$ 2,786.96	$ 123.74	$ 2,936.92	$ 30,760.98	9
Simsbury	$ 24,779.16	$ 1,261.44	$ 14.93	$ 1,225.32	$ 36,280.86	3
Somers	$ 12,817.43	$ 5,908.19	$ 18.96	$ 466.44	$ 19,211.02	2
South Windsor	$ 27,327.35	$ 2,522.06	$ 131.90	$ 1,807.84	$ 31,789.16	7
Southington	$ 46,381.69	$ 5,504.14	$ 157.57	$ 3,460.65	$ 55,504.05	12
Stafford	$ 14,758.75	$ 7,262.92	$ 21.77	$ 638.06	$ 22,681.49	4
Suffield	$ 12,380.22	$ 2,394.83	$ 24.17	$ 652.17	$ 15,451.39	1
Tolland	$ 20,806.41	$ 9,627.90	$ 13.12	$ 543.21	$ 30,990.63	2
Vernon	$ 29,494.01	$ 3,355.13	$ 42.51	$ 2,760.80	$ 35,652.44	15
West Hartford	$ 82,521.13	$ 22,664.67	$ 162.19	$ 4,650.69	$ 109,998.68	24
Wethersfield	$ 33,946.74	$ 3,155.29	$ 67.21	$ 3,665.42	$ 40,834.65	14
Willington	$ 8,105.01	$ 4,195.40	$ 5.66	$ 373.18	$ 12,679.25	2
Windsor	$ 22,433.41	$ 3,605.81	$ 83.13	$ 1,574.14	$ 27,696.49	10
Windsor Locks	$ 10,106.50	$ 972.08	$ 68.41	$ 1,288.99	$ 2,435.98	3
Total	$ 1,021,445.06	$ 187,357.07	$ 3,226.39	$ 101,282.67	$ 1,300,556.24	472

While the region could experience severe and widespread losses from rare, strong hurricanes, this hazard poses moderate risk for the Capitol Region given that coastal Connecticut bears the initial brunt of such storms.

Other Loss Estimates

Multiple sources were used to estimate annualized losses due to hurricane and tropical storms in each community, including FEMA Public Assistance data from the past 11 years, the FEMA National Risk Index, and NCEI losses from the last 20 years, with a wide range of results. Based on the FEMA Public Assistance data for 2012-2022 available, the annualized loss estimate for the Capitol Region is $733,703. Based on the FEMA National Risk Index, the annualized loss estimate for the Capitol Region is $39,018,299. Based on the NCEI, the annualized loss estimate for the Capitol Region is $2,508,790. Annualized losses for each community based on each of these data sources are presented in each municipal annex.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to hurricanes. As an initial screening of exposure to hazards, areas of risk (in this case, the entire CRCOG region) 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 23.

Table 23. Exposure analysis for hurricanes in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Hurricane Risk Area	Approx. Appraised Parcel Value in Hurricane Risk Area	Number of Historical Resources (SHPO) in Hurricane Risk Area	Approx. Appraised Parcel Value of SHPO in Hurricane Risk area	Number of Critical Facilities in Hurricane Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Hurricane Risk area
Andover	$219,735	1,704	$374,429,046	40	$8,789,414	2	$439,471
Avon	$418,390	7,932	$3,318,671,261	11	$4,602,292	13	$5,439,073
Berlin	$305,900	9,017	$2,758,301,127	91	$27,836,908	3	$917,700
Bloomfield	$321,812	8,510	$2,738,623,920	5	$1,609,062	9	$2,896,312
Bolton	$238,182	2,366	$563,537,451	9	$2,143,634	6	$1,429,089
Canton	$343,744	3,964	$1,362,602,800	289	$99,342,131	5	$1,718,722
Columbia	$270,752	2,615	$708,015,200	37	$10,017,806	4	$1,083,006
Coventry	$193,998	6,610	$1,282,324,786	126	$24,443,710	8	$1,551,982
East Granby	$258,272	2,653	$685,195,086	111	$28,668,170	8	$2,066,174
East Hartford	$282,361	14,331	$4,046,522,571	226	$63,813,698	9	$2,541,253
East Windsor	$235,621	4,960	$1,168,678,871	25	$5,890,519	9	$2,120,587
Ellington	$302,974	6,100	$1,848,139,057	65	$19,693,285	5	$1,514,868
Enfield	$257,182	16,651	$4,282,334,586	552	$141,964,368	15	$3,857,727
Farmington	$412,953	11,221	$4,633,746,946	357	$147,424,263	15	$6,194,297
Glastonbury	$357,701	15,300	$5,472,826,486	457	$163,469,392	36	$12,877,239
Granby	$252,015	5,167	$1,302,160,286	83	$20,917,225	7	$1,764,103

Town	Average Appraised Parcel Value	Parcel Count in Hurricane Risk Area	Approx. Appraised Parcel Value in Hurricane Risk Area	Number of Historical Resources (SHPO) in Hurricane Risk Area	Approx. Appraised Parcel Value of SHPO in Hurricane Risk area	Number of Critical Facilities in Hurricane Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Hurricane Risk area
Hartford	$255,726	19,160	$4,899,719,451	4,237	$1,083,513,117	10	$2,557,265
Hebron	$284,390	4,011	$1,140,687,600	51	$14,503,881	4	$1,137,559
Manchester	$354,302	16,252	$5,758,122,239	1,301	$460,947,393	10	$3,543,024
Mansfield	$301,081	4,640	$1,397,014,420	106	$31,914,554	8	$2,408,646
Marlborough	$281,882	2,732	$770,100,857	0	$0	6	$1,691,290
New Britain	$201,446	15,736	$3,169,958,733	129	$25,986,571	8	$1,611,570
Newington	$271,063	12,416	$3,365,524,343	21	$5,692,333	10	$2,710,635
Plainville	$256,639	7,472	$1,917,603,547	72	$18,477,979	5	$1,283,193
Rocky Hill	$548,247	4,922	$2,698,472,686	277	$151,864,473	10	$5,482,472
Simsbury	$298,583	10,795	$3,223,206,986	153	$45,683,249	14	$4,180,167
Somers	$291,809	3,865	$1,127,841,671	181	$52,817,424	14	$4,085,326
South Windsor	$315,866	11,129	$3,515,275,849	210	$66,331,919	13	$4,106,262
Southington	$294,296	18,395	$5,413,572,556	18	$5,297,326	10	$2,942,959
Stafford	$183,379	5,384	$987,314,543	3	$550,138	6	$1,100,276
Suffield	$289,760	6,417	$1,859,390,877	184	$53,315,867	13	$3,766,882
Tolland	$243,246	6,562	$1,596,182,814	49	$11,919,073	12	$2,918,957
Vernon	$337,929	7,990	$2,700,053,470	861	$290,956,951	10	$3,379,291
West Hartford	$455,991	19,953	$9,098,386,094	327	$149,109,019	14	$6,383,872
Wethersfield	$298,996	9,958	$2,977,402,886	1,074	$321,121,781	7	$2,092,973
Willington	$219,478	2,453	$538,379,359	66	$14,485,543	14	$3,072,691
Windsor	$314,027	12,177	$3,823,906,683	127	$39,881,428	14	$4,396,378
Windsor Locks	$340,933	4,391	$1,497,034,814	6	$2,045,595	7	$2,386,528
Total	**$11,310,662**	**325,911**	**$100,021,261,958**	**11,937**	**$3,617,041,492**	**373**	**$115,649,817**

Tornadoes and Other Severe Weather (Climate Driver: Extreme and Severe Storms)

Tornadoes are a relatively infrequent occurrence in Connecticut but can be very destructive when they occur. While small tornadoes in outlying areas cause little to no damage, larger tornadoes in populated sections of Connecticut have historically caused significant damage, injury, and death through the destruction of trees, buildings, vehicles, and power lines. Thunderstorms are a common occurrence in Connecticut and occur on approximately 20 to 30 days each year. While many thunderstorms produce relatively little damage, stronger "supercell" thunderstorms can produce heavy winds, hail, significant damaging lightning strikes, and even tornadoes. Such storms have historically caused significant damage, injury, and even death through the destruction of trees; damage to buildings, vehicles, and power lines; and direct lightning strikes.

Location

All areas of the Capitol Region communities are susceptible to tornadoes and thunderstorms. The likelihood of damage, injury, and death increases dramatically when a tornado or supercell thunderstorm occurs in a populated area. Tornadoes typically cause damage in a straight line although "skipping" tornadoes are also possible where a tornado can pass over portions of its route without causing damage. While the heavy winds and tornadoes associated with strong thunderstorms are more likely to cause measurable damage near populated areas, hail can cause damage to crops in rural areas as well as damaging vehicles and buildings in populated areas, and lightning can cause injuries or fires in any area.

Extent

A tornado is a violent, destructive whirling wind storm accompanied by a funnel-shape cloud that progresses in a narrow path over the land.

The strength of tornadoes is measured based on the Enhanced Fujita scale (EF) released by NOAA in 2007. The EF scale updated the original Fujita (F) scale developed in 1971. The EF scale uses 3-second gusts estimated at the point of damage based on a judgement of eight levels of damage to 28 specific indicators. Table 24 links EF classifications to estimated 3-second wind gusts.

The strength of thunderstorms is typically measured in terms of its effects, namely the speed of the wind, the presence of significant lightning, and the size of hail. In general, thunderstorm winds are less than tropical cyclone speeds, but strong winds associated with downbursts can be extremely hazardous and reach speeds up to 168 mph.

Lightning

Image courtesy of NOAA

Lightning is a discharge of electricity that occurs between the positive and negative charges within the atmosphere or between the atmosphere and the ground. According to NOAA, the creation of lightning during a storm is a complicated process that is not fully understood. In the initial stages of development, air acts as an insulator between the positive and negative charges. However, when the potential between the positive and negative charges becomes too great, a discharge of electricity (lightning) occurs.

In-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom. Cloud-to-cloud lightning occurs between the positive charges near the top of the cloud and the negative charges near the bottom of a second cloud. Cloud-to-ground lightning is the most dangerous. In summertime, most cloud-to-ground lightning occurs between the negative charges near the bottom of the cloud and positive charges on the ground.

Downbursts

A downburst is a severe localized wind blasting down from a thunderstorm. They are more common than tornadoes in Connecticut. Depending on the size and location of downburst events, the destruction to property may be significant.

Downbursts fall into two categories:

Microbursts affect an area less than 2.5 miles in diameter, last 5 to 15 minutes, and can cause damaging winds up to 168 mph.

Macrobursts affect an area at least 2.5 miles in diameter, last 5 to 30 minutes, and can cause damaging winds up to 134 mph.

Downburst activity is, on occasion, mistaken for tornado activity. Both storms have very damaging winds (downburst wind speeds can exceed 165 mph) and are very loud. These "straight line" winds are distinguishable from tornadic activity by the pattern of destruction and debris such that the best way to determine the damage source is to fly over the area.

Hail

Hailstones are chunks of ice that grow as updrafts in thunderstorms keep them in the atmosphere. Most hailstones are smaller in diameter than a dime, but stones weighing more than 1.5 pounds have been recorded. NOAA has estimates of the velocity of falling hail ranging from 9 meters per second (m/s) (20 mph) for a 1-centimeter (cm)-diameter hailstone to 48 m/s (107 mph) for an 8 cm, 0.7 kilogram stone.

Previous Occurrences

Hartford and Litchfield Counties are at the highest risk for tornadoes within the state based on historical patterns and locations of their occurrence (Map 8). Between 1950 and 2003, Hartford County experienced 14 tornadoes, and Tolland County experienced 10. These tornadoes occurred between April and October. Between 2006 and 2018, Connecticut experienced 27 tornadoes. Three of these were in Hartford County, and three were in Tolland County. Since the last plan update in 2019, two tornadoes have impacted the CRCOG region.

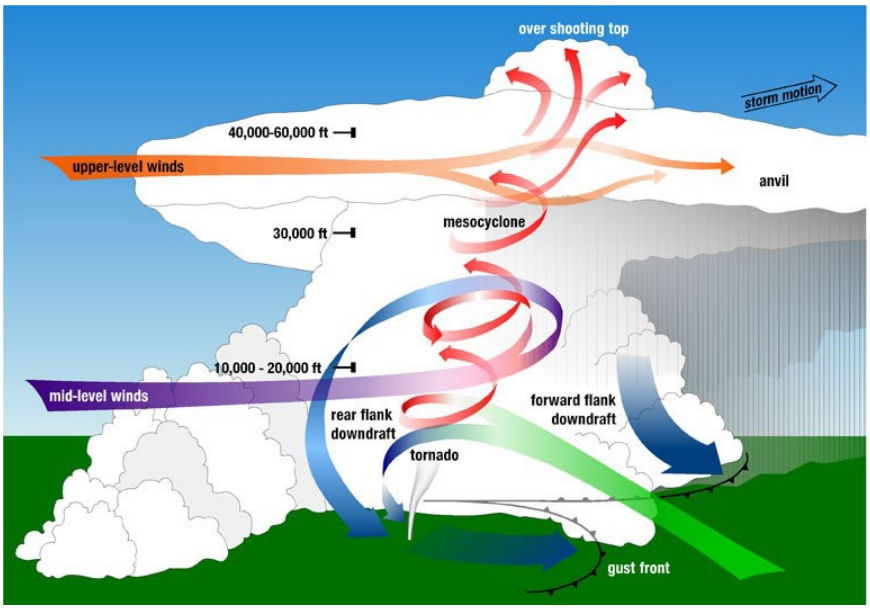


Figure 12. Anatomy of a Tornado. (Source: NOAA National Severe Storms Laboratory)

Table 24. Enhanced F-Scale for Tornado Damage

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS: *The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage judgments.* **Source:** http://www.spc.noaa.gov/efscale/ef-scale.html

An extensively researched list of tornado activity in Connecticut is available on Wikipedia. Milone & MacBroom, Inc previously compared this list to NOAA reports and found that the list remains reliable and surprisingly current with frequent updates. This list extends back to 1648 although it is noted that the historical data prior to 1950 is incomplete due to lack of official records and gaps in populated areas. Tornadoes that have impacted the Capitol Region communities are noted below:

From A History of Connecticut's Deadliest Tornadoes (Robert Hubbard, 2015)

Wethersfield Tornado of 1787

- Path was New Britain to Newington to Wethersfield to Glastonbury to Bolton to Coventry
- It was only the second time that a tornado in Connecticut caused fatalities and the first time in the area that is now the Capitol Region
- It was the state's deadliest tornado until the Wallingford tornado of 1878

Windsor/Windsor Locks Tornado of 1979

- Path was Windsor to Windsor Locks to Suffield
- ¼ to 1 mile wide
- Three fatalities
- At the time, it was the 6th most costly tornado in U.S. history
- Remains one of the three most deadly tornadoes in Connecticut

June 14, 1648: A "great tempest" downed trees somewhere in present-day Hartford County.

1728 or 1729: A possible tornado passed through New Britain and/or Wethersfield.

August 17, 1784: Two tornadoes struck central-western Connecticut. The second tornado injured one person while moving down a hillside west of Southington.

August 15, 1787: The "Four-State Tornado Swarm" affected most of New England. The first of four tornadoes to impact Connecticut on this day touched down near New Britain and tracked into Wethersfield where it did most of its damage, killing a mother and her two children and injuring 10 others. What may have been another tornado caused additional damage as far east as Coventry. Another tornado struck East Windsor, damaging several homes and barns.

June 30, 1808: One or more tornadoes moved from Windsor to Coventry, killing one person.

July 22, 1808: Trees and buildings were damaged by a tornado that moved from East Windsor to North Bolton.

July 16, 1810: A tornado produced damage in or around Somers.

August 9, 1851: A "tornado" (possibly a squall line) affected New Hartford, Suffield, and Windsor.

August 17, 1872: What may have been a small tornado hit Windsor Locks.

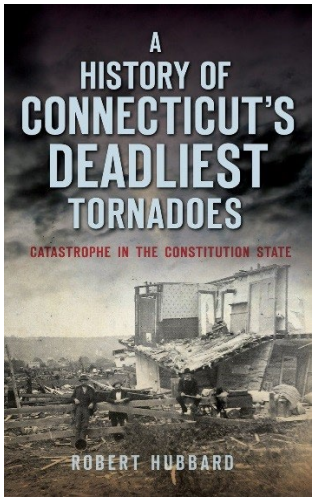
August 18, 1877: "Something like a tornado," described as a "whirling mass of black clouds" cut across Hartford, tearing down trees and branches.

May 29, 1880: A tornado touched down in Suffield, moving northeast and crossing the Connecticut River. It destroyed 25 buildings in Thompsonville and Enfield.

August 25, 1885: A tornado passed through the towns of Bloomfield and Windsor, crossing the Connecticut River before dissipating. Nearly the entire tobacco crop in the area was destroyed at a loss in the millions of dollars. Another tornado may have struck East Hartford a few weeks earlier.

September 12, 1886: A tornado touched down outside of Ellington, Connecticut, destroying barns and downing trees before lifting near Burnside (East Hartford), Connecticut.

June 12, 1918: A small tornado (possibly a microburst) caused $50,000 in damage to roofs and windows in New Britain.



July 13, 1922: A weak tornado tracked across Hartford, downing tree branches and utility poles.

September 24, 1942: A tornado touched down in Plainville, destroying a church. The tornado passed into Bristol, destroying a garage on its 3-mile path.

August 20, 1951: An F2 tornado briefly touched down in Willington.

August 21, 1951: A long-tracked F2 tornado touched down in New Milford and tracked 40 miles to eastern Hartford County. Nine people were injured by this tornado.

May 10, 1954: An F3 tornado (some sources say F2) hit Windsorville (East Windsor) at 9:30 a.m., destroying a house and some sheds, injuring two, and causing $30,000 in damage. Additionally, an F2 tornado touched down in northwestern Hartford County that afternoon.

October 24, 1955: An F1 tornado touched down in central Hartford County.

August 8, 1956: An F0 tornado briefly touched down in East Glastonbury.

June 19, 1957: An F1 tornado touched down in central Glastonbury.

September 7, 1958: An F2 tornado injured two in Willington.

May 30, 1959: An F1 tornado briefly touched down in Bloomfield, damaging a few greenhouses.

April 26, 1961: An F1 tornado briefly touched down in western Tolland County.

May 24, 1962: An F3 tornado killed one person, injured 50 more, and razed 200 buildings and damaged 600 more, causing $4 million in damage along its 11-mile path from Middlebury to Southington.

August 19, 1965: An F2 tornado tracked 6 miles (10 km) through northern Tolland County.

August 17, 1968: An F1 tornado touched down in southern Tolland County.

October 3, 1970: An F1 tornado injured one in northern Hartford County.

June 28, 1973: An F1 tornado injured one person in western Hartford County.

August 31, 1973: An F2 tornado briefly touched down in central Hartford County.

September 6, 1973: An F2 tornado touched down in eastern Hartford County, damaging houses in Manchester, Vernon, and Talcottville (Vernon).

Tornado Damaged Aircraft from New England Air Museum, 10/4/1979
Credit: John Long, *Hartford Courant*
http://www.courant.com/business/connecticut-insurance/hrt-hc-aircraft-devasted20120104123803,0,2414026.photo

September 18, 1973: Three tornadoes briefly touched down, an F1 in Greenwich, an F2 in southwestern Hartford County, and another F1 in southern Tolland County.

October 3, 1979: The Windsor Locks, Connecticut, tornado, an extremely destructive F4 tornado and one of the worst in Connecticut history, killed three and injured 500 in northern Hartford County. The tornado, with winds in excess of 200 mph, struck without warning, tearing an 11-mile path from Windsor to Suffield. The tornado destroyed more than a dozen airplanes at Bradley International Airport and narrowly missed a Boeing 727 that was attempting to land. The tornado killed 3 people, injured 500, and caused an estimated $250 million in damage, mostly in Windsor Locks and Suffield. About 100 homes were completely leveled.

July 5, 1984: An F2 tornado tracked from Bristol to Farmington, injuring one person and causing $500,000 in damage to homes and vehicles.

August 4, 1992: An F0 tornado struck central Hartford County.

June 29, 1994: A strong microburst accompanied by an F0 tornado struck Avon. Many trees were downed, but there was very little property damage.

August 16, 2000: An F1 tornado touched down in Ellington. It tossed several large trailers through the air and damaged a cow barn.

May 28, 2007: An EF0 land spout damaged the roof of a barn in Somers on an otherwise calm day.

June 26, 2009: An EF1 tornado hit the town of Wethersfield. There was widespread damage across town, especially near the area of Wolcott Hill. Many downed trees caused damages, most notably in Old Wethersfield where a tree split a house in two and destroyed a front porch. Damage was estimated at around $2.4 million, but no injuries were reported.

Wethersfield House torn in two by tree toppled during tornado of June 26, 2009
Credit: Wethersfield Historical Society **http://www.wethhist.org**

July 1, 2013: A series of three tornadoes touch down across the state; one in Fairfield County and two in Hartford County (an EF0 in Enfield and an EF1). The majority of impact was limited to downed trees although the EF1 tornado that tracked from Windsor Locks to East Windsor caused notable structural damage near East Windsor. This EF1 tornado, with an estimated maximum wind speed of 86 mph and a width of 200 yards, hit between 1:30 p.m. and 1:35 p.m. Various news outlets reported that the tornado traveled through tobacco fields, flattening the crops and tearing netting off the crops and sending it onto trees, roofs, and I-91. The tornado also knocked down a sports center bubble dome. Young campers at the center sought shelter in an adjacent building before the tornado struck. There were no injuries reported. Minutes later, the EF0 tornado, with a maximum wind speed of 65 mph, hit Enfield, knocking down trees and fencing. Over $5 million in damage was reported.

During this same storm, three tornadoes touched down in Hampden County, Massachusetts, just north of the Connecticut state line. The strongest, an EF3 tornado, resulted in four deaths, 200 injuries, and $227,600,000 in property damage. This tornado first touched down in Westfield and continued on a 39-mile path through West Springfield, Springfield, Wilbraham, Monson, Brimfield, and Sturbridge.

The July 1, 2013 Tornado Credit: http://wjar.images.worldnow.com/images/22735124_BG1.jpg

Sports Dome Damage from July 1, 2013 Tornado in East Windsor
Credit: John Woike, *Hartford Courant*. http://articles.courant.com/2013-07-01/news/hc- tornado- warning-0702-20130701_1_windsor-locks-tornado-rips-ef1

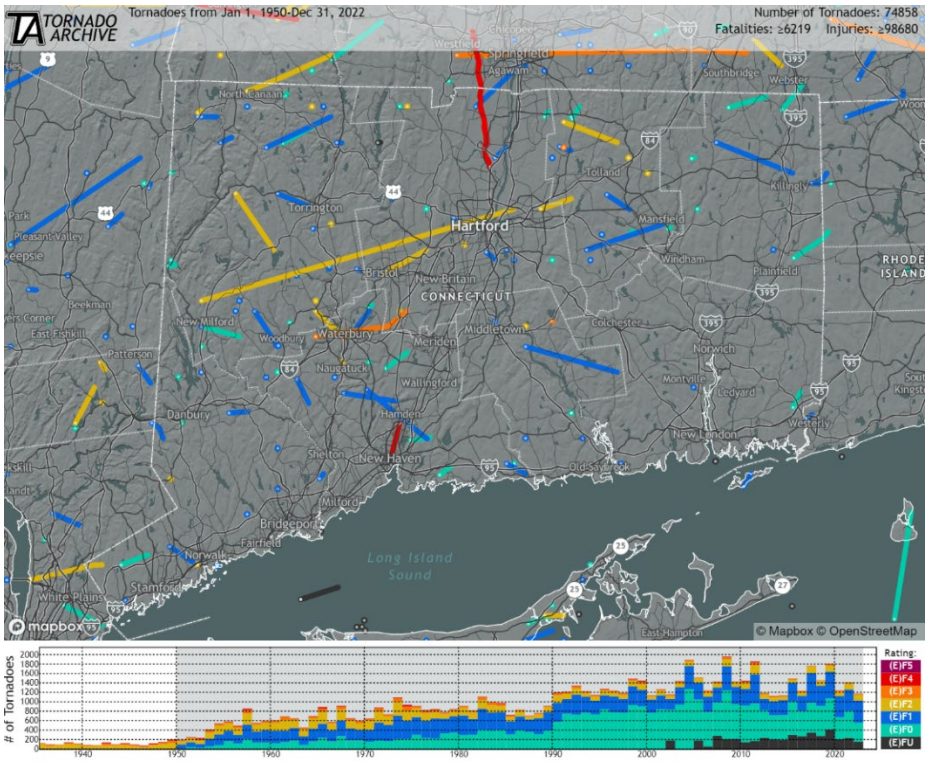
July 10, 2013: An EF1 tornado touched down in Andover and caused tree damage along an 11.2-mile-long (18.0 km) intermittent path in Tolland County through Coventry and Mansfield. The tornado traveled for over 30 minutes, had maximum wind speeds of 90 mph, and was up to 100 yards wide. The same storm system caused a microburst that hit Tolland, toppling numerous large trees.

Storm approaching Sleeping Giant State Park
Credit: Hailey Wilson. https://www.nbcconnecticut.com/weather/stories/May-15-2018---Southbury-to-Hamden-Tornado-483123751.html

October 2, 2018: An EF-0 tornado touched down in Mansfield center, with winds of 70 mph. The tornado was almost 100 feet wide and traveled for nearly a half mile. Minor damage was caused to roofs and buildings, and debris was lifted into the air.

September 4, 2019: An EF-1 tornado hit the towns of Coventry and Mansfield, causing tree damage and knocking over a building sign.

July 18, 2021: An EF-0 tornado hit the town of Somers.



Map 8. 1950 to 2022 Tornado Tracks across Connecticut

Approximate spot locations and tracks of tornadoes affecting Connecticut between 1950 and 2022, shown with Fujita scale rankings. (Source: TornadoArchive.com)

Table 25 displays a list of the tornadoes that occurred in Hartford and Tolland Counties from 1950 to 2022. The majority of tornadoes that touch down in the Capitol Region are of a lesser intensity; however, the 1979 Windsor Locks tornado illustrates that the region is vulnerable to tornadoes as strong as those that occur in the Midwest.

Table 25. Tornadoes in Hartford and Tolland Counties 1950-2022

Location of Touchdown / Date	Time	# Dead	# Injured	F Scale
Hartford County				
August 21, 1951	1715	0	9	F2
May 10, 1954	1255	0	0	F2
October 24, 1955	1735	0	0	F1
June 19, 1957	1500	0	0	F1
May 30, 1959	1530	0	0	F1
May 24, 1962	1700	0	5	F3
October 3, 1970	1700	0	1	F1
June 28, 1973	1345	0	1	F1
August 31, 1973	1730	0	0	F2
September 6, 1973	1000	0	0	F2
October 3, 1979	1400	3	500	F4
July 5, 1984	1657	0	0	F2

Location of Touchdown / Date	Time	# Dead	# Injured	F Scale
Hartford County				
August 4, 1992	1505	0	0	F0
June 29, 1994	1416	0	0	F0
June 26, 2009	1450	0	0	EF1
July 1, 2013	1328	0	0	EF1
July 1, 2013	1400	0	0	EF0
Tolland County				
August 20, 1951	1630	0	0	F2
May 10, 1954	930	0	2	F3
August 8, 1956	1630	0	0	F0
September 7, 1958	1610	0	2	F2
April 26, 1961	1115	0	0	F1
August 19, 1965	1705	0	0	F2
August 17, 1968	1800	0	0	F1
September 18, 1973	1208	0	0	F1
August 16, 2000	1135	0	0	F1
May 28, 2007	1100	0	0	EF0
July 10, 2013	1720	0	0	EF1
October 2, 2018	1600	0	0	EF0
September 4, 2019	1740	0	0	EF1
July 18, 2021	1811	0	0	EF0

Sources: The Tornado Project, www.tornadoproject.com and
"List of Connecticut Tornadoes," https://en.wikipedia.org/wiki/List_of_Connecticut_tornadoes

Previous occurrences of thunderstorm damage since 1993 are reported in the NCEI Storm Events database for the Capitol Region communities. Highlights of this damage are presented below:

August 28, 1993: Thunderstorm winds knocked out power to 44,000 customers in Connecticut. Large limbs were downed in Southington.

April 4, 1995: Thunderstorm winds with wind gusts of 40 to 60 mph, with some gusts exceeding 70 mph, caused damage in Connecticut. Trees and power lines were reported blown down in Plymouth, and considerable wind damage was reported in Southington. Up to 87,000 customers lost power.

May 29, 1995: Severe thunderstorms produced large hail and gusty winds. 0.88-inch diameter hail was reported in Southington.

July 11, 1995: 1.00-inch-diameter hail was reported in New Britain and Burlington.

July 3, 1996: The remnants of an F1 tornado that moved through Waterbury produced thunderstorm wind gusts and pea-size hail in Southington. Trees and power lines were blown down.

May 6, 1997: Dime-size hail (0.75-inch) was reported in New Britain.

July 23, 1998: A severe thunderstorm produced nickel-size hail. Lightning struck a chimney in New Britain, starting a fire.

July 24, 1999: Severe thunderstorms produced damaging winds and large hail, with 1.50-inch-diameter hail reported in New Britain.

May 18, 2000: A severe thunderstorm downed large tree limbs in Southington.

June 20, 2001: Lightning struck a house in Berlin, setting the roof on fire. No injuries were reported.

August 13, 2003: A severe thunderstorm downed power lines and caused minor flooding. Plainville was hardest hit with nearly 3,600 customers left without power. $25,000 in property damage was reported.

May 23, 2004: Severe thunderstorms produced ping-pong-ball-size (1.50-inch) hail in Plainville and Bristol.

August 21, 2004: Severe thunderstorms downed large branches in Southington.

May 27, 2005: Severe thunderstorms brought down power lines in Southington, igniting several house fires. Damage was estimated at $50,000.

July 11, 2006: Severe thunderstorms produced penny-size (0.75-inch) hail in Berlin.

October 29, 2006: A storm with peak gusts of 49 mph brought down trees and power lines in West Hartford, Andover, Ellington, and Tolland.

June 5, 2007: A thunderstorm dropped hail varying in size from pennies to golf balls (1.75-inch) in Southington. A few cars sustained damage from some of the larger hailstones.

July 15, 2007: Thunderstorm winds knocked down trees and wires on Camp Street in Plainville.

March 8, 2008: Trees and wires were downed in Glastonbury, closing a portion of Route 17. In South Windsor, a light pole was downed on Garnett Lane, and large tree limbs were downed on Avery Street,

June 8, 2008: Thunderstorm winds were reported in Southington that knocked down large branches and power lines. Two homes were struck by lightning. $10,000 in damages were reported.

June 26, 2009: Severe thunderstorms produced hail 0.88 inches in diameter in New Britain, with trees knocked down near a golf course. 0.75-inch-diameter hail was reported in Southington. The storms caused $1.8 million in property damage across Connecticut.

May 26, 2010: 1.00-inch-diameter hail was reported in Berlin and Terryville. Thunderstorm winds downed trees and limbs on Brooklawn Street and Pierremount Avenue in New Britain, causing $10,000 in property damage.

July 21, 2010: Severe thunderstorms produced an intermittent F1 tornado in northwestern Connecticut. One-inch hail was reported in New Britain and Berlin. Numerous trees were downed in Plainville and Southington by straight-line winds. In Southington, tree damage occurred on West Queen Street and Dunham Road as well as a tree downed onto a car on Oakland Drive. A tree on Stanley Street in New Britain was downed as well as large branches on Kenyon Circle. Total damage in the region was estimated at $108,000.

February 19, 2011: Multiple trees were downed across Hartford County, including one that was downed onto a garage on Halwood Drive in Granby, another on a garage in East Hartford, and two on April Drive and Indian Hill Road in Glastonbury.

June 22, 2012: A cold front moved through a hot and humid southern New England, producing showers and thunderstorms. Many of these storms became severe, resulting in damaging winds, large hail, and some flash flooding. Trees on Perkins Street in Manchester were downed by thunderstorm winds, causing $5,000 is damage, and 0.75-inch-diameter hail was observed. A tree and wires were downed by thunderstorm winds on Crystal Lake Road and Old Post Road in Tolland, causing $10,000 in damage. Also in Tolland, trees and wires on Route 30, Doyle Road, and Robin Circle were downed by thunderstorm winds, causing another $30,000 in damage, and 0.88- to 1.0-inch-diameter hail was observed. 0.75-inch-diameter hail was observed in Vernon, and 0.88-inch-diameter hail was observed in Mansfield. A tree on Bridge Street in Ellington was downed onto wires by thunderstorm winds; $10,000 in damages were reported. Several trees in Hartford were downed by thunderstorm winds; $15,000 in damages were reported.

July 2, 2012: Scattered showers and thunderstorms occurred throughout southern New England. Two trees in Hebron were struck by lightning, one falling on a house and ripping out some of the power lines. The lightning travelled through the house, likely through the plumbing, sending a jolt through an occupant's arm as he was brushing his teeth, holding his hand in the running water. The man was injured. $10,000 in property damage occurred.

July 18, 2012: Several trees and branches were downed by thunderstorm winds in Berlin, including one on New Britain Road. Part of a screen was blown off a screen door. Pea- to nickel-size hail fell in New Britain, and hail 1.0 inch in diameter was measured in Tolland. Lightning struck at the intersection of the two main runways at Bradley International Airport, damaging the runway surface. The runways were closed for about an hour while debris was cleared and the runway was patched. $11,000 in property damage was reported.

August 12, 2012: According to the *Hartford Courant*, a microburst resulted from a violent storm that formed on a warm front to the south and moved into central Connecticut. Winds up to 100 mph hit an area of Glastonbury one-half mile wide and 2.5 miles long, bringing down trees and damaging property. Based on the damage, the National Weather Service determined the microburst had wind speeds of 85 to 100 mph in the Butler Drive and Needletree Lane area and 75 to 90 mph around Homestead Drive and Paddok Street. Outside of those areas, the storm brought wind speeds ranging from 55 to 80 mph. The National Weather Service explained that for the area it affected the microburst was as powerful as a category 2 hurricane, which is characterized by wind speeds of 96 to 100 mph. While Glastonbury appeared to be the hardest hit, other parts of the state saw flash flooding and wind-related damage. Downed trees and wires were reported in Coventry, Enfield, Hebron, Manchester, Mansfield, South Windsor, Tolland, and Vernon. About 17,000 homes and businesses powered by Connecticut Light & Power were without electricity as a result of the storm. $65,000 in property damage was reported.

June 17, 2013: A cold front pushed through southern New England, resulting in showers and thunderstorms. Some of the storms became severe, producing damaging winds. A large tree in Manchester was uprooted and downed by thunderstorm winds, causing $5,000 in damage. A utility pole in South Windsor was downed by thunderstorm winds, causing $10,000 in damage. Trees and wires along Route 6 in Bolton were downed by thunderstorm winds, causing $10,000 in damage.

July 10, 2013: A severe thunderstorm downed several trees and large branches on Mountain Spring Road in Tolland. All of the downed trees were blown down in the same direction, indicating straight-line winds. $25,000 in damages occurred.

July 3, 2014: Thunderstorm winds downed trees and wires in Southington. In New Britain, a wind gust reached 63 mph. $12,000 in property damage was reported. Trees and wires were downed on Merrow Road in Tolland, causing $10,000 in damages.

July 27, 2014: Showers, thunderstorms, and severe thunderstorms occurred over New York and New England. Lightning struck a house on Prospect Street in Thompsonville, setting it on fire, causing $50,000 in damage. A

tree was downed onto a car on Shaker Road in Enfield by thunderstorm winds, causing $5,000 in damage. Trees and wires on North Maple Street in Enfield were downed by thunderstorm winds, causing $10,000 in damage, and 1.0-inch-diameter hail was reported. Trees and wires on George Wood Road in Somers were downed by thunderstorm winds, and $10,000 in damage occurred. A tree was downed onto wires on Jobs Hill Road in Ellington, causing $5,000 in damage, and 0.88-inch-diameter hail was reported. 0.75-inch-diameter hail was reported in Vernon. A microburst occurred in Tolland with winds 80 to 90 mph, downing numerous trees and wires on Interstate 195; Goose Lane; and Cedar Mill, Reed, and Mile Hill Roads, with $50,000 in damages occurring. A tree was downed onto wires on Route 320 near the Willington/Mansfield line, causing $5,000 in damages. Trees and wires on Jonathan Lane in Mansfield were downed by thunderstorm winds, causing $10,000 in damages. Trees and wires on Westwood Road and Codfish Falls Road in Storrs were downed by thunderstorm winds, causing $10,000 in damages.

October 8, 2014: Thunderstorm winds downed trees and wires on Liberty Street in Southington. $10,000 in property damage was reported.

June 23, 2015: Showers and thunderstorms occurred across southern New England. Many of these thunderstorms became severe, producing strong to damaging winds. Trees, utility poles, and wires were downed at the intersection of Russell Road and Route 10, causing $40,000 in damage. Trees and wires were downed on Chestnut Hill Road, Maston Hill Road, and Clark Hill Road, causing $15,000 in damage.

February 25, 2016: Severe thunderstorm winds and high winds occurred across Connecticut. Wind gusts up to 68 mph were recorded at Hartford-Brainard Airport. Several tree limbs in New Britain were downed by severe thunderstorm winds, causing $2,000 in damages. Trees and wires were downed throughout South Windsor, with several roads closed due to this damage including Ellington Road between Pierce Road and Deming Street and Niederwerfer Road at the East Windsor town line, and $30,000 in damages occurred. Multiple large branches, small trees, and wires were downed in the eastern part of Enfield, and $5,000 in damages occurred. Power lines on Newbury Street and a large limb and wires on Grandview Terrace in Hartford were downed by severe thunderstorm winds, and $5,000 in damages occurred. Trees and wires on Hubbard Road in Hartford were also downed, causing another $10,000 in damages. A tree and wires on Forest Valley Road in Hebron were downed by severe thunderstorm winds, causing $5,000 in damages. Trees and wires were downed by severe thunderstorm winds in Tolland, causing $10,000 in damages. Power lines on Anthony Road between Virginia Lane and Rhodes Road in Tolland were downed by thunderstorm winds, causing $5,000 in damages. Wires at the intersection of Stone House Road and Old Eagleville Road in Coventry were downed, and $5,000 in damages occurred. An amateur radio operator recorded a wind gust of 75 mph on their home weather station in Glastonbury. A tree and wires on Grist Mill Road at Route 83 in Glastonbury were downed, causing $5,000 in damages. A tree and wires were downed in Andover, causing $5,000 in damages. Trees and wires in East Windsor were downed, causing $10,000 in damages. Trees and wires in Stafford were downed, causing $10,000 in damages.

May 15, 2018: According to the *Hartford Courant*, two lines of severe thunderstorms produced damaging tornadoes, high winds, and hail in Connecticut. At least two people were killed, and many more were injured due to falling trees. Nearly 122,000 people lost power throughout Connecticut, and 17 state roads were closed. Although damage was greatest in western Connecticut, damage extended across Hartford and Tolland Counties into Windham County. Baseball-size hail was reported in some parts of northern Connecticut. According to WFSB Channel 3, barns were reported collapsed on South Street in Coventry, and an oak tree crashed through the roof of a home.

July 17, 2018: According to the NCEI Storm Events database, a thunderstorm crossing Farmington, New Britain, and Stafford Connecticut brought a tree and wires down on Colton Street (Farmington), a tree down on Reservoir Road (Farmington), a tree down on wires on Slater Street (New Britain), and a tree down on wires on Diamond Ledge Road (Stafford).

August 2, 2018: According to the NCEI Storm Events database, thunderstorm winds in Suffield brought a tree down on wires on Suffield Street, and a tree down on a house on Hickory Street. $5.5 million dollars in property damage were reported (although this may be a data entry error given the magnitude of the claim). Damage and power outages were also reported in West Granby and Enfield.

July 31, 2019: According to the NCEI Storm Events database, numerous trees and wires were downed on Albany Avenue in West Hartford, leading to $8,000 in reported property damages.

August 21, 2019: According to the NCEI Storm Events database, scattered severe thunderstorms in Manchester led to trees down on a house on Pearl Street, a tree down on Bissell Street, wires down at Bissell Street at Spruce Street, power lines down on Summit Street, large branches down on wires on Florence Street, and a branch down on wires on Clinton Street.

July 23, 2020: According to the NCEI Storm Events database, slow-moving thunderstorms impacted multiple communities in the CRCOG region. In Windsor Locks, cable wires were down on West Street. In Vernon, three trees were down on Grandview Terrace, near the Rockville line. Also, a tree was down on Grove Street. In Tolland, trees and wires were down on both Grandview Street and Weigold Road. In Farmington, lightning struck a pole on Main Street, bringing down the pole and wires. In Canton, trees and power lines were down on Freedom Drive and Powder Mill Road. Also the public reported 6 to 8 trees down on their property at an unspecified location in Canton. In Mansfield, a tree and wires were down on Mansfield City Road. Also, a large tree and wires were down on Puddin Lane. $10,000 in property damage was reported.

October 7, 2020: According to the NCEI Storm Events database, a squall line formed in New York State then raced eastward in the late afternoon and early evening, gathering strength as it raced across Massachusetts, northeast Connecticut, and northern Rhode Island. Hundreds of thousands of people were left without power in southern New England, as there was widespread tree and power line damage from winds generally gusting to between 50 and 80 mph. The Storm Prediction Center officially classified it as a derecho. In the CRCOG region, multiple communities were impacted. In Enfield, multiple trees were downed at several locations in town. In Somers, multiple trees were down in several locations across the town. In Windsor Locks, the ASOS at Bradley International Airport (KBDL) measured a wind gust to 64 mph.

November 15, 2020: According to the NCEI Storm Events database, a warm front moved through southern New England in the evening, followed by strong to damaging wind gusts. A cold front then moved through late in the evening, accompanied by a fine line of thunderstorms, which also produced some damaging winds. Damages were reported in Hartford, Coventry, Tolland, Newington, Somers, Bloomfield, Vernon, and Stafford.
April 21, 2021: According to the NCEI Storm Events database, a cold front moving into southern New England produced a line of severe thunderstorms late in the afternoon, across portions of northern CT and western-central MA. In Simsbury a tree was down on a house on The Butterchurn. In Granby a tree was down on Notch Rd. Three miles northwest of Suffield, power poles were snapped and 3 inch tree limbs were down.
In Enfield a tree was down on wires on George Washington Rd. Over $10,000 in damages were reported.

June 29-30, 2021: According to the NCEI Storm Events database, oppressive heat and humidity and strong low level lapse rates created the environment for scattered severe thunderstorms to form across portions of Massachusetts and northern Connecticut. In Enfield, a large tree was down on a house. Two people had to be freed from the house and were transported to a hospital. In Somers, trees and wires were down on Maple Street near the Enfield town line. In Tolland, trees and wires were down on Rhodes Road. In Bolton, wires were down on Route 44. In Ellington, a tree was down on wires on Maple Street. Nearly $20,000 in damages were reported.

July 6-7, 2021: According to the NCEI Storm Events database, a cold front moving into a hot and humid air mass triggered severe thunderstorms across portions of MA and northern CT. In Suffield, trees were down on Warnertown Road. In Enfield, a tree was down on a house on Belle Ave. Another tree fell on a house on Taylor Road. In West Hartford, trees and wires were down on Farmington Avenue at Everett Avenue. Trees and wires

were also down on Mountain Road. In Ellington, a tree and wires were down on Standish Road and a tree was down on Pinnacle Road. In Canton, a tree was down onto a house on Cherry Brook Road. In Suffield, power lines were down on Route 75. In Manchester, a tree was down on I-291 at Route 384. In South Windsor, a large tree was down on Pleasant Valley Road. In Somers, a tree and wires were down on Hall Hill Road. In Bolton, a large tree was down on Route 85 at Riga Lane. In Stafford, trees and wires were down on New City Road. In Columbia, trees and wires were down on Old Willimantic Road. In Storrs, multiple trees and wires down on Rockridge Road at Route 195. A wind gust to 61 mph was recorded on the ASOS at Bradley International Airport (KBDL) in Windsor Locks. Over $20,000 in damages were reported.

August 12, 2021: According to the NCEI Storm Events database, excessive Heat Warnings were in effect across much of southern New England with temperatures well up into the 90s and dewpoints in the mid 70s. Very high CAPE values led to the development of late afternoon and evening severe thunderstorms in portions of western and central Massachusetts and northern Connecticut. In Enfield, six power poles were blown down on South Street, leading to $20,000 in reported damages. In Willington, trees were down on Eldredge Mills Road.

November 13, 2021: According to the NCEI Storm Events database, a fast-moving cold front combined with a potent short-wave trough lifting northeastward across western and northern New England to produce severe thunderstorms across southern New England. Despite dewpoint temperatures only in the 30s and 40s, the cold pool aloft created instability and there was very strong low-level helicity. The result was an unprecedented outbreak of tornadoes across Long Island, Connecticut, and Rhode Island. In Windsor Locks at 404 PM EST, the ASOS at Bradley International Airport (KBDL) recorded a gust to 47 knots. However, the Bradley Weather Contract Observer Supervisor estimated that a gust to 70 knots occurred within one-half mile of the ASOS. A small brick wall just outside of the Signature building got completely blown down and flattened. There was also some structural damage to the front of the building. A small airplane that was parked on the ramp got blown and moved onto the grass. The top part of their backup rain gauge, the piece which funnels the precipitation into the collection tube, got torn off of the metal can and it blew completely away. The wind also had picked up something and slammed it into their metal precipitation can, causing a three-inch dent in the can. In Marlborough, a tree and power lines were down on Walker Lane at Pettengill Road. In Coventry, a tree was down on Plains Road. In Storrs, a tree and wires were down on Jim Calhoun Way. Over $10,000 in damages were reported.

July 12, 2022: According to the NCEI Storm Events database, an upper level short wave trough moving through northern New England combined with an advancing cold front to produce severe thunderstorms in the late afternoon and evening hours. Despite low K Indices and dry air aloft, the storms managed to strengthen and the dry air helped enhance the severe wind gusts. The storms mainly impacted areas from western MA east-southeastward into northern CT and northern RI. In Enfield at 614 PM EDT, police reported a tree was down on Mathewson Avenue. Also in Enfield, at 616 PM EDT, amateur radio operators reported a large tree was down on Bailey Road. In Windsor Locks, a house on Juniper Drive had a fire in the attack and in the walls, likely due to a lightning strike. In East Windsor, a tree and wires were down on Holcomb Terrace. In Tolland, the Fire Dept. reported a tree down on wires on Pilgrim Drive. In Tolland, the Fire Dept. reported a tree and wires down at Old Stafford Road and Curtis Drive. Over $10,000 in damages were reported.

July 14, 2022: According to the NCEI Storm Events database, a weak cold front triggered isolated severe thunderstorms in eastern Connecticut during the early evening. In Columbia, a billboard was blown down on Route 66 East. Trees were downed on Cherry Valley Road, Flanders River Road, Cards Mill Road, and Old Willimantic Road. A tree and wires were down on both Newberry Road and on Devonshire Lane, per the Fire Department. $30,000 in property damages were reported.

August 7, 2022: According to the NCEI Storm Events database, heat and humidity, with CAPE of 2500 north of the Mass Pike but little other forcing, led to scattered severe thunderstorms over eastern Massachusetts and far northern Connecticut in the late afternoon and early evening. In Suffield, a tree fell on two cars on Barndoor Hills Drive, leading to $10,000 in reported damages.

August 26, 2022: According to the NCEI Storm Events database, a cold front moved into a warm and humid air mass, triggered scattered severe thunderstorms in southern New England during the mid and late afternoon. Impacts were reported in East Windsor, East Granby, Enfield, Windsor, Vernon, Tolland, Coventry, and Hebron. Approximately $20,000 in damages were reported.

July 16, 2023: According to the NCEI Storm Events database, a deep longwave trough, south-southwest flow at all levels, and the development of a QLCS (quasi-linear convective system) created all the ingredients for a widespread and substantial flash flood event across much of southern New England. In Rocky Hill, a large tree was uprooted. In Manchester, trees were down on wires in multiple locations. In Glastonbury, a tree and wires were down on Naubuc Avenue. In Wethersfield, several small trees were uprooted, flashing was ripped off a building, and a large bronze landscaping piece was tipped over on Silas Deane Highway. In Tolland, trees were down on wires on an unspecified street. Over $14,000 in damages were reported.

July 27, 2023: According to the NCEI Storm Events database, a potent mid level shortwave moved in from the Great Lakes bringing widespread wind damage. In Simsbury, a tree was down on Corey Rd. In West Hartford, a tree was down on wires and a utility pole was snapped. In Farmington, wires were down on Rt. 4 and New Britain Ave. In South Windsor, power lines were down on the 100 block of Oak St. In Columbia, a 2 inch diameter tree limb snapped from the top of a tree and a tree was down on Old Willimantic Road. Another tree was down on wires on Erdoni Road in Columbia, and there was another tree and wires were down on Rt. 87 and on Lake Rd. Over $5,000 in damages were reported.

Probability of Future Events

According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, it is estimated that the state will experience one to two tornado events per year, with the northwest area of the state, Litchfield and Hartford Counties, having the highest historical incidences of tornadoes; these areas therefore may be considered to have a higher risk for the occurrence of future tornadoes. Based on the data presented in Table 124 of the state plan for Hartford and Tolland Counties, Hartford County could experience 0.25 tornado events per year, while Tolland County could experience 0.21. In other words, the Capitol Region could experience roughly one tornado every 4 years. NOAA states that climate change has the potential to increase the frequency and intensity of tornadoes, so it is possible that the pattern of occurrence in Connecticut could change in the future.

The 2023 State Natural Hazard Mitigation Plan update notes that thunderstorms typically occur on 18 to 27 days each year in Connecticut, with a statewide average of 9.34 lightning density events/km2/year. Hartford and Tolland Counties have the highest density of lightning strikes in the state. According to the NCEI, there have been 27 days with lightning strike events in Hartford and Tolland Counties since 1996, with no associated deaths and 16 associated injuries. According to the CDC there have only been 2 lightning-related fatalities in the entire state of Connecticut between 2006 and 2021. On June 8, 2008, lightning struck a pavilion at Hammonasset Beach in Madison, injuring four and killing one. On May 8, 2010, lightning struck three men fishing on a jetty at Seaside Park in Bridgeport, killing one and injuring two.

NOAA reports that there are 10 downburst reports for every tornado report in the United States. This implies that there are approximately 10,000 downbursts reported in the United States each year and further implies that downbursts occur in approximately 10% of all thunderstorms in the United States annually. This figure suggests that downbursts are a relatively uncommon yet persistent hazard.

Hailstorms typically occur in at least one part of Connecticut each year during a severe thunderstorm. According to the NCEI, there has been a total of 107 days with a hail event in Hartford and Tolland Counties since 1956.

Impacts to Community Assets

While Connecticut clearly faces some risk from tornadoes, the nature of the storms makes them unpredictable. Tornadoes can strike with very little warning; cause significant to catastrophic damage to homes, vehicles, and businesses; and result in significant injury and death. All towns in the region share equal vulnerability to these events (although Hartford County towns are likely to be at higher risk due to a slightly increased frequency of occurrence), and although property destruction may be unavoidable, loss of life can be minimized through efficient, coordinated response. The more populated areas in the Capitol Region are more likely to experience damage and casualties than the less densely populated communities.

Although impacts to Connecticut and the Capitol Region from tornadoes are infrequent, tornadoes that have struck the area have had devastating impacts. According to the NCEI Database, three people have died as a result of tornadoes since 1951 in Hartford County, and 520 people have been injured in both Hartford and Tolland Counties.

Annualized losses due to tornadoes in each community were prepared based on the FEMA National Risk Index and NCEI losses from the last 20 years, with a wide range of results. Based on the FEMA National Risk Index, the annualized loss estimate for the Capitol Region is $9,065,692. Based on the NCEI, the annualized loss estimate for the Capitol Region is $939,245. Annualized losses for each community based on each of these data sources are presented in each municipal annex. Note that this method does not take into account site-specific details or particular tornado damages that may have directly affected a particular community in the historic record. Therefore, these annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall vulnerability of the Capitol Region to tornadoes.

Table 26. Annualized Loss Estimates due to Tornadoes

Hazard	Source	Average Annualized Losses (AAL)
Tornados/High Winds	NCEI	$939,245
	NRI	$9,065,692

All areas of the Capitol Region communities are susceptible to thunderstorms. Fortunately, in Connecticut, injury and death due to thunderstorm winds is relatively uncommon. Although thunderstorm damage is expected each year, the majority of events do not cause measurable damage. Most thunderstorm damage is associated with downbursts, which typically have a greater effect on elevated areas such as hilltops, ridges, and "wind corridors" within communities. Areas with more trees in close proximity to power lines and structures are more vulnerable to the effects of thunderstorm damage than more urban areas.

While crops are the major victims of hail, larger hail is also a hazard to people, vehicles, and property. Lightning strikes are relatively infrequent in Connecticut but can cause permanent damage or death to a person along with starting fires. Lightning can also occur on any day even if a thunderstorm is not

occurring. In general, the economic impact of thunderstorms is much lower than that of tropical cyclones but still significant because the damage is expected to occur each year.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to tornadoes and other severe weather. As an initial screening of exposure to hazards, areas of risk (in this case, the entire CRCOG region) 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 27.

Table 27. Exposure analysis for tornadoes in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Tornado Risk Area	Approx. Appraised Parcel Value in Tornado Risk Area	Number of Historical Resources (SHPO) in Tornado Risk Area	Approx. Appraised Parcel Value of SHPO in Tornado Risk area	Number of Critical Facilities in Tornado Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Tornado Risk area
Andover	$219,735	1,704	$374,429,046	40	$8,789,414	2	$439,471
Avon	$418,390	7,932	$3,318,671,261	11	$4,602,292	13	$5,439,073
Berlin	$305,900	9,017	$2,758,301,127	91	$27,836,908	3	$917,700
Bloomfield	$321,812	8,510	$2,738,623,920	5	$1,609,062	9	$2,896,312
Bolton	$238,182	2,366	$563,537,451	9	$2,143,634	6	$1,429,089
Canton	$343,744	3,964	$1,362,602,800	289	$99,342,131	5	$1,718,722
Columbia	$270,752	2,615	$708,015,200	37	$10,017,806	4	$1,083,006
Coventry	$193,998	6,610	$1,282,324,786	126	$24,443,710	8	$1,551,982
East Granby	$258,272	2,653	$685,195,086	111	$28,668,170	8	$2,066,174
East Hartford	$282,361	14,331	$4,046,522,571	226	$63,813,698	9	$2,541,253
East Windsor	$235,621	4,960	$1,168,678,871	25	$5,890,519	9	$2,120,587
Ellington	$302,974	6,100	$1,848,139,057	65	$19,693,285	5	$1,514,868
Enfield	$257,182	16,651	$4,282,334,586	552	$141,964,368	15	$3,857,727
Farmington	$412,953	11,221	$4,633,746,946	357	$147,424,263	15	$6,194,297
Glastonbury	$357,701	15,300	$5,472,826,486	457	$163,469,392	36	$12,877,239
Granby	$252,015	5,167	$1,302,160,286	83	$20,917,225	7	$1,764,103
Hartford	$255,726	19,160	$4,899,719,451	4,237	$1,083,513,117	10	$2,557,265
Hebron	$284,390	4,011	$1,140,687,600	51	$14,503,881	4	$1,137,559
Manchester	$354,302	16,252	$5,758,122,239	1,301	$460,947,393	10	$3,543,024
Mansfield	$301,081	4,640	$1,397,014,420	106	$31,914,554	8	$2,408,646
Marlborough	$281,882	2,732	$770,100,857	0	$0	6	$1,691,290
New Britain	$201,446	15,736	$3,169,958,733	129	$25,986,571	8	$1,611,570
Newington	$271,063	12,416	$3,365,524,343	21	$5,692,333	10	$2,710,635
Plainville	$256,639	7,472	$1,917,603,547	72	$18,477,979	5	$1,283,193
Rocky Hill	$548,247	4,922	$2,698,472,686	277	$151,864,473	10	$5,482,472

Town	Average Appraised Parcel Value	Parcel Count in Tornado Risk Area	Approx. Appraised Parcel Value in Tornado Risk Area	Number of Historical Resources (SHPO) in Tornado Risk Area	Approx. Appraised Parcel Value of SHPO in Tornado Risk area	Number of Critical Facilities in Tornado Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Tornado Risk area
Simsbury	$298,583	10,795	$3,223,206,986	153	$45,683,249	14	$4,180,167
Somers	$291,809	3,865	$1,127,841,671	181	$52,817,424	14	$4,085,326
South Windsor	$315,866	11,129	$3,515,275,849	210	$66,331,919	13	$4,106,262
Southington	$294,296	18,395	$5,413,572,556	18	$5,297,326	10	$2,942,959
Stafford	$183,379	5,384	$987,314,543	3	$550,138	6	$1,100,276
Suffield	$289,760	6,417	$1,859,390,877	184	$53,315,867	13	$3,766,882
Tolland	$243,246	6,562	$1,596,182,814	49	$11,919,073	12	$2,918,957
Vernon	$337,929	7,990	$2,700,053,470	861	$290,956,951	10	$3,379,291
West Hartford	$455,991	19,953	$9,098,386,094	327	$149,109,019	14	$6,383,872
Wethersfield	$298,996	9,958	$2,977,402,886	1,074	$321,121,781	7	$2,092,973
Willington	$219,478	2,453	$538,379,359	66	$14,485,543	14	$3,072,691
Windsor	$314,027	12,177	$3,823,906,683	127	$39,881,428	14	$4,396,378
Windsor Locks	$340,933	4,391	$1,497,034,814	6	$2,045,595	7	$2,386,528
Total	**$11,310,662**	**325,911**	**$100,021,261,958**	**11,937**	**$3,617,041,492**	**373**	**$115,649,817**

Severe Winter Storms (Climate Driver: Extreme and Severe Storms)

Winter storms, consisting of snow, ice, wind, and other cold-weather precipitation, are a regular occurrence in Connecticut. Temperatures during the winter months typically drop below freezing at night and occasionally fall below zero degrees Fahrenheit. Some winter storms are mild and of little consequence. However, others, including blizzards, ice storms, and nor'easters, cause large-scale and regular disruptions by restricting transportation, causing the loss of electricity, and through direct physical damages due to wind, snow, sleet, ice, and bitter cold.

Location

All areas of the Capitol Region communities are susceptible to winter storms. Some areas, particularly those at higher elevations, experience more frequent winter storms than those at lower elevations. In addition, low-lying areas (such as floodplains) can experience additional impacts of winter storms such as flooding.

Extent

According to NOAA, there are several types of winter storms and associated precipitation conditions.

- **Blizzards** include winter storm conditions of sustained winds or frequent gusts of 35 mph or greater that cause major blowing and drifting of snow, reducing visibility to less than one-quarter mile for 3 or more hours. Extremely cold temperatures and/or wind chills are often associated with dangerous blizzard conditions.

- **Freezing Rain** consists of rain that freezes on objects, such as trees, cars, or roads, and forms a coating or glaze of ice. Temperatures in the mid to upper atmosphere are warm enough for rain to form, but surface temperatures are below the freezing point, causing the rain to freeze on impact.

- **Ice Storms** are forecast when freezing rain is expected to create ice buildups of one-quarter inch or more that can cause severe damage.

- **Nor'easters** are the classic winter storm in New England caused by a warm, moist, low pressure system moving up from the south colliding with a cold, dry, high-pressure system moving down from the north. The nor'easter derives its name from the northeast winds typically accompanying such storms, and such storms tend to produce a large amount of rain or snow. They usually occur between November 1 and April 1 of any given year, with such storms occurring outside of this period typically bringing rain instead of snow.

- **Sleet** occurs when raindrops freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. It can accumulate like snow and cause a hazard to motorists.

- **Snow** is frozen precipitation composed of ice particles that forms in cold clouds by the direct transfer of water vapor to ice.

- **Winter Storms** are defined as heavy snow events that have a snow accumulation of more than 6 inches in 12 hours or more than 12 inches in a 24-hour period.

Until recently, the Northeast Snowfall Impact Scale (NESIS) was used by NOAA to characterize and rank high-impact northeast snowstorms. This ranking system has evolved into the currently used Regional Snowfall Index (RSI). The RSI ranks snowstorms that impact the eastern two thirds of the United States, placing them in one of five categories: Extreme, Crippling, Major, Significant, and Notable. The RSI is based on the spatial extent of the storm, the amount of snowfall, and the juxtaposition of these elements with population based on the 2000 census. RSI differs from NESIS in that it uses more refined geographic areas to define the population impact, resulting in a more region-specific analysis of a storm's impact. The use of population in evaluating impacts provides a measure of societal impact from the event. The table below presents the RSI categories, their corresponding RSI values, and a descriptive adjective.

Table 28. Regional Snowfall Index (RSI) Categories

Category	RSI Value	Event Description
1	1 to 3	Notable
2	3 to 6	Significant
3	6 to 10	Major
4	10 to 18	Crippling
5	18+	Extreme

Source: NOAA

RSI values are calculated within a Geographic Information System (GIS). The aerial distribution of snowfall and population information are combined in an equation that calculates the RSI score, which varies from around one for smaller storms to over 18 for extreme storms. The raw score is then converted into one of the five RSI categories. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers.

In addition to snowfall, the wind associated with winter storms heightens the effect of cold temperatures, leading to increased risk of frostbite. The National Weather Service Wind Chill Chart (Figure 13) demonstrates the thresholds for frostbite at varying level of wind and cold temperatures.

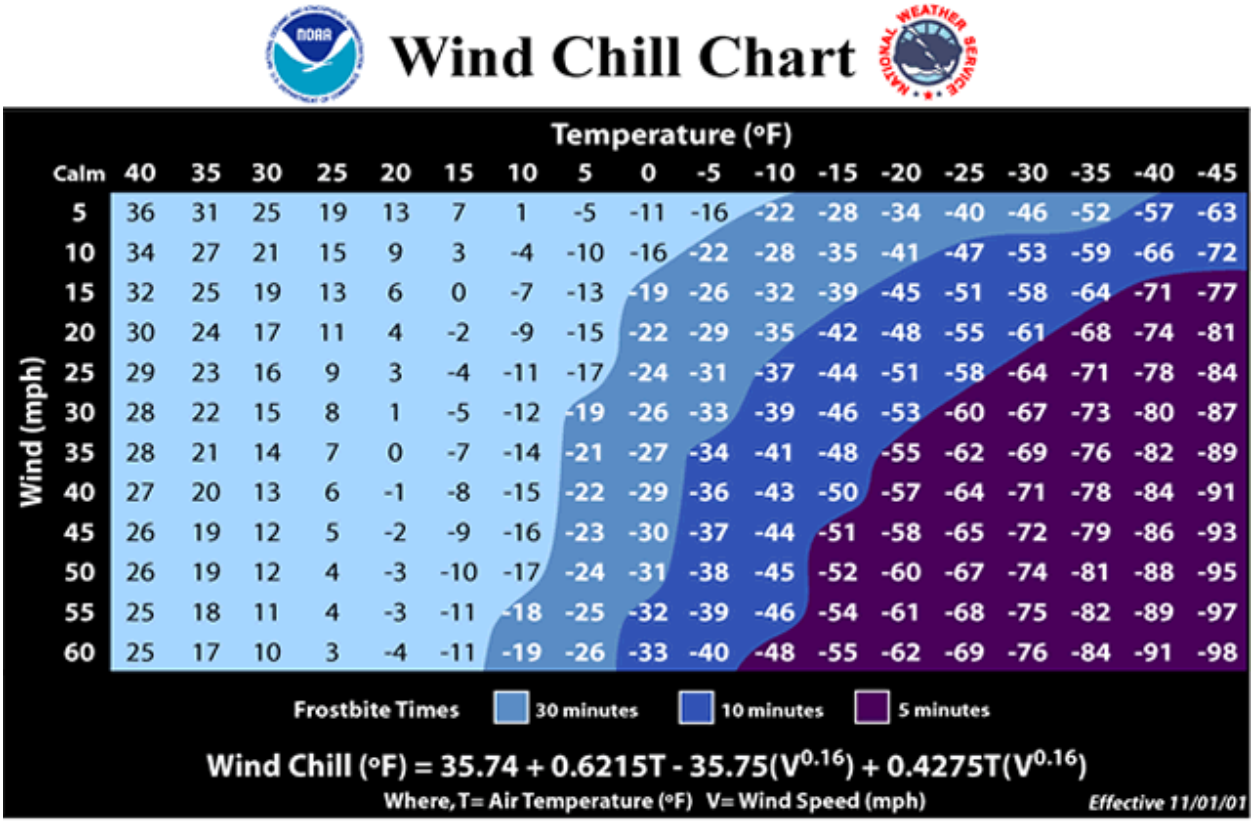


Figure 13. Wind Chill Chart (Source: National Weather Service).

Previous Occurrences

According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, Hartford and Tolland Counties receive, on average, 2.5 to over 4 feet of snowfall each year, although snowfall amounts vary widely from year to year and can vary dramatically across the region in any given storm. Severe winter

storms can result in damage to buildings and infrastructure, loss of life, and disruptions to regional transportation and communication systems.

More than a third of the federal disaster declarations for Connecticut since 1954 have followed major winter or snowstorms. Federal assistance is frequently used to offset the snow/ice removal costs the state and municipalities incur. For example, a federal emergency was declared for the February 11-12, 2006, snowstorm in several counties in Connecticut (including Hartford and Tolland) to help share the costs of snow removal. FEMA obligated over $74 million in Public Assistance funds to Connecticut to reimburse state agencies, local governments, and nonprofit organizations for costs associated with the January 11-12, 2011, snowstorm and Storm Alfred in October (see Table 7). The frequency, intensity, and timing of winter storms dramatically impacts snow removal budgets. Storm Alfred was particularly costly for municipalities because of the heavy debris loads resulting from the high number of fully leafed trees downed in this storm. Municipalities also incur higher labor costs for snow removal on weekends and holidays.

Notable winter storms such as the blizzards of 1888, 1978, and 2013 delivered nearly an entire season's worth of snow in single events to the region. The blizzard of 1888, called the Great White Hurricane, occurred on March 11 through 14. This blizzard produced over 50 inches of snow in some parts of the state and caused over 400 deaths along the East Coast. The blizzard of 1978, which occurred on February 6, paralyzed the state for 3 days and resulted in four Connecticut deaths. The blizzard caused widespread damage throughout New England, resulting in 99 deaths and $520 million in damages. This storm is rated 4th overall in the RSI as an "Extreme" storm. Ice storm Felix which occurred on December 18, 1973, was Connecticut's most severe ice storm and resulted in two deaths and widespread power outages.

Other notable winter storms in Connecticut include nor'easters in 1979, 1983, 1988, 1992, 1996, 2003, October 2011's Storm Alfred, Winter Storms Nemo (2013), Juno (2015), and Anna (2016), and the Blizzard of January 29, 2022. Following are descriptions of some of the winter storms that have hit the region in the last 30 years and their impacts from the National Weather Service's Storm Events Database (unless otherwise noted). As is evident from these descriptions, individual winter storm events need not be unusually intense to cause damages and even loss of life.

March 13-14, 1993: A massive, powerful storm dubbed the "Storm of the Century" caused "whiteout" blizzard conditions stretching from Jacksonville, Florida, into eastern Canada and affected 26 states, producing 24 inches of snow in Hartford and up to 21 inches of snow in New Haven County. A total of 40,000 power outages and $550,000 in property damage was reported throughout Connecticut, and the state received a federal emergency declaration. The storm had an RSI rating of "Extreme" and is the 2nd highest ranking storm recorded by RSI.

January 7, 1996: This storm was one of the most significant winter storms to hit southern New England in the past 20 years and was named the "Blizzard of '96" from the middle Atlantic states to southern New England. However, by National Weather Service definition, Winter Storm Ginger did not bring actual blizzard conditions to the state. Snowfall across the north and northeast portions of the state ranged from 15 to 23 inches. In Hartford County, Bradley International Airport recorded 18.2 inches. New Britain had 18 inches, and Wethersfield had 15.3 inches. In Tolland County, 22.5 inches were recorded in Mansfield. This storm disrupted transportation systems and closed schools and businesses. A barn roof collapsed in Simsbury within a week or so following this very heavy snowfall. The storm had an RSI rating of "Extreme" and is the 3rd highest ranking storm recorded by RSI.

March 2, 1996: A total of 6 to 7 inches of snow fell across the northern part of the state. There were 391 skidding accidents reported to the state police. Three people were killed and dozens injured on the icy roadways. A number of state highways were closed for a time due to the numerous accidents and very slippery conditions, including Route 30 in Tolland and Route 195 in Mansfield.

December 6, 1996: An intensifying storm system moving eastward from the southeast tip of Long Island caused heavy, wet snow across northern Connecticut. The greatest totals were reported from the higher elevations. Several thousand electric customers lost power, including a total of 1,700 in Avon. In Simsbury, a town-owned tobacco barn collapsed under the weight of the snow. The barn was in rough shape to start with, but the collapse amounted to approximately $37,000 according to the Simsbury Assessors' Office. Road conditions became very poor as the snow continued to fall throughout the day.

December 7, 1996: This storm brought heavy, wet snow and resulted in widespread power outages. There had been another heavy, wet snow event the day before, too. A total of 225,000 electric customers lost power statewide, including 100,000 in central Connecticut and 95,000 in the eastern part of the state. Power remained out for several days despite the efforts of dozens of electric company repair crews, many from out of state. Many roads remained unplowed until the utility companies could clear away fallen wires. A firefighter died instantly while on duty in Somers when he came in contact with a 23,000-volt power line that had been knocked down by the heavy snow. Route 44 was closed for 15 hours due to a fallen power line. Up to 22 shelters were opened across the region, and many residents left their unheated and darkened homes. Many vehicles and homes were damaged by falling tree limbs, and damage was estimated in the millions of dollars.

January 24, 1997: Light freezing rain created very treacherous driving conditions and caused numerous skidding accidents, including many multiple-car accidents. State police at the Tolland barracks reported 60 to 80 accidents, mostly minor, late Friday night, January 24. Several bridges had to be closed in the Hartford area when more than a dozen cars collided. Several other highways also were closed in northern Connecticut due to icing conditions. A spotter in Windsor reported 1/4" to 1/3" of ice on trees during the early morning hours on January 25.

December 20, 1999: Light freezing rain fell in the deeper valleys of northern Connecticut as rain fell into a shallow layer of below-freezing air at the surface. The resultant light coating of ice formed "black ice" on many roadways, which caused many accidents. It was estimated that there were nearly 100 accidents, mostly fender benders, throughout Hartford, Tolland, and Windham Counties as a result of the slick driving conditions.

November 26, 2000: Low pressure moving north up the mid Atlantic coast brought a period of light freezing rain to much of northern Connecticut. Ice accretion was under one quarter inch, but the freezing rain left black ice on roads, causing dozens of accidents at the end of the Thanksgiving weekend, usually a busy travel day. Temperatures warmed into the 40s by late morning, ending the danger of icing.

February 5, 2001: A major winter storm brought heavy snow and strong winds to northern Connecticut. The highest snowfall totals, between 12 and 24 inches, were reported in Hartford County. Totals of 12 to 18 inches were widely observed in Tolland and Windham Counties. Several minor accidents were attributed to the storm, and traffic in greater Hartford was brought to a standstill during the height of the storm. Several thousand electric customers were left without power.

November 16, 2002: A major ice storm caused significant damage in north central Connecticut. There were numerous reports of downed trees, limbs, and power lines as a result of one-half to three-quarters of an inch of icing. An estimated 100,000 customers in Hartford and Tolland Counties were left without power because of the storm. Damage was especially severe in western Hartford County where entire communities such as Hartland, Granby, Simsbury, and Canton were left without power for as much as 5 days. Sections of Canton were completely isolated due to downed trees and wires according to local police. The damage from the ice storm was compounded by high winds 1 day later. Gusts as high as 50 mph hampered the cleanup effort and downed more trees and branches that were weighted down by ice. Total damage from the storm in Hartford

County was estimated at 2 million dollars. The damage was less severe in neighboring Tolland County, but there were still many reports of downed trees, limbs, and wires county wide. Total damage was estimated at half a million dollars.

February 17, 2003: A heavy snowstorm caused near-blizzard conditions and produced 24 inches of snow in areas of the state. The storm had an RSI rating of "Crippling" and is the 8th ranked winter storm by RSI. Connecticut received a federal emergency declaration.

January 8, 2005: Low pressure quickly strengthened as it passed south of New England and brought a mix of snow, sleet, and freezing rain to much of interior southern New England. North central Connecticut was especially hard hit by freezing rain where as much as one half inch of glaze brought down trees, tree limbs, and power lines. There was no estimate of how many customers lost power, but dozens of accidents were reported as a result of icy roads.

March 8, 2005: Low pressure strengthened rapidly off the Delaware coast and tracked southeast of New England, bringing heavy snow and high winds to parts of northern Connecticut. Several highways, including Interstate 84, were described by state police as "barely passable" during the height of the storm. In Hartford, downtown streets were jammed with cars as many businesses and state offices closed early. Commuting times were doubled or tripled in many locations.

February 11, 2006: The "Blizzard of 2006" was a nor'easter that began on the evening of February 11, 2006. It dumped heavy snow across the northeast United States from Virginia to Maine through the early evening of February 12 and ended in Canada on February 13. Hartford received a total of 21.9 inches of snow — the second largest snowfall since 1906 — and West Hartford received 27 inches of snow. Despite the large amounts of snow, there were only isolated individual power outages. Bradley International Airport was closed for several hours. While Connecticut was one of the hardest hit areas, the state was well prepared for the storm and managed to avoid major problems. At the storm's onset, Governor M. Jodi Rell ordered all tractor-trailer trucks off the state's highways to facilitate the efforts of highway crews with snow removal. Connecticut mobilized 2,500 state-owned and privately contracted snowplows to keep state highways open during the storm. The state's 169 cities and towns employed hundreds of additional plows to keep local roads passable.

December 2, 2007: A strong low-pressure system moved across southern New England producing wintry precipitation across much of northern Connecticut. Ice accretion downed tree limbs and wires, causing power outages across much of Hartford County.

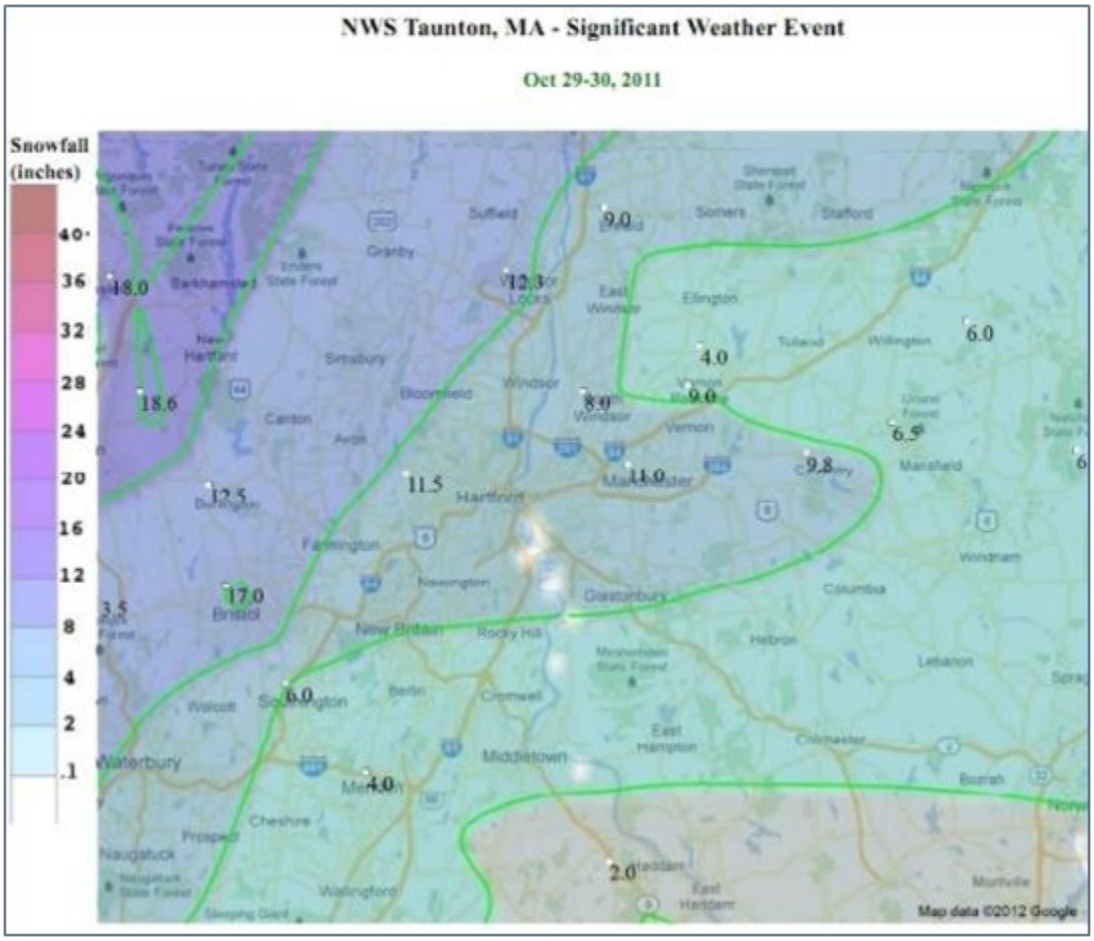
Winter 2010/2011: Significant snowfalls from December 2010 through February 2011 with only brief thaws in between allowed snow to pile up across southern New England, resulting in numerous roof collapses, towns seeking permission to dump excess snow in area rivers and bays, and numerous disruptions to transportation. The first major snowstorm occurred December 26 and 27, 2010, with several other snowfalls following in January. On January 11 and 12, 2011, a developing nor'easter and coastal storm dumped up to 2.5 of snow across Connecticut in a 24-hour period. Twenty-two and a half inches fell at Bradley International Airport, setting a 1-day snowfall record for that location. This was the second major storm of an above-average winter of snowfall. Then on January 26, 2011, a strong low-pressure system moved up the coast and southeast of Nantucket producing up to a foot and a half of snow across Connecticut. Six to 17 inches of snow fell across Hartford County, and 13 to 19 inches fell across Tolland County. Another major storm hit February 1 and 2. Because there was no appreciable melting between storms, roof collapses continued, including 75 structures in Hartford County. Federal assistance was sought by Governor Malloy for costs associated with the January 12 winter storm and its cleanup. It was granted by President Obama for Hartford and Tolland Counties. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private nonprofit agencies incurred expenses of over $3.15 million due to the heavy snowfalls associated with the federally declared disaster. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program. Snow for the winter season totaled 86.4 inches.

Hebron Building Collapse due to Heavy Snow Loads, February 2, 2011
Credit: John Sholtis, WTNH.com

Storm Alfred, October 29, 2011: A rare and historic October nor'easter brought very heavy snow to portions of southern New England on Saturday October 29. Low pressure tracked northeast from the North Carolina coast Saturday morning, rapidly strengthening as it passed well south of Nantucket Saturday evening. As the storm intensified, colder air from aloft was drawn into New England resulting in heavy snow in the interior. The precipitation started as mainly snow early Saturday afternoon across the interior of southern New England although a brief period of rain at the onset was common across the lower elevations. The snow tapered off just after midnight Saturday night in western New England with the last of the precipitation exiting eastern New England Sunday morning. The accumulation of the heavy wet snow on trees and power lines resulted in widespread tree damage and power outages across many communities in central and western Massachusetts, southern New Hampshire, and northeastern Connecticut. Six to 17 inches of snow fell across Hartford County, and 6 to 10 inches of snow fell across Tolland County. Heavy, wet snow fell on foliated trees, breaking branches and downing trees and wires, resulting in widespread power outages that lasted for up to 11 days. This resulted in school closures, and numerous towns cancelled or rescheduled Halloween and trick-or-treating activities. At the peak, 830,000 customers in Connecticut were without power. Over 250 trees and 106 utility poles were downed in Somers. In addition, eight transformers were destroyed and 24 were damaged in Tolland County. A motorist died in a traffic accident in Hebron that was blamed on the road conditions and weather. The Glastonbury Pheasant Farm lost more than 4,000 birds. Throughout Connecticut, 164 AT&T cell phone towers were damaged, resulting in degraded cell phone service until towers could be repaired and power restored. Air travel in and around the Hartford area was disrupted when numerous flights were diverted to Bradley International Airport from the New York City metro area and then power outages affected the airport. Several airplanes were not able to allow their passengers to disembark for 7 hours or more. The Enfield DMV roof was compromised by the heavy snow and was shut down. Both Avon and South Windsor estimated 100,000 cubic yards of debris from fallen trees and power lines. According to the Connecticut Division of Emergency Management and Homeland Security, municipalities and other local and private nonprofit agencies incurred expenses of over $68 million due to Alfred. Most of this expense was due to cleanup efforts associated with the enormous amount of debris generated by the storm. The municipalities and agencies are eligible for reimbursement of 75% of these costs under FEMA's Public Assistance program.

Snow Covered Trees and Streets, Glastonbury, October 30, 2011, CRCOG

October 2011 Storm Cleanup in Windsor, FEMA



Map 9. October 2011 Snowfall Totals Across Central Connecticut
Source: National Weather Service

Manchester Shelter, October 31, 2011, Credit: CTNow

Blizzard of 2013: A massive nor'easter hit the Northeast February 8 and 9 bringing record amounts of snow to Connecticut and other areas in New England. According to NOAA's National Climatic Data Center (http://www.ncdc.noaa.gov/news/evaluating-february-2013-blizzard-regional-snowfall-index), over 49,000 people across a 192-square-mile area (including much of Connecticut) saw 30 inches or more of snow as a result of this storm. According to meteorologist Geoff Fox, the National Weather Service reported snow totals in Hartford County that ranged from 20 inches in East Hartford and Enfield to 33.5 inches in Glastonbury and snow totals in Tolland County that ranged from 25 inches in Vernon to 32.5 inches in Coventry (http://www.geofffox.com/MT/archives/2013/02/09/2013-blizzard-snow-totals-for-connecticut.php). At times, snow fell at a rate of 6 inches per hour. The governor closed limited-access highways on February 8 and all roads on February 9. Cleanup took days and required cities and the State to bring in additional crews and equipment. According to the *Hartford Courant*, the Connecticut DOT brought in 150 additional payloaders to handle the massive accumulations of snow on the roads. The blizzard was also responsible for several deaths in Connecticut including two in Manchester (http://articles.courant.com/2013-02-12/news/hc-weather-snow-connecticut-0208-20130205_1_clear-snow-dannel-p-malloy-asylum-avenue). The Connecticut Department of Agriculture reported that more than 300 agricultural structures partially or completely collapsed (Connecticut Weekly Agricultural Report, February 27, 2013; http://www.ct.gov/doag/cwp/view.asp?a=3243&q=400466).

The following more recent storm descriptions are quoted from the 2023 *Connecticut Natural Hazard Mitigation Plan Update:*

"February 7-8, 2013 "Winter Storm Nemo": On February 7, 2013, a blizzard warning was in effect for Connecticut, and a state of emergency was declared February 8, 2013. The highest amount of snowfall nationally recorded was 40 inches in Hamden, CT. More than 800 National Guard soldiers and airmen were activated in Connecticut, Massachusetts, and New York to support road emergencies.

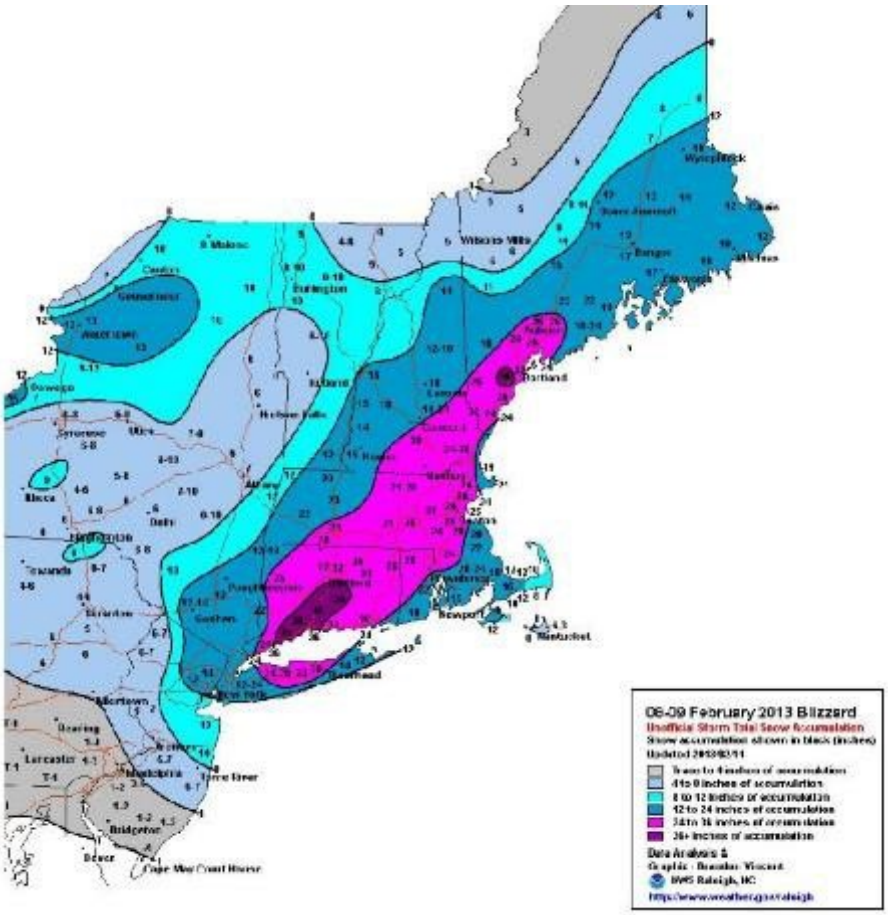
The Blizzard of January 26-27, 2015 "Winter Storm Juno": On January 26, a strong nor'easter brought heavy snow and strong winds to the State. The heaviest snow and strongest winds occurred across eastern Long Island and southeastern Connecticut where up to 2 feet of snow fell, with blizzard conditions observed.

The Blizzard of January 22-24, 2016 "Winter Storm Anna": Low pressure moving across the deep South January 21 - 22 intensified and moved off the Mid Atlantic coast January 23, bringing heavy snow and strong winds to southern Connecticut, and blizzard conditions to coastal locations. Bridgeport ASOS (KBDR) reported blizzard conditions for three hours.197

The Blizzard of February 9, 2017: The day before the blizzard, record warmth was observed across the Tri-State area. Record highs included 62 degrees at Central Park, NY. Temperatures dropped 30-40 degrees within 12-15 hours to the mid-upper 20s during the storm.198 Blizzard conditions occurred across southern Connecticut with heavy snow and strong winds. The blizzard also created delays and cancellations to the region's transportation systems as well as numerous accidents on roadways.199

March 14th, 2017, Nor'easter: Rapidly deepening low pressure tracked up the eastern seaboard on March 14 creating blizzard conditions in New Haven County. Heavy snow and sleet were observed across southern Connecticut. Trees fell onto power lines causing approximately 3,700 power outages due to strong winds and heavy snow. CTDOT reported 10.3 inches of snow and sleet in Milford and 8.8 inches of snow and sleet in New Haven. The Oxford-Waterbury AWOS showed blizzard conditions, with visibility less than one quarter mile in heavy snow and frequent wind gusts over 35 mph March 14.200

January 3-4, 2018 (Bomb Cyclone): The blizzard developed Wednesday, January 3 as a low pressure off the coast of Florida. The rapid intensification of the storm led to heavy snow and blizzard conditions across portions of the region, setting a daily snowfall record for January 4 at Bridgeport, CT (9.0").
The Blizzard of January 29, 2022: A blizzard hit the Northeastern United States on January 29, 2022. Forming from the energy of a mid- to upper-level trough, the system developed into a low-pressure area off the Southeast United States, intensifying as it traveled northeasterly, bringing heavy snowfall blow by high winds to the Northeast and to Connecticut. In Connecticut, the highest snowfalls were in the southeast of the state in areas such as New London and Norwich seeing up to 21 and 22 inches respectively. Bridgeport to the west saw 10.5 inches of snow and Hartford to the north saw 8.5 inches of snow."



Map 10. Blizzard of 2013 Snowfall Totals

Source: National Oceanic and Atmospheric Administration, National Weather Service, Raleigh, North Carolina, taken from http://en.wikipedia.org/wiki/February_2013_nor%27easter

Probability of Future Events

Winter storms of varying levels of severity are fairly common in the region. The 2023 *Connecticut Natural Hazard Mitigation Plan Update* notes that 4.42 annualized winter storm events are expected for both Hartford County and Tolland County. Climate change has the potential to make winter storms less frequent but more intense, with denser wetter snow. These data demonstrate that the Capitol Region communities should expect several heavy snows per year and, therefore, should be adequately prepared for these storms.

Impacts to Community Assets

Impacts from severe winter weather can become dangerous and a threat to people and property. Most winter weather events occur between December and March although in 2011 Connecticut experienced a significant October snowstorm that left much of the state without power for a week. According to NOAA, winter storms were responsible for the death of 55 people in 2022. 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 is a common effect of these types of events. Secondary effects include loss of power and heat and flooding as a result of snowmelt.

While the probability of a winter storm occurring is roughly the same in all parts of the region, the risk of damage will vary depending on infrastructure and population density. There is a high probability for traffic accidents and traffic jams during heavy snow and light icing events. Roads may become impassable, inhibiting the ability of emergency equipment to reach trouble spots and the accessibility of medical and shelter facilities. To a large extent, the areas with the greatest risk of experiencing damage due to winter storms are those with the greatest amount of development and the most extensive networks of roads (which increases the burden of snow removal). Conversely, the travelers who must go through less-developed areas face a potentially greater risk due to the lower density of roads, which provides fewer alternate routes as well as potentially relatively steep topography.

After a storm, snow piled on the sides of roadways can inhibit sight lines and reflect a blinding amount of sunlight. When coupled with slippery road conditions, poor sight lines and heavy glare create dangerous driving conditions. Stranded motorists, especially senior and/or handicapped citizens, are at particularly high risk of injury or death from exposure during a blizzard.

According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, recent climate change studies predict a shorter winter season for Connecticut (by as much as 2 weeks) and less snow-covered days with a decreased overall snowpack. These models also predict that fewer, more intense precipitation events will occur with more precipitation falling as rain rather than snow. This trend suggests that future snowfalls will consist of heavier (denser) snow, and the potential for ice storms will increase. Such changes will have a large impact on how the state and its communities manage future winter storms and will affect the impact such storms have on the residents, roads, and utilities in the state.

Areas with greater levels of development are also at greater risk of business disruptions, loss of life, and damage to structure. Hartford and New Britain have the greatest level of development (with the exception of a few parks, the entire area of each city is developed) and the greatest potential risk. For

example, with more roofs comes more potential for roof collapse. There are also simply more sidewalks to clear, more homes to heat, and more people to protect.

While picturesque, snow and ice can create impassable roads, interrupt utility service, knock down trees and power lines, and isolate people in their homes or workplaces, sometimes without electricity or heat. Melting snow and ice can also cause flooding as can winter rainstorms that hit when the ground is already frozen. The following discussions examine the economic impact of snowstorms on the region.

Municipal Budgets

Snow and ice removal has a tremendous impact on municipal budgets. The impact varies by community; some communities use their own staff to clear roads, which may represent savings but also be inefficient. Other towns hire contractors to remove 100% of the snow and ice. The remainder of towns use a combination of municipal staff and contractors.

The size, scope, and timing of a particular storm can drastically affect a community's annual expenditures. Blizzards in 1888 and 1978 each delivered nearly a season's worth of snow in a single event. Nor'easters in 1979, 1983, 1988, 1992, 1996, 2003, 2005, 2007, 2011, 2013, 2014, and 2017 dropped masses of snow, causing deadly car crashes and widespread blackouts. Even storms that are not unusual can cause damage and loss of life.

Roof Collapse

Heavy snow and ice accumulation bring with it the threat of roof collapse and catastrophic damage to the building's occupants. As seen in the table below, snow alone can put a large burden on roofs; however, when coupled with rain and sleet, this load per square foot increases.

Table 29. The Burden of Snow on a Roof

Type	Equivalent to 1 inch of water	Load per Square Foot	Maximum
Fresh Snow	10-12 inches	5 lbs.	4 ft.
Packed Snow	3-5 inches	5 lbs.	2 ft.

Source: Insurance Institute for Business & Home Safety

Two feet of old snow and 2 feet of new snow could weigh as much as 60 pounds per square foot of roof space, which is beyond the typical snow load capacity of most roofs. One inch of ice is equivalent to 1 foot of fresh snow. A house should be able to support 20 to 25 pounds of snow per square foot (Insurance Institute for Business & Home Safety; https://disastersafety.org/).

The winter of 2011 saw many buildings condemned by snow accumulation, collapsing their roofs. In Southington, several businesses experienced roof collapse including the Home Depot and Country Dog Training. Yarde Metals also had to be evacuated after the roof was damaged.

Road Closures

Like many other types of disasters, winter weather and heavy snowfall can cause localized and widespread road closures. Closures can result from a variety of causes such as poor driving conditions, heavy snow, and drifts as well detritus like fallen trees and power lines. When a blizzard struck on February 8, 2013, Governor Malloy called for a traffic ban on all vehicles for the following day except for

those emergency response and recovery vehicles with the capacity to maneuver in heavy snow. Events with large impacts on transit also have major economic impacts such as preventing employees from reaching work and halting or delaying shipments and deliveries.

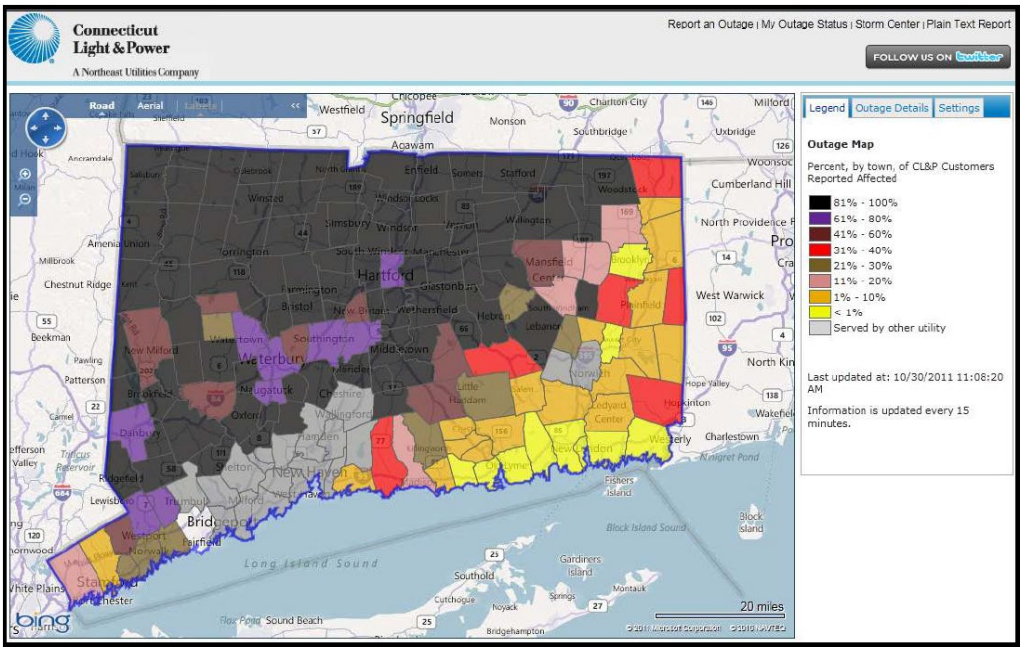
Burst Pipes

Cold and winter weather not only wreaks havoc outside a building but inside as well. Frozen pipes can cause severe damage. A complete ice blockage in a pipe causes freezing and expansion which in turn causes water pressure to increase to the faucet. The increase in water pressure leads to pipe failure. In 2013, frozen and broken water pipes ranked second to hurricanes in terms of both the number of homes damaged and the total amount of damages claimed in the U.S. (Insurance Information Network of California, 2014). While there are few records of burst pipes in the region, in Farmington at the UConn Health Center, a frozen sprinkler pipe burst. This caused extensive damage with water leaking into the main floor, the ground floor and a storage room, and some labor and delivery rooms as well as the newborn nursery (Lank, 2014).

Power Outages

Heavy snow and ice can cause tree limbs to fall, bringing power lines down with them. Winter weather frequently causes significant power outages throughout the state, especially in more rural areas. Urban areas where a greater percentage of power lines are underground are impacted to a lesser degree. Not only are power outages an inconvenience, but they can cause damage to property, disrupt business, and threaten lives if heating systems or medical devices and equipment are impacted.

The snowstorm of October 2011 was particularly impactful. During that storm, more than 80% of the region was without power during peak outages, and outages often lasted for 5 days or more. The figure below has a summary of the number of customers who were without power.



Map 11. Outage Map from October 2011 Winter Storm Alfred
Source: CT DEMHS

Other Loss Estimates

Multiple sources were used to estimate annualized losses due to winter storms in each community, including FEMA Public Assistance data from the last 11 years, the FEMA National Risk Index, and NCEI losses from the last 20 years, with a wide range of results. Based on the FEMA Public Assistance data for 2012-2022 available, the annualized loss estimate for the Capitol Region is $655,889. Based on the FEMA National Risk Index, the annualized loss estimate for the Capitol Region is $1,159,569. Based on the NCEI, the annualized loss estimate for the Capitol Region is $744,050. Annualized losses for each community based on each of these data sources are presented in each municipal annex. These annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall vulnerability of the Capitol Region to winter storms.

Table 30. Annualized Loss Estimates due to Winter Storms

Hazard	Source	Average Annualized Losses (AAL)
Winter Storms	NCEI	$744,050
	NRI	$1,159,569
	FEMA PA	$655,889

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to winter storms. As an initial screening of exposure to hazards, areas of risk (in this case, the entire CRCOG region) 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 31.

Table 31. Exposure analysis for winter storms in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Winter Storm Risk Area	Approx. Appraised Parcel Value in Winter Storm Risk Area	Number of Historical Resources (SHPO) in Winter Storm Risk Area	Approx. Appraised Parcel Value of SHPO in Winter Storm Risk area	Number of Critical Facilities in Winter Storm Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Winter Storm Risk area
Andover	$219,735	1,704	$374,429,046	40	$8,789,414	2	$439,471
Avon	$418,390	7,932	$3,318,671,261	11	$4,602,292	13	$5,439,073
Berlin	$305,900	9,017	$2,758,301,127	91	$27,836,908	3	$917,700
Bloomfield	$321,812	8,510	$2,738,623,920	5	$1,609,062	9	$2,896,312
Bolton	$238,182	2,366	$563,537,451	9	$2,143,634	6	$1,429,089
Canton	$343,744	3,964	$1,362,602,800	289	$99,342,131	5	$1,718,722
Columbia	$270,752	2,615	$708,015,200	37	$10,017,806	4	$1,083,006
Coventry	$193,998	6,610	$1,282,324,786	126	$24,443,710	8	$1,551,982
East Granby	$258,272	2,653	$685,195,086	111	$28,668,170	8	$2,066,174
East Hartford	$282,361	14,331	$4,046,522,571	226	$63,813,698	9	$2,541,253
East Windsor	$235,621	4,960	$1,168,678,871	25	$5,890,519	9	$2,120,587

Town	Average Appraised Parcel Value	Parcel Count in Winter Storm Risk Area	Approx. Appraised Parcel Value in Winter Storm Risk Area	Number of Historical Resources (SHPO) in Winter Storm Risk Area	Approx. Appraised Parcel Value of SHPO in Winter Storm Risk area	Number of Critical Facilities in Winter Storm Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Winter Storm Risk area
Ellington	$302,974	6,100	$1,848,139,057	65	$19,693,285	5	$1,514,868
Enfield	$257,182	16,651	$4,282,334,586	552	$141,964,368	15	$3,857,727
Farmington	$412,953	11,221	$4,633,746,946	357	$147,424,263	15	$6,194,297
Glastonbury	$357,701	15,300	$5,472,826,486	457	$163,469,392	36	$12,877,239
Granby	$252,015	5,167	$1,302,160,286	83	$20,917,225	7	$1,764,103
Hartford	$255,726	19,160	$4,899,719,451	4,237	$1,083,513,117	10	$2,557,265
Hebron	$284,390	4,011	$1,140,687,600	51	$14,503,881	4	$1,137,559
Manchester	$354,302	16,252	$5,758,122,239	1,301	$460,947,393	10	$3,543,024
Mansfield	$301,081	4,640	$1,397,014,420	106	$31,914,554	8	$2,408,646
Marlborough	$281,882	2,732	$770,100,857	0	$0	6	$1,691,290
New Britain	$201,446	15,736	$3,169,958,733	129	$25,986,571	8	$1,611,570
Newington	$271,063	12,416	$3,365,524,343	21	$5,692,333	10	$2,710,635
Plainville	$256,639	7,472	$1,917,603,547	72	$18,477,979	5	$1,283,193
Rocky Hill	$548,247	4,922	$2,698,472,686	277	$151,864,473	10	$5,482,472
Simsbury	$298,583	10,795	$3,223,206,986	153	$45,683,249	14	$4,180,167
Somers	$291,809	3,865	$1,127,841,671	181	$52,817,424	14	$4,085,326
South Windsor	$315,866	11,129	$3,515,275,849	210	$66,331,919	13	$4,106,262
Southington	$294,296	18,395	$5,413,572,556	18	$5,297,326	10	$2,942,959
Stafford	$183,379	5,384	$987,314,543	3	$550,138	6	$1,100,276
Suffield	$289,760	6,417	$1,859,390,877	184	$53,315,867	13	$3,766,882
Tolland	$243,246	6,562	$1,596,182,814	49	$11,919,073	12	$2,918,957
Vernon	$337,929	7,990	$2,700,053,470	861	$290,956,951	10	$3,379,291
West Hartford	$455,991	19,953	$9,098,386,094	327	$149,109,019	14	$6,383,872
Wethersfield	$298,996	9,958	$2,977,402,886	1,074	$321,121,781	7	$2,092,973
Willington	$219,478	2,453	$538,379,359	66	$14,485,543	14	$3,072,691
Windsor	$314,027	12,177	$3,823,906,683	127	$39,881,428	14	$4,396,378
Windsor Locks	$340,933	4,391	$1,497,034,814	6	$2,045,595	7	$2,386,528
Total	**$11,310,662**	**325,911**	**$100,021,261,958**	**11,937**	**$3,617,041,492**	**373**	**$115,649,817**

Climate Driver #2: Sea Level Rise

Sea level rise refers to an increase in mean sea level over time. There is strong scientific evidence that global sea level is now rising at an increased rate and will continue to rise during this century. The primary causes of global sea level rise are:

- Thermal expansion, which is caused by the warming of the oceans (since water expands as it warms), and
- Loss of land-based ice (such as glaciers and polar ice caps) due to increased melting from warming temperatures

The NOAA Technical Report titled Global and regional Sea Level Rise Scenarios for the United States: Update Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines (February 2022) has built upon previous efforts from the 2017 NOAA report. The 2022 edition presents an increased confidence level in proving a narrower range of global, national, and regional sea level rise projections than the previous report. The report anticipates a rise of **0.25 to 0.30 meters by 2050, with an additional 5 centimeters for the East Coast**. Longer term projections include **0.6 to 2.2 meters by 2100** along the U.S. Coastline, and up to 3.9 meters by 2150. On a global scale, mean sea level is expected to rise between 0.15 to 0.43 meters by 2050, 0.3 to 2.0 meters by 2100, and up to 3.7 by 2150.

To provide more local guidance for Connecticut, CIRCA has developed local sea level rise scenarios (Figure 14). These localized scenarios were derived from the 2012 NOAA report but modified to include the effects of local oceanographic conditions, more recent data and models, and local land motion. Based on the localized scenarios, **CIRCA recommends that Connecticut communities plan for 0.5 meters (1.64 feet) of sea level rise above 2001 levels by 2050**, and continued sea level rise beyond that date. These projections have been developed per Connecticut Public Act 18-82; the Act also requires CIRCA to update these projections no less than once every ten years to ensure communities have up to do regional projections.

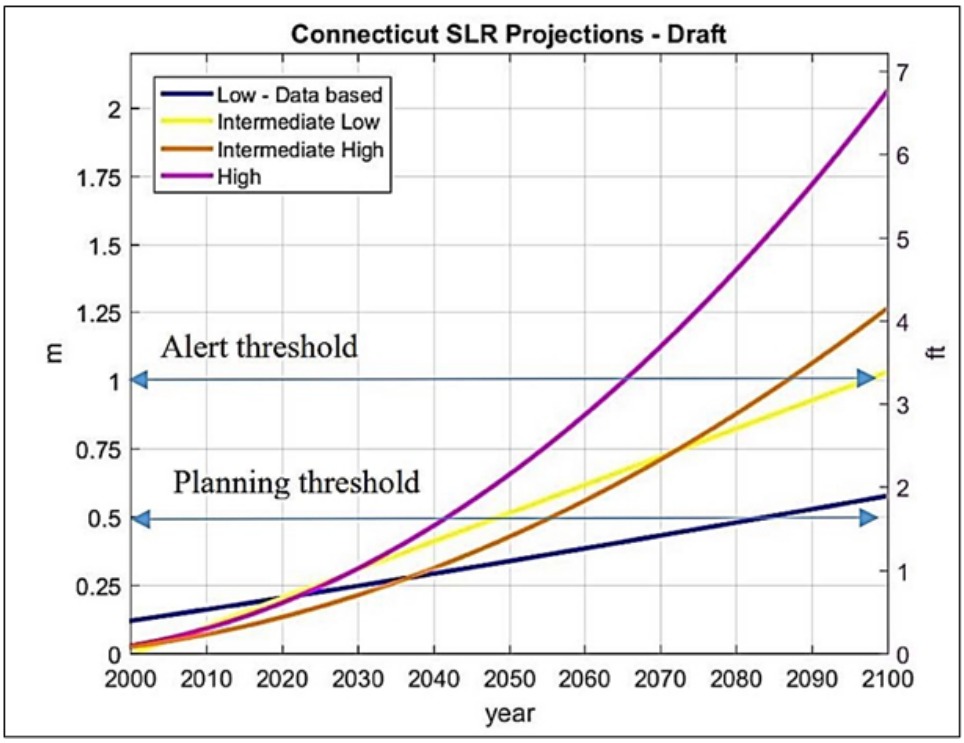


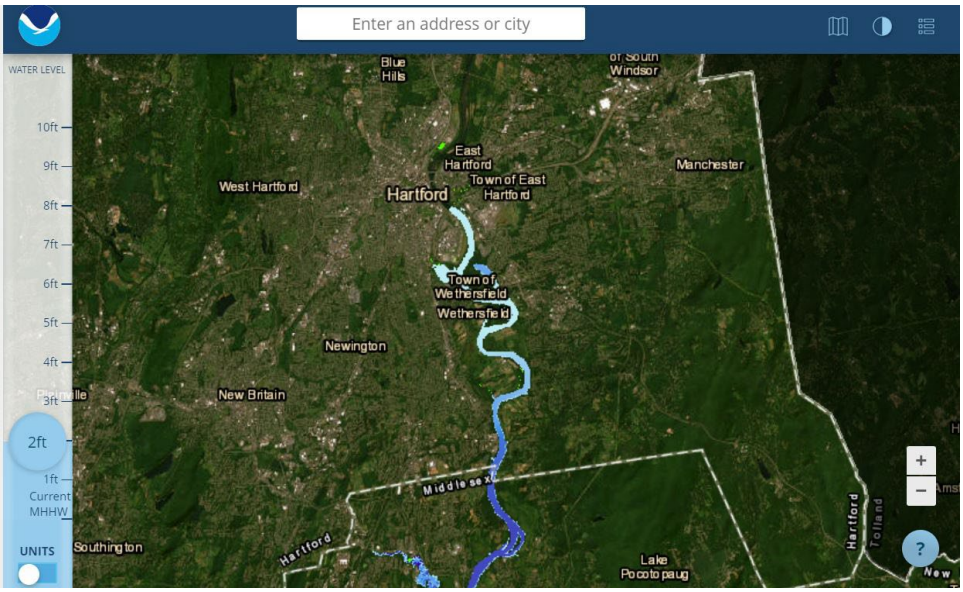
Figure 14. Sea level rise projections for Connecticut.

Tidal Connecticut River Flooding (Climate Driver: Sea Level Rise)

The CRCOG region is entirely inland, and therefore flooding is typically the result of moderate precipitation over several days or intense precipitation over a short period. However, because the Connecticut River is tidally influenced, sea level rise could eventually impact the water surface elevations along the Connecticut River, which in turn could affect its floodplains and potentially other low-lying areas along the river in the lower CRCOG region. For this reason, tidal Connecticut River flooding is considered as a hazard in this plan, with sea level rise as the associated climate driver.

Location

The municipalities along the Connecticut River in the lower CRCOG region may be most vulnerable to the impacts of sea level rise due to the tidally influenced Connecticut River, as shown in the NOAA sea level rise viewer (Map 12) below. The specific communities adjacent to this stretch of the Connecticut River include Hartford, East Hartford, Wethersfield, Glastonbury, and Rocky Hill. Future editions of this plan will determine whether communities north of Hartford should be given special attention for this risk.



Map 12. NOAA Sea Level Rise viewer displaying tidal influence on Connecticut River with a projection of 2 ft of sea level rise.

Extent

At this time, the specific scales and measures that characterize tidally influenced flooding due to sea level rise in inland communities cannot be distinguished from those available for general riverine flooding. Please see the next hazard section (Floods) for a full discussion of flooding extent in the CRCOG

region. It should be noted that the 100-year and the 500-year floodplains discussed in the Floods section are determined based on past events, and as a result, these flood maps do not reflect projected sea level rise.

Previous Occurrences

Sea level rise projections are future-facing, and it is not possible at this time to distinguish the specific role of sea level rise in previous floods along the Connecticut River within the CRCOG region. Please see the next hazard section (Floods) for a full discussion of previous flooding in the CRCOG region, including flooding along the Connecticut River.

Probability of Future Events

The majority of the CRCOG municipalities face very little direct risk associated with sea level rise. Nevertheless, a significant flood event along the Connecticut River could impact the towns adjacent to the river, including through backwater flooding of connecting rivers. As sea level rises, the probability of this occurring will increase along the stretch of the Connecticut River that is tidally influenced, with possibly increased vulnerability for the municipalities of Hartford, East Hartford, Wethersfield, Glastonbury, and Rocky Hill. Future editions of this plan will need to comment on whether the probability of tidally influenced flooding has increased due to sea level rise.

Impacts to Community Assets

Specific loss estimates from changes to the Connecticut River tidal range due to sea level rise cannot be distinguished from the general flooding estimates. Please see the next hazard section (Floods) for a full discussion of flooding impacts in the CRCOG region.

Exposure Analysis

The CRCOG communities of Hartford, East Hartford, Glastonbury, Wethersfield, and Rocky Hill are all adjacent to the tidally influenced portion of the Connecticut River, and thus are all potentially exposed to the effects of sea level rise on tidal Connecticut River flooding. As an initial screening of exposure to hazards, areas of risk (in this case, the abovementioned municipalities) 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 32. Within these communities, there are 184 parcels directly abutting the river, including 2 critical facilities and 16 historic resources.

Table 32. Exposure analysis for tidal Connecticut River flooding in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Sea Level Rise Risk Areas	Average Appraised Parcel Value in Sea Level Rise Risk Areas	Number of Historical Resources (SHPO) in Sea Level Rise Risk Areas	Average Appraised Parcel Value of SHPO in Sea Level Rise Risk Areas	Number of Critical Facilities in Sea Level Rise Risk Areas	Average Appraised Parcel Value of Critical Facilities in Sea Level Rise Risk Areas
East Hartford	$282,361	23	$6,494,314	0	$0	0	$0
Glastonbury	$357,701	75	$26,827,580	11	$3,934,711	2	$715,402
Hartford	$255,726	11	$2,812,991	0	$0	0	$0
Rocky Hill	$548,247	53	$29,057,101	5	$2,741,235	0	$0
Wethersfield	$298,996	22	$6,577,913	0	$0	0	$0

Climate Driver #3: Changing Precipitation

The Fourth National Climate Assessment states that recent trends show an increase in rainfall intensity throughout the northeast, and further intensity increase is expected during winter and spring months, with little change during summer months. There are also certain studies that show some agricultural operations may benefit from this increase in rainfall intensity and there might be greater productivity over a longer growing season. The report also states that droughts have also intensified across the United States and may continue to do so as global temperatures continue to rise. Though precipitation events are expected to become larger and more frequent, it is projected that the length of time between these events will also increase, resulting in lengthier dry spells. In addition, as temperatures increase, soil moisture is expected to decrease due to evapotranspiration, ultimately intensifying droughts, and reducing groundwater levels. A reduction in groundwater level, which can be attributed to lack of conservation, reduced recharge during dry spells, and saltwater inundation along the shoreline, will likely also exacerbate droughts.

According to the Connecticut Governor's Council on Climate Change, climate change is expected to shift precipitation patterns throughout the state. CIRCA has previously released a fact sheet reporting that the average amount of precipitation is expected to increase by about 8%, or four inches per year. In addition, the number of heavy precipitation days is expected to increase from three to five, with the fraction of heavy precipitation increasing from 15% to 20%. The 1-day precipitation maximum is anticipated to rise from 2.8 to 3.5 inches, and the 3-day from 4.5 to 5.4 inches. These increases in heavy rainstorms may also increase the frequency or severity of flood events along rivers and streams in the region, and throughout urban areas that already experience drainage related, urban flooding.

Floods (Climate Driver: Changing Precipitation)

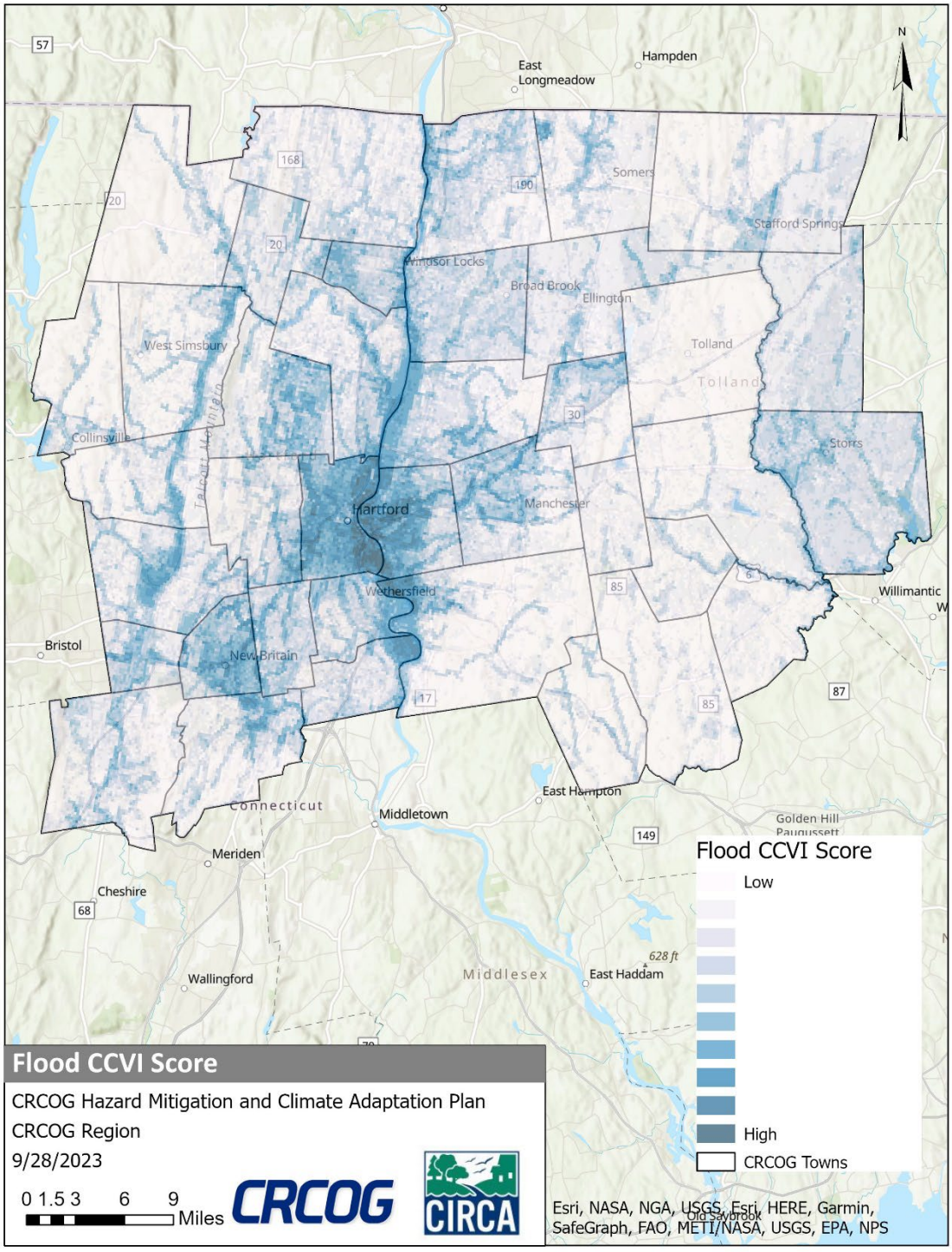
Flooding is the most common natural disaster encountered in the Capitol Region. Triggered by a variety of events, flooding can occur as a result of other natural hazards such as heavy precipitation, hurricanes, winter storms, snowmelt, ice jams, or dam failures. The Capitol Region's numerous rivers and streams, as well as its urbanized areas, make floods and flash floods a regular risk. Historical development

patterns encouraged dense construction of town centers near water bodies; consequently, many areas with chronic flooding problems are in population centers. Individuals and local governments face significant economic loss, risks to public safety, and degraded waterways from flooding.

Location

According to FEMA, most municipalities in the United States have at least one clearly recognizable area at risk of flooding around a river, stream, or large body of water. Many communities also have localized flooding areas outside the Special Flood Hazard Area (SFHA). These floods tend to be shallower and chronically reoccur in the same area due to a combination of factors. Such factors can include ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed drainageways, sewer backup, or overbank flooding from minor streams.

CIRCA has developed a Climate Change Vulnerability Index that combines built, social, and ecological factors to identify areas that are vulnerable to flooding impacts of climate change. This statewide tool can be used to view vulnerability at a regional scale. More information about the CIRCA Climate Change Vulnerability Index can be found here: https://resilientconnecticut.uconn.edu/ccvi/ The CCVI Flood Vulnerability map for the CRCOG region is displayed in Map 13.



Map 13. Climate Change Vulnerability Index Flood Vulnerability Scores for the CRCOG Region

Extent

According to FEMA, there are several different types of inland flooding:

- **Riverine Flooding**: Also known as overbank flooding, it occurs when channels receive more rain or snowmelt from their watershed than normal, or the channel becomes blocked by an ice jam or debris. Excess water spills out of the channel and into the channel's floodplain area.

- **Flash Flooding**: A rapid rise of water along a water channel or low-lying urban area, usually a result of an unusually large amount of rain and/or high velocity of water flow (particularly in hilly areas) within a very short period of time. Flash floods can occur with limited warning.

- **Shallow Flooding**: Occurs in flat areas where a lack of a water channel results in water being unable to drain away easily. The three types of shallow flooding include:
  - **Sheet Flow**: Water spreads over a large area at uniform depth.
  - **Ponding**: Runoff collects in depressions with no drainage ability.
  - **Urban Flooding**: Occurs when man-made drainage systems are overloaded by a larger amount of water than the system was designed to accommodate.

Floodplains are lands along watercourses that are subject to periodic flooding; **floodways** are those areas within the floodplains that convey the majority of flood discharge. Floodways are subject to water being conveyed at relatively high velocity and force. The **floodway fringe** contains those areas of the 1% annual chance floodplain that are outside the floodway and are subject to inundation but do not convey the floodwaters at a high velocity.

In order to provide a national standard without regional discrimination, the 1% annual chance flood has been adopted by FEMA as the base flood for purposes of floodplain management and to determine the need for insurance. The floods are often described in terms of the annual percentage chance of occurrence. Floodplains have been delineated by FEMA to reflect 1% and 0.2% annual flood events previously known as 100-year and 500-year floods, respectively. The area that has a 1% annual chance to flood each year is delineated as a Special Flood Hazard Area (SFHA) for the purposes of the National Flood Insurance Program (NFIP). The 0.2% annual chance floodplain indicates areas of moderate flood hazard.

However, because the 1% floodplain (or any percent floodplain) reflects the percentage chance that area will be inundated in any given year, it is possible to observe a 1% flood more than once every 100 years. For example, FEMA notes that a structure located within a 1% annual chance flood zone has a 26% change of suffering flood damage during the term of a 30-year mortgage. Furthermore, the 1% floodplain is based on empirical evidence. If more or less floods of a certain magnitude are observed, FEMA may restudy the floodplains and update corresponding insurance maps. This means that there can be a lag between the official risk and the empirical risk. A table of the two terms, x% annual chance flood and their corresponding y-year floods, is found in Table 33.

Table 33. Current and Antiquated Terms for Various Intensities of Flooding

Previous Terminology	Current Annual Percent Chance Terminology
2-Year	50%
10-Year	10%
25-Year	4%
50-Year	2%
100-Year	1%
500-Year	0.20%

SFHAs in the Capitol Region communities are delineated on a Flood Insurance Rate Map (FIRM) delineated as part of a Flood Insurance Study (FIS). Major watercourses in the Capitol Region communities typically have SFHAs mapped as Zone AE while smaller tributary streams are mapped as Zone A. Other small streams have shading as Zone X, and other classifications are also possible. Table 34 presents the various flood hazard zones mapped on FIRM panels in the Capitol Region.

Table 34. FIRM Zone Descriptions in the Capitol Region

Zone	Description
A	An area with a 1% chance of flooding in any given year for which no base flood elevations (BFEs) have been determined
AE	An area with a 1% chance of flooding in any given year for which base flood elevations have been determined. This area may include a mapped floodway.
X (Levee)	An area where the flood risk has been reduced below the 1% annual chance by a levee
X (Shaded)	An area with a 0.2% chance of flooding in any given year for which no base flood elevations have been determined
X (Unshaded)	An area that is determined to be outside of the 1% and 0.2% annual chance floodplains

Source: FEMA

During large storms, the recurrence interval level of a flood discharge on a tributary tends to be greater than the recurrence interval level of the flood discharge on the main channel downstream. In other words, a 1% annual chance flood event on a tributary may only contribute to a 2% annual chance flood event downstream. This is due to the distribution of rainfall throughout large watersheds during storms and the greater hydraulic capacity of the downstream channel to convey floodwaters. Dams and other flood control structures can also reduce the magnitude of peak flood flows if pre-storm storage is available. Similarly, the recurrence interval level of a precipitation event also generally differs from the recurrence interval level of the associated flood. Flood events can also be mitigated or exacerbated by in-channel and soil conditions such as low or high flows, the presence of frozen ground, or a deep or shallow water table as can be seen in the following historic record.

Previous Occurrences

Historically, the region has seen a great deal of flooding. According to the FEMA FIS for Hartford County, major floods have occurred in 1927, 1936, 1938, 1949, 1955, and 1960. Historic floods of the 1930s and 1950s resulted in widespread damage in Connecticut.

The greatest flood of record on the Connecticut River occurred in March 1936 with a discharge of 290,000 cubic feet per second (cfs) in Hartford. According to accounts from the National Atmospheric and Oceanic Administration (NOAA), the combination of several heavy rain events and melting snow resulted in major flooding throughout New England. New flow records were established on the Connecticut River in Hartford and other locations upstream such as on the Hockanum River in East Hartford. Flooding was again widespread in New England following the hurricane of 1938.

The flood of 1955 was one of the worst in Connecticut's history. It resulted from heavy rains caused by back-to-back hurricanes in August. According to NOAA, Hurricane Connie produced 4 to 6 inches of rainfall over southern New England on August 11 and 12, saturating the ground and raising river and reservoir levels to above-normal levels. Then Hurricane Diane came a week later and "dealt a massive punch" to New England. Rainfall totals from Diane ranged up to nearly 20 inches over a 2-day period.

The headwaters of the Farmington River in Connecticut recorded 18 inches in a 24-hour period. These were record accumulations. Damage was widespread throughout Connecticut - for example, Salmon Brook in East Granby experienced a 500-year flood, and the Willimantic River in Mansfield experienced a 200-year flood according to the Town of Mansfield FIS. Table 35 below summarizes the damages experienced in the Capitol Region communities.

Table 35. Damage Estimates to Capitol Region Municipalities from the August 19, 1955 Flood

Capitol Region Municipality	Public Facilities	Residential	Industrial	Business	Private Schools, Churches, & Institutions	Total
Avon	$18,184	$100,000		$16,500		$134,684
Bloomfield	$17,500	$17,500	$22,500	$66,250	$1,600	$125,350
Canton	$80,000	$215,000	$1,000,000	$219,275		$1,514,275
Coventry	$104,000	$5,000	$15,000			$124,000
East Granby	$47,000	$480,000				$527,000
East Hartford	$35,000					$35,000
East Windsor	$20,000	$35,000	$6,500	$41,000		$102,500
Ellington	$35,000					$35,000
Enfield	$55,000					$55,000
Farmington	$200,000	$1,800,000	$1,700,000	$500,000		$4,200,000
Glastonbury	$8,000	$10,000	$58,300	$14,550		$90,850
Granby	$455,000	$15,110	$14,000			$484,110
Hartford	$25,000	$1,500,000	$1,800,000	$270,000	$100,000	$3,695,000
Manchester	$12,095					$12,095
Mansfield	$78,500					$78,500
New Britain	$266,275					$266,275
Plainville	$25,000					$25,000
Rocky Hill		$2,000				$2,000
Simsbury	$57,350	$350,000				$407,350
Somers	$175,000					$175,000
South Windsor	$5,000	$50,000				$55,000
Stafford	$190,000	$150,000	$500,000	$250,000		$1,090,000
Suffield	$75,000	$50,000				$125,000
Tolland	$11,000					$11,000
West Hartford	$62,065	$255,000		$545,000		$862,065
Wethersfield	$2,500	$75,000	$10,000			$87,500
Willington	$17,000					$17,000
Windsor	$78,500	$50,000	$100,000	$11,500		$240,000
Windsor Locks	$10,000					$10,000
Capitol Region	$2,164,969	$5,159,610	$5,226,300	$1,934,075	$101,600	$14,586,554

Source:
Report of the Connecticut Flood Recovery Committee to Governor Abraham Ribicoff, November 3, 1955
http://cslib.cdmhost.com/digital/collection/p128501coll2/id/188260/rec/1

Heavy rainfall in June 1982 also resulted in record floods on the Farmington River and many smaller streams through the central part of the state. For example, the June 1982 flood is the most severe flood on record for the Quinnipiac River in Southington, with the 1938 and 1982 floods having recurrence intervals of 100 years and 350 years, respectively.

According to NOAA, "One of the ironies of this event was that one of the facilities that was impacted was the Northeast River Forecast Center. The NERFC offices, which at that time were located in Bloomfield CT, were flooded for a day. Staff had to move to other locations including one home in order to complete their forecast responsibilities. The floods caused the loss of at least eleven lives. In addition damage estimates of approximately 230 million dollars were incurred. Thousands of homes suffered varying degrees of damage. One significant development from the aftermath of this flooding was the development of a statewide flood warning system (the now-defunct Automated Flood Warning System) under the management of the Connecticut Department of Environmental Protection. While this will not prevent flooding to occur in the future, it may help provide advance warning and prevent the loss of lives and property."

The severe flooding of October 2005 demonstrated once again the region's vulnerability to this hazard. Two heavy rainfalls during the week of October 7-15, 2005, caused major flooding in several small rivers in Hartford and Tolland Counties and moderate flooding elsewhere. Several dams were breached, and roads and bridges washed out. The storms flooded many basements, and some towns conducted evacuations because of severe urban flooding. Interstate 91 developed a sinkhole in Windsor. Enfield was particularly hard hit. The storms produced sufficient damage to provoke a federally declared major disaster in certain counties, including Tolland County ($1.16 million) and eventually Hartford County ($2.52 million).

October 2005 Flooding of Capitol Region Rivers and Streams

River/Stream	Flooding Severity	Recurrence Interval
Broad Brook	Major	> 100-year
Connecticut River	Minor	2-Year
Hockanum River	Moderate	25-Year
Stony Brook	Moderate	40-Year

Municipality	Rainfall for Week of Oct. 7-15, 2005
Enfield	15.90"
Farmington	11.61"
Glastonbury	13.27"
Hartford	10.51"
South Windsor	15.90"
Wethersfield	13.22"
Windsor Locks	13.12"

From http://ct.water.usgs.gov/DATA/floodindex.html **Route 191, East Windsor**

The National Centers for Environmental Information (NCEI) Storm Events Database lists a number of other flooding events in the Capitol Region over the past 2 decades including the following:

July 8, 1995: Thunderstorms produced very heavy rainfall. One road was reported to be impassable between Ellington and Stafford Springs, and overflow and street flooding was reported on secondary roads off Route 84.

January 24, 1996: Strong south winds with gusts to 40 to 60 mph and isolated gusts to hurricane force preceded a sharp cold front. Peak wind gusts to 58 mph were recorded at both Bradley International Airport in Windsor Locks and at Glastonbury. There were scattered reports of wind damage including downed trees, downed tree limbs, and scattered power outages. Part of a roof of a Hartford apartment building was damaged, displacing about 15 people. Power outages affected up to 41,000 electric customers statewide. The

high winds also brought a strong January thaw with temperatures rising into the 50s. This combined with rain and melting snow caused some street flooding. Flash flooding occurred in West Hartford and Hartford where homes flooded and roads washed out along the upper portion of the South Branch of the Park River and also along the North Branch of the Park River in the parking lots at the University of Hartford and Hartford Community College.

April 16, 1996: Two to 3 inches of rain fell on April 16 in northern Connecticut, with totals of 3 to 5 inches in the south portion of Hartford and Tolland Counties. All of the rain fell in about a 12-hour period. The ground had remained saturated from heavy snowmelt during the previous week and this combined with the heavy rain to produce urban flooding, flooding of small streams, and finally minor to moderate flooding of the major rivers resulting in the most significant main-stem river flooding along the Connecticut River in 9 years. A flash flood occurred in Berlin where boats were needed to rescue people stuck in two cars on Route 71. Moderate flooding was reported along the Quinnipiac River in Southington. In general, during this event, low-lying riverfront land and some roads were flooded, but no significant damage was reported.

July 13, 1996: Tropical Storm Bertha brought heavy rainfall totals of 3 to 5.5 inches as the center of the storm passed over the southeast part of Connecticut, moving northeast. The maximum rainfall reported was 5.5 inches at Vernon. Urban street flooding occurred throughout the area, and minor river flooding occurred along the North Branch of the Park River in Hartford.

December 2, 1996: Heavy rainfall amounts of 2 to 3 inches on the first and second of the month, combined with some snowmelt in the Connecticut River Basin, produced runoff that resulted in minor flooding of several small streams and flooding along the Connecticut River below Thompsonville.

August 29, 1997: A cold front moving very slowly across Connecticut caused an area of showers and thunderstorms that produced intense rainfall amounts of 3 to 6 inches in 1 to 3 hours across parts of Hartford County. A flash flood occurred in Manchester where Bigelow Brook rose at least 6 feet out of its banks, flooding roads and basements. Sixteen homes received extensive water damage. A majority of these had basement flooding. Three homes had total basement failure or collapse. One home was severely damaged. Many residents had to be evacuated to local shelters. Electric power was disrupted for 1,200 customers. A local shopping area also was flooded. An estimated 6 to 12 automobiles received extensive water damage when water rose to at least as high as the windows. Property damage was likely a half million dollars. Maximum rainfall totals reached 5 to 6 inches in the area of the flash flood, and there was extensive urban street flooding in addition to the flash flood. The cloudburst was really confined to Manchester. Only one town away in Vernon, there was heavy rain, but no flooding was reported.

March 9, 1998: A powerful storm system moving slowly northeast from the Ohio Valley to the eastern Great Lakes brought strong winds and heavy rainfall to Connecticut, which resulted in urban street flooding, basement flooding, small stream flooding, and main-stem river flooding. At times, the rainfall was torrential, especially in thunderstorms during the evening hours.

June 30, 1998: An area of heavy showers and thunderstorms associated with a slow-moving warm front brought 2 to 4 inches of rainfall to Hartford County, resulting in urban street, basement, small stream, and river flooding. In West Hartford, the Trout Brook went over its banks flooding nearby areas. Urban street flooding was reported with water 4 feet deep on Pen Drive and 1 foot deep in some other areas.

September 16, 1999: Tropical Storm Floyd brought torrential rainfall and strong winds to northern Connecticut as it tracked up the Connecticut River valley into central Massachusetts. Although many areas received torrential rainfall, with totals between 4 and 8 inches, the heaviest rain fell in western Hartford County where as much as 10.80 inches was reported in Bristol. The rainfall produced widespread flooding of low-lying areas, especially in Hartford County. Surprisingly, no flood damage was reported, even in those areas where the smaller rivers rose rapidly. Strong winds were also felt in northern Connecticut as Floyd passed. There were scattered reports of small trees or branches downed, which did not cause significant damage.

June 2, 2000: Severe thunderstorms moved across northern Connecticut in advance of a strong cold front. The storms moved through late in the afternoon and early evening. In Hartford County, a spotter in Granby reported nickel- to quarter-size hail and observed a funnel cloud near State Route 20. The hail accumulated 2 inches deep. In Ellington, in Tolland County, thunderstorm winds downed two large trees, and torrential rainfall caused flash flooding of a small stream in the vicinity of Pinney Road.

March 22-30, 2001: The combination of melting snow and heavy rain caused flooding along the Quinnipiac River in Southington. The river crested at 4.6 feet. Several roads near the river were closed by floodwaters, but no damage was reported. River levels remained above normal for nearly a week when a storm system brought 2 to 3 additional inches of rainfall. The river crested at 4.4 feet during the latter event, and no damage was reported.

May 28, 2003: A slow-moving severe thunderstorm produced penny-size hail in Enfield and Manchester. The storm then dumped 3 to 4 inches of rain in Bloomfield, West Hartford, and Hartford in less than one hour. This resulted in flash flooding on Beaman Brook in Bloomfield and significant urban flooding in West Hartford and Hartford. Dozens of cars were submerged in floodwaters, and several people needed to be rescued. The north end of West Hartford along Trout Brook Drive was hardest hit along with the neighborhood surrounding Bloomfield High School. There were no injuries reported. Lightning from the storm struck several houses in West Hartford causing minor damage. Power was briefly knocked out in West Hartford and Windsor, cutting off service to thousands of customers.

September 28, 2003: Significant urban flooding affected central Hartford County after nearly 4 inches of rain fell in a few hours. Several cars were stranded in Berlin, and Willow Brook rose out of its banks in New Britain flooding a nearby park. This event included flash flooding in Berlin that caused $25,000 worth of property damage.

July 15, 2005: Slow-moving, nearly stationary, thunderstorms produced heavy downpours that lead to flash flooding and road closures in Hartford County. No direct injuries resulted from these storms.

July 27, 2005: A hot and humid air mass combined with an approaching cold front sparked strong to severe thunderstorms. These thunderstorms produced severe winds, damaging lightning, and flash flooding across north central and northeast Connecticut, especially Hartford County. The severe winds brought trees, utility poles, and power lines down. In Hebron, approximately 40 trees were knocked down as these storms pushed through the area. Lightning and flash flooding were also produced from these storms. In Hartford, lightning destroyed a wooden shed. In East Hartford, flash flooding left cars stranded on a road. No direct injuries resulted from these storms, however.

April 16, 2007: An unusually strong and slow-moving coastal storm for mid April tracked to western Long Island Sound on April 16 before weakening slowly and drifting offshore. This storm brought strong winds and widespread river and stream flooding to northern Connecticut. Northeast winds gusted as high as 55 mph in the higher elevations of Tolland and Windham Counties. Rainfall totals of 3 to 5 inches, combined with wet antecedent conditions, resulted in widespread river and stream flooding as well as significant flooding of urban areas. Minor to moderate flooding occurred on the Farmington and Connecticut Rivers. The Connecticut River at Thompsonville crested at 7 feet at 3:00 p.m. on the 17 (flood stage is 5 feet), and at Hartford, it crested at 23.4 feet at 12:15 pm on the 18 (flood stage is 16 feet). On the Farmington River, a crest of 16.6 feet was recorded at Simsbury at 9:15 a.m. on the 17 (flood stage is 12 feet) while at Tarriffville the river crested at 9.9 feet at 4:30 p.m. on the 17 (flood stage is 9 feet). The Hockanum River in Manchester came out of its banks and threatened nearby homes. Several roads were flooded in Granby.

September 28, 2008: Tropical Storm and then Hurricane Kyle moved east of Massachusetts on its trek toward Maine and Nova Scotia. The effects of Kyle were minimal on southern New England with heavy rainfall and high surf the only concerns. Kyle, combined with a separate coastal storm that moved through southern New

England the day before, produced anywhere from 2 to 7 inches of rain. This resulted in significant flooding across two counties in southeastern Massachusetts and flash flooding in Hartford County, Connecticut. Heavy rainfall behind Tropical Storm Kyle resulted in flash flooding across Hartford. On Elliot Street and on Flatbush Avenue, a total of six cars were stuck in floodwaters. Numerous basements were flooded on both Maple and Wethersfield Avenues and on Parkview Drive.

July 21, 2010: Severe thunderstorms produced 12 to 18 inches of water over Corbin Avenue in New Britain.

March 7, 2011: Heavy rains with amounts ranging 2 to 5 inches across coastal and interior New England, coupled with melting snows, resulted in flooding of tributaries and major rivers, inundating local neighborhoods and roadways. Several rivers and small streams in Hartford County flooded including the Farmington River at Tarriffville, Unionville, and Simsbury; the Hockanum River at East Hartford; and the Connecticut River at Hartford. In addition, basements were flooded in Avon, Windsor, and Windsor Locks. Bloomfield Avenue was closed near the Bloomfield/Windsor line because a nearby pond overflowed its banks. Several intersections were flooded, including the intersection of Old Farms and Tillotson Roads in Avon and the intersection of Wolcott and Wescott Roads in Simsbury. In Ellington, Route 140 was closed near its intersection with Route 30 because of flooding. Portions of Freshwater Boulevard in Enfield were flooded. In Somers, portions of Durkee, Four Bridges, and King Roads adjacent to the Scantic River flooded.

September 8, 2011: A slow-moving cold front moved across southern New England and stalled just south of the area. This front was instrumental in bringing tropical moisture from the remnants of Tropical Storm Lee into New England, resulting in several periods of showers and steady rainfall. Rainfall totals throughout the area over the 4 days totaled anywhere from 2 to 8 inches, with most areas receiving 4 to 6 inches. This resulted in flooding both on the rivers and small streams and in urban areas. The bulk of the flooding in urban areas occurred on September 8 as a band of very heavy rain moved through, dumping up to 2 inches of rain in an hour to hour and a half in some locations. Numerous roads were closed throughout Bloomfield because of water 1 to 2 feet deep over the roads. In addition, a 10-foot section of Bloomfield Avenue was washed out near the intersection of Bloomfield Avenue and Route 218. Dozens of cars in Parking Lot E of the University of Hartford were floating after the north branch of the Park River overflowed its banks into the parking lot. University officials said it was only the second time in the past 15 years that flooding had been this bad. In addition, several main-stem rivers experienced flooding, including the Farmington River at Simsbury and Unionville and the Connecticut River at Thompsonville and Hartford. No damage associated with this flooding was reported.

June 22, 2012: Severe storms occurred throughout southern New England, resulting in damaging winds, large hail, and some flash flooding. Collins and Gardner Streets in Hartford were flooded and impassable. Several streets were flooded in Manchester. Peldon Street in East Hartford was closed due to flooding.

July 28, 2012: Several areas of low pressure along a stationary front stalled across southern New England, producing very heavy rain showers and a few thunderstorms. Many locations received up to 2 to 3 inches in less than an hour. This resulted in flash flooding, particularly in more urban areas. Flooding was reported in New Britain on Farmington Avenue near Barube Street. Several cars were stuck in floodwaters or stalled. West Main Street between Norton Road and Corbin Avenue was flooded with 4 to 8 inches of water. In addition, Route 190 and Stafford Road in Stafford were flooded with 2 feet of water, and cars were stuck in the floodwaters. In Stafford Springs, the parking lot in front of the Stafford Springs Savings Bank was flooded with 1 foot of water.

August 5, 2012: Rainfall from showers and thunderstorms resulted in minor street flooding in New Britain at the intersections of Corbin Avenue and Osgood Avenue and at the intersection of Berube Street and Farmington Avenue.

August 10, 2012: Very heavy rain showers and thunderstorms developed, many with high winds. Route 190 in Stafford Springs was closed due to flooding.

September 18, 2012: A line of thunderstorms produced rainfall resulting in flooding at the intersection of Clinton Street and Albany Avenue in New Britain as well as at the intersection of Lincoln Street and West Main Street.

July 10, 2013: A warm front lifted northward through southern New England, igniting showers and thunderstorms and a tornado across much of the area. The main threat with many of these storms was flash flooding. Three feet of water flooded Love Lane in Hartford, and a car was stuck in floodwaters on Lyme and Palm Streets. $3,000 in damage was reported.

August 9, 2013: Widespread rain, along with thunderstorms, occurred across southern New England. The high moisture content of the atmosphere resulted in torrential downpours across much of the region, which led to flash flooding in some areas. Route 10 and Route 189 in Granby were flooded, with cars stuck on both roads. In Windsor Locks, the Farmington River overflowed its banks near the junction of Interstate 91 and Route 159. $30,000 in damage was reported.

September 2, 2013: Showers and thunderstorms produced heavy rain that caused flooding 4 to 8 inches deep on several streets in New Britain. A car was stuck in floodwaters on Golden Hill Street. $5,000 in damage was reported.

May 31, 2015: Showers and thunderstorms produced flooding and pockets of flash flooding. Route 189 in Granby was blocked by floodwaters that were not draining. The Lower Lane area of Berlin also experienced localized flooding.

July 30, 2015: A cold front produced showers and thunderstorms across much of southern New England. Heavy rain came with some of these storms, resulting in some minor street flooding such as on Trout Brook Drive in West Hartford.

August 25, 2015: Thunderstorms occurred across much of western Massachusetts and northern Connecticut. A few of these storms produced damaging winds. Floydville Road was flooded between Routes 202 and 189 in Granby and East Granby.

August 11, 2016: A few afternoon showers and thunderstorms developed across northern Connecticut. Several of these storms produced wind damage, flooding, and numerous lightning strikes. Route 83 (Main Street) in Manchester was flooded with 8 inches of water between Henry and Woodland Streets. In Glastonbury, minor street flooding occurred on Route 17, and at the nearby intersection of Hubbard and Willieb Streets, manhole covers popped off due to flooding.

June 30, 2017: Showers and thunderstorms were generated over western Connecticut. In West Hartford, the junction of North Main Street and Albany Avenue had flooding to a depth of 2.5 feet.

August 2, 2017: Some showers and storms produced heavy downpours and strong wind gusts. Heavy downpours in Manchester brought street flooding to the east side. Pearl Street and Birch Street were under 1 to 2 feet of water, making them impassable. $10,000 in damage was reported.

August 22, 2021: Connecticut experienced flash flooding associated with Hurricane Henri after it made landfall in southwest Rhode Island and moved northwestward and westward across northern Connecticut. The worst flash flooding occurred in northeast Connecticut. The highest rainfall totals over the two-day period ranged from 5 to 6 inches in Hartford and Tolland Counties in northern Connecticut.

September 1-2, 2021: Connecticut experienced extremely heavy rainfall associated with the remnants of Hurricane Ida, with 5-8+ inches of rain, much of it falling in just a few hours. The heavy rain and flash flooding resulted in over $5 million in damages.

September 13, 2023: Some flash flooding and wind was reported in Hartford and Tolland Counties due to the impacts of Hurricane Lee passing to the east of Connecticut, but little damage was recorded in the NCEI Storm Events database.

The storms listed in the NCEI database present notable storm events tied to flooding, but unlisted storms also have a significant impact on the region. For example, in 1992 New Britain, experienced extensive flooding from a rainstorm that, according to a report by Maguire Group, exceeded a 100-year storm. The flooding that resulted from this unlisted storm inundated local playing fields and caused $654,000 worth of damage to bridges, culverts, and roads.

Probability of Future Events

There is not a "flood season" per se in Connecticut; however, waterways are normally higher during spring and are thus especially vulnerable to flooding from intense precipitation. According to the state's Hazard Mitigation Plan, multiple flood events can be expected to occur each year across the state, with one to six flood events of some significance occurring in each county each year. While inundation-related flood loss is a significant component of flood disasters, fluvial (river-related) erosion is another significant source of damage. Climate change is expected to increase the intensity of rain events, amplifying pluvial flooding impacts.

The Connecticut Department of Transportation (DOT) maintains indexes linking return periods with expected precipitation amounts. A chart including events by expected return period, the expected volume of precipitation recorded in 1 day for each hypothetical event, the observed number of events that have crossed the volume threshold, and the observed probability for the return of any such event in any given year is given in Table 36. This table highlights the uncertainty of the predictions. According to the official numbers, 2% annual chance rainfall events have occurred five times in the last roughly 50 years. This implies that there is actually a 10% annual observed chance of an event of this magnitude within the region; this is five times more likely than expected probability.

Table 36. CTDOT Observed Rainfall vs. Expected Flood Probability

Return Period	Expected Probability	Expected Rainfall/Day (inches)	Observed Occurrences	Observed Probability
100-Year	1%	7.00	4	8.2%
50-Year	2%	6.35	5	10.2%
25-Year	4%	5.75	8	16.4%
10-Year	10%	4.95	10	20.5%
5-Year	20%	4.20	17	34.8%
2-Year	50%	3.25	41	84.0%

Several recent studies have shown that the amount of rainfall being experienced in Connecticut is increasing over time. Although annual precipitation in Connecticut is approximately 47 inches per year, the average annual precipitation has been increasing by 0.30 inches per decade since the end of the

19th century according to the NOAA National Centers for Environmental Information (NCEI). Figure 15 demonstrates this information graphically.

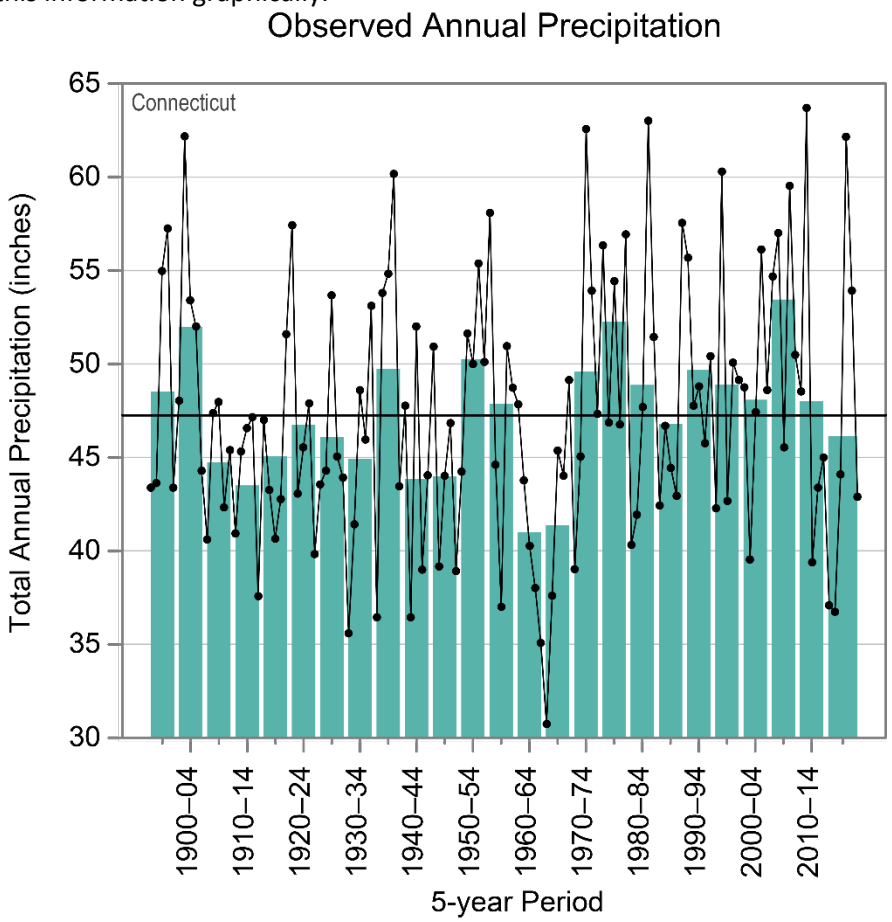


Figure 15. Precipitation trends in Connecticut. Source: NOAA NCEI State Summaries.

Like many areas in the United States, the Capitol Region experienced a population boom following World War II. This population increase led to concurrent increases in impervious surfaces and the amount of drainage infrastructure. Many post-war storm drainage systems and culverts were likely designed using rainfall data published in *Technical Paper No. 40* by the U.S. Weather Bureau (now the National Weather Service) (Hershfield, 1961). The rainfall data in this document dates from the years 1938 through 1958. These figures are the standard used in the current Connecticut DOT *Drainage Manual* (2000) and were the engineering standard in Connecticut for many years. This engineering standard was based on the now disproven premise that extreme rainfall series in Connecticut do not change through time, and therefore, the older analyses reflect current conditions.

The Northeast Regional Climate Center (NRCC) has partnered with the Natural Resources Conservation Service (NRCS) to provide a consistent, current regional analysis of rainfall extremes for engineering design (http://precip.eas.cornell.edu/). The increase in precipitation over time is reflected in the changing rainfall magnitudes published by the NRCC. As shown in Table 37, the 24-hour storm has increased in magnitude since the initial figures were published by the National Weather Service in 1961, with the greatest increase occurring in the more extreme events. Note that the 2004 USGS rainfall recurrence intervals were based on rainfall data processed by NRCC through 2003 as post-processed by USGS.

On November 3, 2015, the Connecticut Department of Transportation (CT DOT) Office of Engineering put out a bulletin (number EB-2015-2) directing that updated precipitation frequency estimates from the NOAA Atlas 14 released on September 30, 2015, be used in planning and design. Twenty-four-hour rainfall amounts for Hartford are presented in Table 37.

Table 37. Increase in Rainfall Recurrence Intervals for 24-Hour Storm

Rainfall Data Source	Total Rainfall (Inches) by Storm Recurrence Interval					
	2-Year (50% Annual Chance)	10-Year (10% Annual Chance)	25-Year (4% Annual Chance)	50-Year (2% Annual Chance)	100-Year (1% Annual Chance)	500-Year (0.2% Annual Chance)
TP-40 (1961)	3.2	4.7	5.5	6.2	6.9	8.9
USGS *StreamStats (2004)*	3.2	4.5	5.5	6.4	7.5	N/A
NRCC (2008)	3.21	4.75	5.95	7.05	8.36	12.43
NOAA Atlas 14 (2015)	2.47	4.91	6.05	6.93	7.81	11.1

The continued increase in precipitation only heightens the need for hazard mitigation planning as the occurrence of floods may change in accordance with the greater precipitation. The National Climate Assessment estimates 5% to 20% more precipitation will occur during winter and spring months for the northeast by the turn of the next century. The assessment also predicts an increase in severe weather events for the region, which may increase the chance of experiencing floods. Additional intense precipitation, combined with an increase in impervious surfaces and thus increase in surface runoff, suggests that the potential for flooding will likely increase in the future. Municipalities can improve their resiliency to flooding by considering the impacts of locally observed severe weather and by exceeding, where necessary, federal, state, and local requirements to meet local needs. Sometime in the next year, NOAA Atlas 14 will be retired in favor of the new precipitation standards of NOAA Atlas 15.

Impacts to Community Assets

Flooding presents several safety hazards to people and property and can cause extensive damage and potential injury or loss of life. Floodwaters cause massive damage to the lower levels of buildings, destroying business records, furniture, and other sentimental papers and artifacts. In addition, floodwaters can prevent emergency and commercial egress by blocking streets, deteriorating municipal drainage systems, and diverting municipal staff and resources.

Furthermore, damp conditions trigger the growth of mold and mildew in flooded buildings, contributing to allergies, asthma, and respiratory infections. Snakes and rodents are forced out of their natural habitat and into closer contact with people, and ponded water following a flood presents a breeding ground for mosquitoes. Gasoline, pesticides, poorly treated sewage, and other aqueous pollutants can be carried into areas and buildings by floodwaters and soak into soil, building components, and furniture.

As recorded in the above descriptions of past flooding events, the potential impacts go beyond lost or damaged property and include reducing access to transportation and limiting the movement of economic goods and services. All communities in the Capitol Region are impacted by floods on a regular basis. The Connecticut, Farmington, Quinnipiac, and Willimantic Rivers flow through the region among

numerous other smaller streams and rivers, and each has floodplains at risk of flooding. Impacts from flooding vary according to the severity of each flood event but can range from minor damage of personal property to dam failure, septic and sewer system failure, and even the destruction of homes and businesses and loss of lives.

Other means can also provide insights into the risks our communities face from flooding. Analysis of the types of land uses within FEMA designated 1% annual chance flood zones gives some indication of the type of damage that flooding can cause in the region. Figure 16 and Table 38 reveal percentages of general land uses, based on municipal zoning districts, in the 1% annual chance flood zone in each municipality. Generally, about half of the region's land in flood zones is zoned residential while over a quarter is zoned resource, recreation, public use, or other uses such as agricultural. Residential areas in flood zones are of particular concern for risk from this hazard.

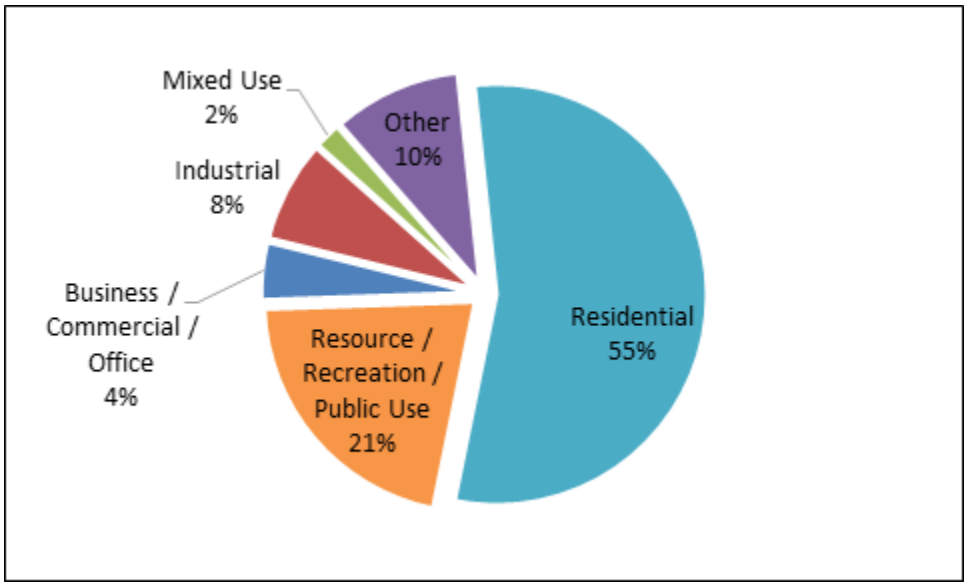


Figure 16. Capitol Region Zoning in FEMA Flood Zones

Table 38. Percentage of Land Uses (by Zoning District Categories) in FEMA Flood Zones

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
ANDOVER				
Town Total Acres	**10,057**	Business/Commercial/Office	35	4.70%
Total Acres in 100-Year Floodplain	**750**	Industrial	116	15.40%
% Town in Floodplain	**7.50%**	Residential	166	22.10%
		Resource/Recreation/Public Use	287	38.20%
		Water	148	19.70%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
AVON				
Town Total Acres	**14,989**	Business/Commercial/Office	39	2.20%
Total Acres in 100-Year Floodplain	**1,779**	Industrial	56	3.20%
% Town in Floodplain	**11.90%**	Residential	602	33.90%
		Resource/Recreation/Public Use	1,081	60.80%
BERLIN				
Town Total Acres	**17,359**	Business/Commercial/Office	129	7.30%
Total Acres in 100-Year Floodplain	**1,774**	Industrial	565	31.80%
% Town in Floodplain	**10.20%**	Mixed Use	266	15.00%
		Residential	814	45.90%
BLOOMFIELD				
Town Total Acres	**16,872**	Business/Commercial/Office	15	0.90%
Total Acres in 100-Year Floodplain	**1,748**	Industrial	145	8.30%
% Town in Floodplain	**10.40%**	Mixed Use	140	8.00%
		Residential	1,447	82.80%
BOLTON				
Town Total Acres	**9,433**	Business/Commercial/Office	12	2.70%
Total Acres in 100-Year Floodplain	**433**	Industrial	11	2.40%
% Town in Floodplain	**4.60%**	Residential	411	94.90%
CANTON				
Town Total Acres	**16,018**	Business/Commercial/Office	30	3.90%
Total Acres in 100-Year Floodplain	**770**	Industrial	81	10.50%
% Town in Floodplain	**4.80%**	Residential	659	85.60%
COLUMBIA				
Town Total Acres	**1,3565**	Business/Commercial/Office	447	61.60%
Total Acres in 100-Year Floodplain	**726**	Industrial	28	3.90%
% Town in Floodplain	**5.40%**	Mixed Use	73	10.10%
		Residential	175	24.10%
		Resources/Recreation/Public Use	3	0.40%
COVENTRY				
Town Total Acres	**23,400**	Business/Commercial/Office	43	3.10%
Total Acres in 100-Year Floodplain	**1,370**	Industrial	42	3.10%
% Town in Floodplain	**5.90%**	Mixed Use	25	1.80%
		Residential	847	61.80%
		Resources/Recreation/Public Use	53	3.90%
		Other	360	26.30%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
EAST GRANBY				
Town Total Acres	**11,217**	Business/Commercial/Office	88	8.80%
Total Acres in 100-Year Floodplain	**994**	Industrial	19	1.90%
% Town in Floodplain	**8.90%**	Mixed Use	13	1.40%
		Residential	216	21.70%
		Resource/Recreation/Public Use	658	66.20%
EAST HARTFORD				
Town Total Acres	**12,040**	Business/Commercial/Office	529	22.40%
Total Acres in 100-Year Floodplain	**2,362**	Industrial	83	3.50%
% Town in Floodplain	**19.60%**	Mixed Use	113	4.80%
		Residential	1,638	69.30%
EAST WINDSOR				
Town Total Acres	**17,108**	Business/Commercial/Office	37	2.30%
Total Acres in 100-Year Floodplain	**1,575**	Industrial	182	11.60%
% Town in Floodplain	**9.20%**	Mixed Use	20	1.30%
		Residential	1,336	84.80%
ELLINGTON				
Town Total Acres	**22,140**	Business/Commercial/Office	66	4.30%
Total Acres in 100-Year Floodplain	**1,532**	Industrial	168	11.00%
% Town in Floodplain	**6.90%**	Residential	890	58.10%
		Resource/Recreation/Public Use	87	5.70%
		Water	321	20.90%
ENFIELD				
Town Total Acres	**21,890**	Business/Commercial/Office	154	7.20%
Total Acres in 100-Year Floodplain	**2,158**	Industrial	185	8.60%
% Town in Floodplain	**9.90%**	Mixed Use	6	0.30%
		Residential	1,257	58.30%
		ROW	37	1.70%
		Water	518	24.00%
FARMINGTON				
Town Total Acres	**18,384**	Business/Commercial/Office	99	3.10%
Total Acres in 100-Year Floodplain	**3,146**	Industrial	228	7.30%
% Town in Floodplain	**17.10%**	Mixed Use	9	0.30%
		Residential	839	26.70%
		Resource/Recreation/Public Use	1,971	62.60%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
GLASTONBURY				
Town Total Acres	**33,413**	Business/Commercial/Office	14	0.40%
Total Acres in 100-Year Floodplain	**3,327**	Industrial	10	0.30%
% Town in Floodplain	**10.00%**	Mixed Use	28	0.90%
		Residential	159	4.80%
		Resource/Recreation/Public Use	3,056	91.90%
		ROW	60	1.80%
GRANBY				
Town Total Acres	**26,301**	Business/Commercial/Office	11	1.00%
Total Acres in 100-Year Floodplain	**1,147**	Industrial	57	5.00%
% Town in Floodplain	**4.40%**	Mixed Use	178	15.50%
		Residential	882	76.90%
		ROW	19	1.60%
HARTFORD				
Town Total Acres	**11,553**	Business/Commercial/Office	14	2.20%
Total Acres in 100-Year Floodplain	**661**	Industrial	81	12.30%
% Town in Floodplain	**5.70%**	Mixed Use	15	2.30%
		Residential	209	31.70%
		Resource/Recreation/Public Use	341	51.70%
HEBRON				
Town Total Acres	**23,938**	Industrial	38	2.40%
Total Acres in 100-Year Floodplain	**1,607**	Mixed Use	3	0.20%
% Town in Floodplain	**6.70%**	Residential	1,565	97.40%
MANCHESTER				
Town Total Acres	**17,704**	Business/Commercial/Office	49	5.90%
Total Acres in 100-Year Floodplain	**823**	Industrial	167	20.30%
% Town in Floodplain	**4.60%**	Mixed Use	4	0.50%
		Residential	552	67.10%
		ROW	51	6.20%
MANSFIELD				
Town Total Acres	**28,182**	Business/Commercial/Office	70	2.60%
Total Acres in 100-Year Floodplain	**2,740**	Industrial	2	0.10%
% Town in Floodplain	**9.70%**	Mixed Use	11	0.40%
		Residential	690	25.20%
		Resources/Recreation/Public Use	2	0.10%
		Other	1,966	71.80%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
MARLBOROUGH				
Town Total Acres	**15,032**	Business/Commercial/Office	21	2.00%
Total Acres in 100-Year Floodplain	**1,045**	Industrial	30	2.90%
% Town in Floodplain	**7.00%**	Residential	748	71.60%
		Resource/Recreation/Public Use	246	23.50%
NEW BRITAIN				
Town Total Acres	**7,028**	Business/Commercial/Office	82	41.20%
Total Acres in 100-Year Floodplain	**199**	Industrial	2	1.00%
% Town in Floodplain	**2.80%**	Mixed Use	15	7.50%
		Residential	72	36.20%
		Resources/Recreation/Public Use	28	14.10%
		Other	0.07	0.04%
NEWINGTON				
Town Total Acres	**8,394**	Business/Commercial/Office	27	5.00%
Total Acres in 100-Year Floodplain	**534**	Industrial	262	49.10%
% Town in Floodplain	**6.40%**	Residential	222	41.70%
		ROW	23	4.20%
PLAINVILLE				
Town Total Acres	**6,360**	Business/Commercial/Office	22	2.90%
Total Acres in 100-Year Floodplain	**739**	Industrial	187	25.30%
% Town in Floodplain	**11.60%**	Residential	110	14.90%
		Other	421	56.90%
ROCKY HILL				
Town Total Acres	**8,904**	Business / Commercial / Office	10	0.65%
Total Acres in 100-Year Floodplain	**1,531**	Industrial	98	6.40%
% Town in Floodplain	**17.19%**	Mixed Use	10	0.65%
		Residential	143	9.34%
		Agricultural	1,035	67.60%
		Water	235	15.35%
SIMSBURY				
Town Total Acres	**21,970**	Business/Commercial/Office	17	0.60%
Total Acres in 100-Year Floodplain	**3,093**	Industrial	409	13.20%
% Town in Floodplain	**14.10%**	Mixed Use	11	0.30%
		Residential	2,656	85.90%
SOMERS				
Town Total Acres	**18,318**	Business/Commercial/Office	3	0.20%
Total Acres in 100-Year Floodplain	**2,109**	Industrial	51	2.40%
% Town in Floodplain	**11.50%**	Residential	2,055	97.50%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
SOUTH WINDSOR				
Town Total Acres	**18,368**	Business/Commercial/Office	37	1.10%
Total Acres in 100-Year Floodplain	**3,386**	Industrial	121	3.60%
% Town in Floodplain	**18.40%**	Mixed Use	24	0.70%
		Residential	3,172	93.70%
		ROW	32	0.90%
SOUTHINGTON				
Town Total Acres	**23,240**	Business/Commercial/Office	135	10.90%
Total Acres in 100-Year Floodplain	**1,235**	Industrial	248	20.10%
% Town in Floodplain	**5.30%**	Residential	851	68.90%
		Mixed Use	0.07	0.500%
STAFFORD				
Town Total Acres	**37,568**	Business/Commercial/Office	111	4.20%
Total Acres in 100-Year Floodplain	**2,620**	Industrial	178	6.80%
% Town in Floodplain	**7.00%**	Other	11	0.40%
		Residential	1,198	45.70%
		Resource/Recreation/Public Use	659	25.10%
		ROW	94	3.60%
		Water	370	14.10%
SUFFIELD				
Town Total Acres	**27,540**	Business/Commercial/Office	9	0.50%
Total Acres in 100-Year Floodplain	**1,834**	Industrial	328	17.90%
% Town in Floodplain	**6.70%**	Mixed Use	16	0.90%
		Residential	1,330	72.50%
		Resource/Recreation/Public Use	152	8.30%
TOLLAND				
Town Total Acres	**25,740**	Business/Commercial/Office	2	0.10%
Total Acres in 100-Year Floodplain	**1,076**	Industrial	36	3.30%
% Town in Floodplain	**4.20%**	Residential	1,038	96.50%
VERNON				
Town Total Acres	**11,601**	Business/Commercial/Office	82	10.80%
Total Acres in 100-Year Floodplain	**753**	Industrial	25	3.30%
% Town in Floodplain	**6.50%**	Mixed Use	73	9.60%
		Residential	537	71.30%
		Resource/Recreation/Public Use	37	4.90%

Municipality and Municipal Statistics		Zoning Category	Total Acres in 1% Floodplain	Percent of Floodplain Land by Zoning Category
WEST HARTFORD				
Town Total Acres	**14,336**	Business/Commercial/Office	15	1.50%
Total Acres in 100-Year Floodplain	**975**	Industrial	29	3.00%
% Town in Floodplain	**6.80%**	Residential	931	95.50%
		Resource/Recreation/Public Use	LT 1	0.00%
WETHERSFIELD				
Town Total Acres	**8,430**	Business/Commercial/Office	57	2.30%
Total Acres in 100-Year Floodplain	**2,529**	Mixed Use	76	3.00%
% Town in Floodplain	**30.00%**	Residential	552	21.80%
		Resource/Recreation/Public Use	1,844	72.90%
WILLINGTON				
Town Total Acres	**21,593**	Business / Commercial / Office	11.5	1.85%
Total Acres in 100-Year Floodplain	**621**	Industrial	0.25	0.04%
% Town in Floodplain	**2.88%**	Residential	577	92.91%
WINDSOR				
Town Total Acres	**19,868**	Business/Commercial/Office	27	1.10%
Total Acres in 100-Year Floodplain	**2,500**	Industrial	115	4.60%
% Town in Floodplain	**12.60%**	Mixed Use	14	0.60%
		Residential	389	15.60%
		Resource/Recreation/Public Use	1,954	78.20%
WINDSOR LOCKS				
Town Total Acres	**5,977**	Business/Commercial/Office	2	1.20%
Total Acres in 100-Year Floodplain	**157**	Industrial	133	84.90%
% Town in Floodplain	**2.60%**	Residential	22	13.90%
CAPITOL REGION				
Region Total Acres	**665,830**	Business / Commercial / Office	2,552	4.50%
Total Acres in 100-Year Floodplain	**56,827**	Industrial	4,516	7.90%
% Region in Floodplain	**8.5%**	Mixed Use	1,143	2.00%
		Other	5,701	4.90%
		Residential	31,957	55.60%
		Resource/Recreation/Public Use	12,373	22.20%

How to explain the 1% annual chance of flooding (100-year event)

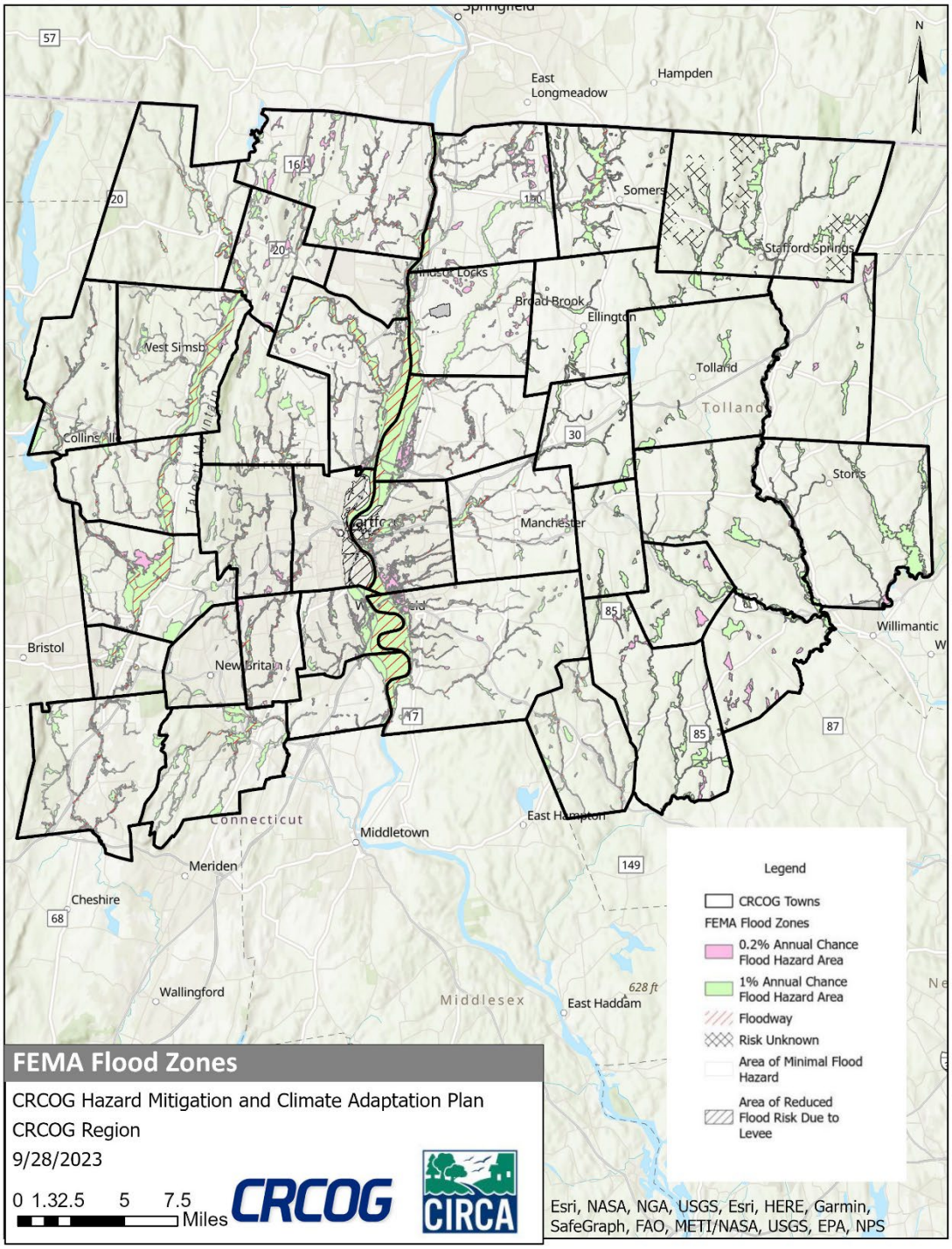
The 1% annual chance exceedance flood sometimes referred to as the 100-year flood, or base flood, has a 1% chance of occurring in any given year. It is not a safety standard, and it has been set as the level that flood insurance is not required if the 1% annual chance flood can be excluded from the floodplain. Although a 1% annual chance flood sounds remote, keep in mind that over the life of an average 30-year mortgage a home located within the 1% flood zone (A or V zone) has a 26% chance of being inundated by the size flood. This same home has less than a 1% chance of fire damage during the same period. What is more significant is the house in a 10-year flood area is almost certain to see a 10-year flood (96% chance) in the same 30-year mortgage cycle. In many areas, the difference in flood heights between a 10% and a 1% event is less than 1 foot.

Flood Frequency Chart

Flood frequency (years)	Chance of flooding in any given year	Percent chance of flooding during 30-year mortgage
10	10 out of 100 (10%)	96%
50	2 out of 100 (2%)	46%
100	1 out of 100 (1%)	26%
500	0.2 out of 100 (0.2%)	6%

Source: U.S. Army Corps of Engineers, Flood Risk Management Program, http://www.nfrmp.us/faqtypical.cfm#question5

The maps and data on the following pages show FEMA flood zones and flood insurance claims and the repetitive flood loss claims community. These illustrate the Capitol Region's potential for losses due to flooding. A review of flood insurance loss claims and repetitive flood loss claims from the past three decades indicates that flooding is a significant risk to the region not only because of its frequency but also because of its damage potential.



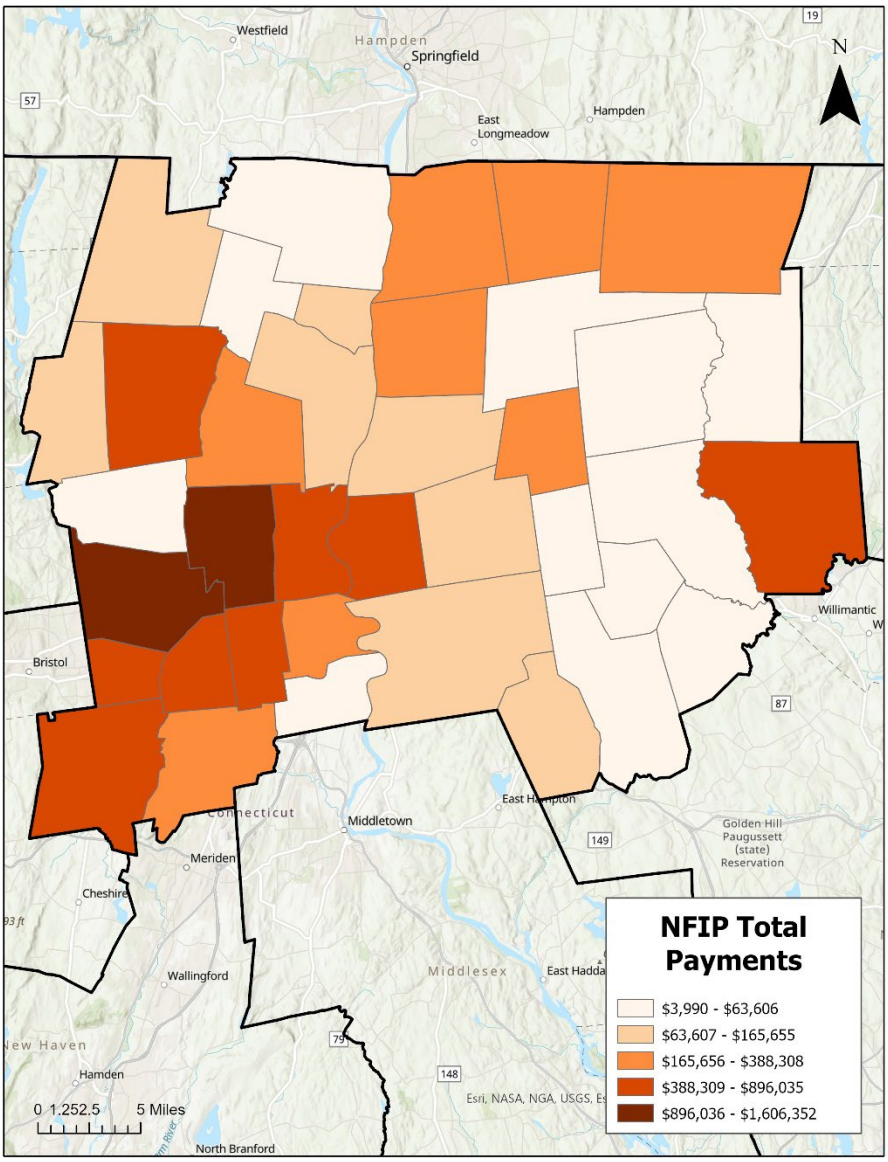
Map 14. Capitol Region Flood Zones

Repetitive Loss Properties

Flood damage is predictable in its location. As seen in Table 39 and Map 15 below, properties in Farmington and West Hartford have experienced substantial losses due to floods. Plainville, Southington, Mansfield, Hartford, Simsbury, East Hartford, Newington, and New Britain have also experienced large numbers of losses.

Table 39. National Flood Insurance Program Loss Statistics as of July 2023

Community Name (Number)	Total Policy Count	Total Net Dollars Paid
Andover	6	$4,980.94
Avon	51	$49,971.57
Berlin	69	$386,299.00
Bloomfield	44	$357,724.61
Bolton	6	$3,989.54
Canton	26	$122,853.58
Columbia	8	$29,366.59
Coventry	10	$50,395.47
East Granby	4	$26,000.00
East Hartford	274	$548,814.67
East Windsor	35	$281,501.59
Ellington	11	$30,868.06
Enfield	91	$317,010.63
Farmington	57	$1,360,495.36
Glastonbury	214	$161,876.64
Granby	18	$98,904.16
Hartford	50	$655,232.50
Hebron	7	$5,043.26
Manchester	64	$123,062.48
Mansfield	20	$737,999.50
Marlborough	15	$94,531.31
New Britain	135	$617,749.27
Newington	60	$662,517.80
Plainville	46	$896,035.15
Rocky Hill	23	$63,605.77
Simsbury	47	$627,167.36
Somers	23	$243,412.27
South Windsor	42	$155,156.63
Southington	67	$810,952.93
Stafford	16	$388,307.61
Suffield	20	$5,733.52
Tolland	9	$28,888.40
Vernon	26	$235,232.67
West Hartford	197	$1,606,352.42
Wethersfield	74	$367,875.24
Willington	4	$11,233.89
Windsor	110	$112,236.37
Windsor Locks	10	$165,655.06
Totals:	**1,989**	**$12,445,033.82**



Map 15. Total Flood Insurance Loss Claims in the Capitol Region by Town through July 2023

Many towns in the region have one or more specific properties that are damaged by flooding on a regular basis. These properties are defined by the National Flood Insurance Program (NFIP) as repetitive flood loss properties or severe repetitive flood loss properties (SRLP). A Repetitive Loss Property (RLP) is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling 10-year period since 1978. At least two of the claims must be more than 10 days apart but within 10 years of each other.

The table and map below show the CRCOG communities that have experienced repetitive losses as of July 2023. The Capitol Region has 153 RLPs region-wide, with the highest numbers in West Hartford,

Farmington, Newington, Southington, Mansfield, and Simsbury. Most of these properties are residential. No insured properties in Andover, Bolton, Coventry, East Granby, East Windsor, Ellington, Glastonbury, Hebron, Somers, Suffield, or Willington have experienced repetitive loss claims as of July 2023.

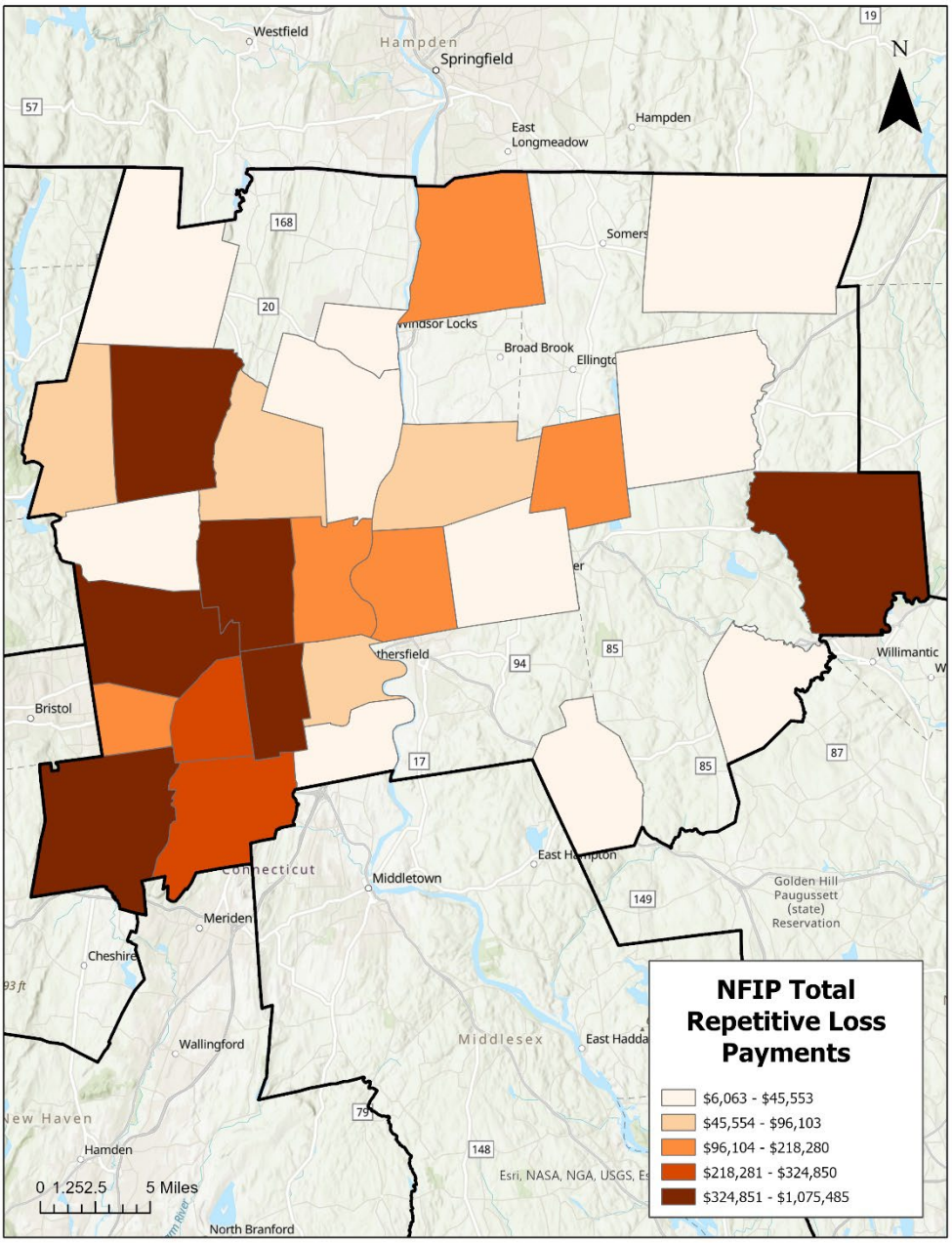
Table 40. National Flood Insurance Program Repetitive Loss Claims 1982-2023

Municipality	Total Payments as of July 2023	Losses (#) as of July 2023	Type of Property
Avon	$45,552.81	7	3-R
Berlin	$280,033.85	20	2-R, 4-N
Bloomfield	$92,004.94	13	5-R
Canton	$96,102.79	18	6-R, 1-N
Columbia	$10,748.20	2	1-N
East Hartford	$186,433.17	16	4-R, 1-N
Enfield	$169,139.71	15	6-R
Farmington	$817,412.23	20	4-R, 2-N
Granby	$23,044.62	4	1-N
Hartford	$153,194.80	11	1-R, 2-N
Manchester	$43,203.94	4	1-R, 1-N
Mansfield	$552,507.58	31	4-R
Marlborough	$6,400.66	2	1-R
New Britain	$324,849.85	40	14-R, 1-N
Newington	$694,499.08	18	1-R, 4-N
Plainville	$218,280.33	21	5-R, 1-N
Rocky Hill	$44,350.16	3	1-R
Simsbury	$534,934.70	48	11-R
South Windsor	$82,255.15	8	1-R, 1-N
Southington	$570,999.51	32	8-R, 2-N
Stafford	$39,628.32	2	1-R
Tolland	$6,063.45	2	1-R
Vernon	$175,237.59	14	2-R, 2-N
West Hartford	$1,075,484.71	114	37-R
Wethersfield	$85,826.92	15	7-R
Windsor	$31,638.42	4	2-R
Windsor Locks	$11,877.85	2	1-R

*R = Residential, N = Nonresidential, i.e., Commercial

Source: FEMA Region 1 July 2023

Note: The above data represent a non-validated sample; several errors are apparent in the list (for example, one property appears twice).



Map 16. Repetitive Flood Insurance Claims in the Capitol Region, June 1982 – July 2023

Loss Estimates

To help assess the risks we face from major flooding, CRCOG used FEMA's HAZUS 6.0 loss estimation program to model the effects of flooding primarily at the local level. The HAZUS model has three levels of analysis depending upon the data used for the analyses. CRCOG performed Level 1 analyses, which primarily rely on default data provided with the software. At this level, loss estimates are approximate,

and the analysis does not include damage/loss due to ground failure or erosion (riverine only), damage/loss due to earthquake driven flooding, or damage/loss due to dam failure. Level 2 analysis improves Level 1 results and requires more extensive inventory data and effort than the Level 1 analysis. For example, knowledgeable users of hydrology and hydraulics models are required to define flood elevations. Level 3 analyses require extensive efforts in developing information on the flood hazards and the measures of exposure. This type of analysis incorporates results from engineering and economic studies carried out using methods and software not included within the software. At this level, one or more technical experts would be required to acquire data, perform detailed analyses, assess damage/loss, and assist in gathering extensive inventory data. It is anticipated that at this level there would need to be extensive participation by local utilities and owners of special facilities. A multiyear effort would likely be required to complete a Level 3 analysis. Level 2 and 3 Analyses are beyond the scope of this planning process.

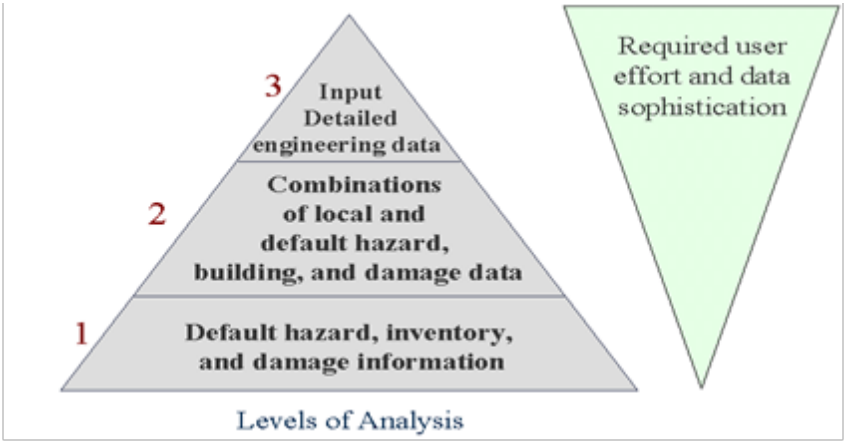


Figure 17: HAZUS Levels of Analysis and User Sophistication

Source: *HAZUS MR4 User Manual*, FEMA

HAZUS was used to estimate losses due to a 1% annual chance (i.e., 100-year) flood in the Capitol Region using an Interpolated Riverine Analysis. The flood hazard modeling included the following input datasets:

- **National Elevation Dataset (NED) 1-Arc Second Digital Elevation Models** – NED 1 arc second DEMs are roughly equivalent to 30-meter grid cells. Therefore, the input ground data utilized for this effort has utilized a dataset that is typical of a HAZUS Level 1 modeling effort.

- **Flood Insurance Rate Maps (FIRM)** – Flood modeling included consultation of the currently effective Flood Insurance Study (FIS) published by FEMA for the region.

HAZUS reports with additional details about the datasets used in this analysis can be found in Appendix O.

Table 41 below shows the damages each town in the region might face from a flood with a 1% probability of occurring in any given year (i.e., the 100-year flood). As can be seen, losses could be particularly high for the Hartford and Farmington communities. In all, the Capitol Region could experience losses of over $3.8 billion from such a major flooding event, including property damage and business interruption loss.

Table 41. Estimated Losses to Capitol Region Communities Due to a 1% Annual Chance Flood Event (in millions of dollars)

Town	Building Loss - Building ($millions)	Building Loss - Content ($millions)	Building Loss - Inventory ($millions)	Business Interruption ($millions)	Total Loss ($millions)	People Seeking Shelter
Andover	$ 3.57	$ 3.20	$ 0.09	$ 6.05	$ 12.91	24
Avon	$ 16.77	$ 21.21	$ 1.03	$ 30.93	$ 69.93	51
Berlin	$ 22.15	$ 40.74	$ 5.81	$ 85.64	$ 154.34	110
Bloomfield	$ 2.71	$ 4.84	$ 0.53	$ 6.78	$ 14.86	65
Bolton	$ 0.20	$ 0.08	$ -	$ 0.14	$ 0.42	9
Canton	$ 35.19	$ 51.25	$ 5.81	$ 91.88	$ 184.13	46
Columbia	$ 4.10	$ 14.39	$ 0.21	$ 242.02	$ 260.72	13
Coventry	$ 2.27	$ 3.12	$ 0.38	$ 5.44	$ 11.20	25
East Granby	$ 2.73	$ 4.23	$ 0.24	$ 7.57	$ 14.76	17
East Hartford	$ 11.72	$ 17.22	$ 2.79	$ 39.73	$ 71.45	292
East Windsor	$ 10.67	$ 18.84	$ 1.78	$ 31.08	$ 62.37	64
Ellington	$ 3.55	$ 4.62	$ 0.24	$ 11.34	$ 19.75	31
Enfield	$ 10.01	$ 17.51	$ 1.27	$ 22.62	$ 51.41	124
Farmington	$ 101.18	$ 142.19	$ 13.92	$ 198.47	$ 455.77	215
Glastonbury	$ 14.16	$ 20.57	$ 1.78	$ 27.77	$ 64.28	121
Granby	$ 8.89	$ 16.22	$ 1.02	$ 33.97	$ 60.11	48
Hartford	$ 77.04	$ 237.46	$ 15.02	$ 531.47	$ 860.98	1270
Hebron	$ 1.68	$ 2.69	$ 0.04	$ 10.68	$ 15.09	7
Manchester	$ 1.97	$ 10.75	$ 0.74	$ 31.73	$ 45.18	219
Mansfield	$ 9.49	$ 13.74	$ 2.47	$ 25.62	$ 51.32	143
Marlborough	$ 1.69	$ 1.71	$ 0.09	$ 3.24	$ 6.73	8
New Britain	$ 18.61	$ 40.52	$ 4.46	$ 162.41	$ 226.01	270
Newington	$ 1.02	$ 1.41	$ 0.11	$ 4.51	$ 7.05	83
Plainville	$ 8.51	$ 17.99	$ 3.57	$ 37.93	$ 68.00	92
Rocky Hill	$ 17.43	$ 31.23	$ 7.86	$ 18.41	$ 74.92	6
Simsbury	$ 42.57	$ 72.28	$ 5.13	$ 129.11	$ 249.10	78
Somers	$ 6.37	$ 12.35	$ 3.50	$ 26.98	$ 49.19	39
South Windsor	$ 13.36	$ 17.10	$ 0.60	$ 39.77	$ 70.82	75
Southington	$ 59.00	$ 139.46	$ 18.89	$ 221.53	$ 438.88	286
Stafford	$ 24.66	$ 53.21	$ 18.34	$ 62.71	$ 158.92	74
Suffield	$ 5.54	$ 4.90	$ 0.26	$ 8.87	$ 19.57	33
Tolland	$ 3.43	$ 3.38	$ 0.37	$ 6.32	$ 13.50	28
Vernon	$ 22.24	$ 54.26	$ 7.98	$ 97.07	$ 181.55	218
West Hartford	$ 31.81	$ 31.07	$ 2.01	$ 46.83	$ 111.72	175
Wethersfield	$ 7.51	$ 10.12	$ 0.41	$ 8.63	$ 26.66	136
Willington	$ 1.43	$ 2.67	$ 0.32	$ 3.81	$ 8.23	14

Town	Building Loss - Building ($millions)	Building Loss - Content ($millions)	Building Loss - Inventory ($millions)	Business Interruption ($millions)	Total Loss ($millions)	People Seeking Shelter
Windsor	$ 16.73	$ 18.84	$ 0.76	$ 31.67	$ 68.01	142
Windsor Locks	$ 2.15	$ 4.87	$ 1.15	$ 4.82	$ 12.99	8
Total	$ 542.24	$ 1,040.41	$ 118.35	$ 2,162.72	$ 3,863.67	3966

Other Loss Estimates

Multiple sources were used to estimate annualized losses due to floods in each community, including NFIP data from the 50-year span of the program, the FEMA National Risk Index, and NCEI losses from the past 20 years, with a wide range of results. Based on the NFIP data, the annualized loss estimate for the Capitol Region is $248,900. Based on the FEMA National Risk Index, the annualized loss estimate for the Capitol Region is $1,551,942. Based on the NCEI, the annualized loss estimate for the Capitol Region is $760,450. Annualized losses for each community based on each of these data sources are presented in each municipal annex.

Table 42. Annualized Loss Estimates due to Flooding

Hazard	Source	Average Annualized Losses (AAL)
Flood	NCEI	$760,450
	NRI	$1,551,942
	NFIP	$248,900

Exposure Analysis

Properties, people, historic resources, and critical facilities in the CRCOG region are exposed to flood impacts. As an initial screening of exposure to flooding, the areas with a 1% probability of flooding in any given year (i.e., the 100-year flood zones) 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 43.

Table 43. Exposure analysis for 1% Annual Chance Flood in the CRCOG region.

Town	Number of Parcels Impacted by 100-Year Flood Risk	Estimated Value for Parcels Impacted by 100-Year Flood Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and 100-Year Flood Risk	Estimated Value for Parcels with Historic Resources and 100-Year Flood Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and 100-Year Flood Risk	Estimated Value for Parcels with Critical Facilities and 100-Year Flood Risk (Based on Grand List Avg.)
Andover	94	$20,655,123	1	$219,735	0	$-
Avon	686	$287,015,690	3	$1,255,170	5	$2,091,951
Berlin	1,092	$334,042,898	3	$917,700	0	$-
Bloomfield	592	$190,512,970	0	$-	3	$965,437

Town	Number of Parcels Impacted by 100-Year Flood Risk	Estimated Value for Parcels Impacted by 100-Year Flood Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and 100-Year Flood Risk	Estimated Value for Parcels with Historic Resources and 100-Year Flood Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and 100-Year Flood Risk	Estimated Value for Parcels with Critical Facilities and 100-Year Flood Risk (Based on Grand List Avg.)
Bolton	155	$36,918,134	0	$-	1	$238,181
Canton	399	$137,154,015	40	$13,749,776	3	$1,031,233
Columbia	177	$47,923,017	3	$812,254	1	$270,751
Coventry	597	$115,816,626	35	$6,789,919	2	$387,995
East Granby	291	$75,157,093	26	$6,715,066	2	$516,543
East Hartford	1,893	$534,510,300	44	$12,423,905	1	$282,361
East Windsor	433	$102,023,780	3	$706,862	4	$942,482
Ellington	364	$110,282,397	1	$302,973	1	$302,973
Enfield	1,776	$456,754,930	12	$3,086,181	3	$771,545
Farmington	792	$327,058,871	38	$15,692,218	6	$2,477,718
Glastonbury	1,259	$450,345,659	137	$49,005,047	9	$3,219,309
Granby	463	$116,682,833	10	$2,520,147	1	$252,014
Hartford	188	$48,076,578	28	$7,160,341	1	$255,726
Hebron	422	$120,012,508	1	$284,389	0	$-
Manchester	408	$144,555,371	22	$7,794,652	3	$1,062,907
Mansfield	570	$171,615,993	12	$3,612,968	1	$301,080
Marlborough	436	$122,900,429	0	$-	1	$281,881
New Britain	741	$149,271,693	0	$-	0	$-
Newington	523	$141,766,205	1	$271,063	1	$271,063
Plainville	466	$119,593,582	0	$-	2	$513,277
Rocky Hill	306	$167,763,640	9	$4,934,224	1	$548,247
Simsbury	797	$237,970,906	25	$7,464,583	4	$1,194,333
Somers	547	$159,619,506	18	$5,252,561	4	$1,167,235
South Windsor	768	$242,585,303	78	$24,637,569	3	$947,598
Southington	1,420	$417,900,135	9	$2,648,662	1	$294,295
Stafford	969	$177,694,609	1	$183,379	1	$183,379
Suffield	537	$155,601,200	15	$4,346,402	3	$869,280
Tolland	162	$39,405,915	0	$-	1	$243,246
Vernon	530	$179,102,423	50	$16,896,455	2	$675,858
West Hartford	1,511	$689,002,219	10	$4,559,908	2	$911,981
Wethersfield	1,175	$351,320,382	218	$65,181,143	2	$597,992
Willington	139	$30,507,432	12	$2,633,735	2	$438,955
Windsor	872	$273,831,535	43	$13,503,160	2	$628,053
Windsor Locks	72	$24,547,143	1	$340,932	2	$681,865
Total	**24,622**	**$7,507,499,059**	**909**	**$285,903,094**	**81**	**$25,818,761**

Drought (Climate Driver: Changing Precipitation)

Although Connecticut has a relatively even distribution of precipitation throughout the year, droughts periodically occur. Lack of precipitation in combination with the typical summer temperatures in the high 80s and low 90s can quickly dry out the soil and streams, leading to drought conditions.

Location

All areas of the Capitol Region communities are susceptible to drought although the likelihood of crop damage and economic loss is generally greater in rural communities. More developed communities are also susceptible to drought, particularly when the drought impacts the availability of water supply. In general, the Capitol Region communities are likely to be part of a larger regional area affected by drought as opposed to being individually affected.

Extent

There are three types of droughts that are a concern in Connecticut: meteorological, hydrological, and agricultural droughts. Both types of droughts can and often do occur simultaneously.

- **Meteorological Droughts** are periods of time where precipitation is lower than "normal" for a time period that is longer than "normal." Because it is defined according to typical conditions, it is region specific. In the New England region, both hydrological droughts and agricultural droughts are directly tied to meteorological droughts.

- **Hydrological Droughts** are characterized by low streamflow, groundwater, and reservoir levels resulting from a lack of precipitation over the course of months. When the presence of rainfall becomes scarce, streams, rivers, and groundwater can suffer, and water utilities can be forced to set restrictions on usage. It can take months to recover from such droughts. Land use also influences the severity and timing of droughts. Areas with vast impervious surface coverage inhibit groundwater recharge and can therefore hasten the onset of a hydrological drought or increase its intensity. Wildfires can also be more prevalent during such droughts.

- **Agricultural Droughts** occur during the growing season due to a lack of adequate precipitation and soil moisture to sustain crops. It is determined when the hydration needs of crops are not being sustained by the soil. The region can recover from an agricultural drought more quickly than from a hydrological drought; however, an agricultural drought can result in significant economic losses for the agricultural community.

The Palmer Drought Severity Index was devised in 1965. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for determining the severity of drought on unirrigated cropland. It primarily reflects long-term drought and has been used extensively to initiate drought relief. The index ranges from -4.0 (or less) to +4.0 (or more), with an index of 0.0 representing normal conditions. Indexes from -2.0 to -.9 indicate moderate drought, indexes from -3.0 to -3.9 represent severe drought, and indexes of -4.0 or less indicate extreme drought. Positive indices represent increasing moisture in the soil.

Previous Occurrences

According to the Connecticut Drought Preparedness and Response Plan, droughts have occurred periodically in the state. Serious hydrological droughts were recorded from June 1929 through July 1932. The 1957 drought was both hydrological and agricultural, with the largest impact being on crops. The most recent droughts occurred in 1964-1968, 1981, 1987, 2002, 2005, 2007-2008, 2012, 2013, 2015-2017, 2020, and 2022.

During the 2002 drought, several water utilities imposed mandatory water conservation and restriction measures on their customers while most other companies imposed voluntary restrictions. Such restrictions can impact businesses as well as residences. The state responded to the 2002 drought by developing a drought management plan, which established monitoring and assessment protocols. (See the Drought Matrix below.) During the height of this drought, some municipalities conducted public outreach and education regarding water conservation.

A meteorological drought was declared for Hartford, Tolland, and Windham Counties from April 12 through April 24, 2012, due to precipitation levels that were approximately half of normal levels. According to the NOAA Storm Events Database, rivers and streams were most affected as most ran at record low levels during the spring runoff season. The state did not issue a drought declaration; however, as reservoirs were at normal levels thanks largely to above-normal precipitation falling between August 2011 and November 2011. The main impact of this meteorological drought was periods of very high fire danger. In addition, small pond levels were reduced. While soil moisture was well below normal, this drought occurred prior to the beginning of the growing season. Thus, no agricultural impacts were realized.

The 2016 drought was one of the most severe for Connecticut in recent memory, with precipitation in Windsor Locks measured at nearly 13 inches below normal for the year. Numerous water utilities imposed mandatory water use restrictions on their customers, and several areas reported private wells running dry. The state responded to this drought by reevaluating the 2003 drought plan.

The most recent severe drought warning for Connecticut was issued in 2022, affecting 87% of the state and causing significant agricultural losses. Shortages in reservoirs, streams, and wells were experienced throughout the state. USDA-declared drought events affected Connecticut, including both Hartford and Tolland counties, in 2020 and 2022.

Probability of Future Events

The 2023 *Connecticut Natural Hazard Mitigation Plan Update* indicates that Connecticut is likely to experience a drought every two to three years.

The future frequency of droughts in the region may depend upon the changes in climate and resource use. As the state's plan notes, predicting the future occurrences of drought within any given time period is difficult. Climate change can bring more intense heat waves and more days without precipitation, which may result in more droughts. Drought remains a potential natural hazard for the Capitol Region. Because human actions can increase the risk of water shortages without any change in meteorological conditions, efforts to conserve water and reduce runoff can protect our water resources even in non-drought periods.

Impacts to Community Assets

Droughts periodically occur in Connecticut and can have serious consequences. While a drought does not pose immediate threats to life and property, it can have severe economic, environmental, and social consequences. A lack of precipitation can affect not only agricultural production but also tourism, water utilities, residential wells, businesses, and more. Droughts may also lead to losses or destruction of fish and wildlife habitat, loss of wetlands, and lower water levels in reservoirs, lakes, and ponds. The reduction in water levels can also cause private wells to go dry or pumps to fail and can cause dry hydrants to be unusable for fire protection purposes.

In addition, droughts can increase the severity of flooding as land that has been dry for extended periods of time does not allow water to infiltrate as quickly, which may lead to flash flooding. Droughts also exacerbate the possibility of wildfires due to the very dry conditions. See the following pages for a checklist of potential consequences from the National Drought Mitigation Center.

According to the American Planning Association, since 1980, drought has been the fourth most common type of disaster in the United States but is the second most costly overall and per incident. Much of the United States was in the midst of a severe and persistent drought in 2012. This drought affected almost 40% of the country's agricultural land and nearly a third of all farms. Although the eastern seaboard did not experience severe drought conditions in 2012, the impacts are likely to be felt nationwide. One consequence of the 2012 drought was an increase in the cost of food; 2013 prices were expected to rise by 2% to 4.5% for a variety of food products.

Loss Estimates

Based on information reported to the NCEI, drought has not caused any damages in Hartford and Tolland Counties. However, this may simply be because drought is a persistent hazard when it occurs, and losses occur gradually over time. Other sources can be used to estimate annualized losses due to droughts in each community, including the FEMA National Risk Index and losses reported to USDA from the past 10 years. The National Risk Index estimates the annualized loss from drought for the Capitol Region at $3,422,783. USDA-reported losses indicate an annualized loss of $1,272,516. More information is presented in the individual annex for each community.

Table 44. Annualized Loss Estimates due to Drought

Hazard	Source	Average Annualized Losses (AAL)
Drought	NRI	$3,422,783
	USDA	$1,272,516

					Palmer Drought Index		
	Precipitation	**Groundwater**	**Streamflow**	**Reservoirs**	**Severity**	**Crop Moisture**	**Fire Danger**
ADVISORY	2 months (cumulative) below %65 of normal	3 consecutive months below normal *	2 out of 3 months below normal *	Average levels less than 80% of normal	-2.0 to -2.99	-1.0 to -1.99 abnormally dry,	Moderate
WATCH	3 months cumulative below 65% of normal	4 consecutive months below normal *	4 out of 5 months below normal *	Average levels less than 70% of normal	-3.0 to -3.99	-2.0 to -2.99 excessively dry	High
WARNING	More than 4months cumulative below 65% of normal,	4 consecutive months below normal *	6 out of 7 months below normal *	Average levels less than 60% of normal.	-4 or less	-3 or less	Very High
EMERGENCY	More than 6 months cumulative below 65% of normal	8 consecutive months below normal *	7 months below normal *	Average levels less than 50% of normal or less than 50 days of supply	-4 or less	-3 or less severely dry	Extreme

* Normal levels for groundwater and streamflow are defined as the 25th percentile of the period of record.

Figure 18. Connecticut Drought Matrix

Source: State of Connecticut Interagency Drought Work Group, www.ct.gov/waterstatus/cwp/view.asp?a=3238&q=397062

Checklist of Potential Drought Impacts

Economic:

Costs and losses to agricultural and livestock producers—

- Annual and perennial crop losses
- Damage to crop quality
- Income loss for farmers due to reduced crop yields
- Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)
- Insect infestation
- Plant disease
- Wildlife damage to crops
- Increased irrigation costs
- Cost of new or supplemental water resource development (wells, dams, pipelines)
- Reduced milk production
- Forced reduction of foundation stock
- High cost/unavailability of water and/or feed for livestock
- Increased feed transportation costs
- High livestock mortality rates
- Disruption of reproduction cycles (delayed breeding, more miscarriages)
- Decreased stock weights

Loss from timber production—

- Wildland fires
- Tree disease
- Insect infestation
- Impaired productivity of forest land
- Direct loss of trees, especially young ones

Loss from fishery production—

- Damage to fish habitat
- Loss of fish and other aquatic organisms due to decreased flows

General economic effects—

- Decreased land prices
- Loss to industries directly dependent on agricultural production
- Unemployment from drought-related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
- Revenue losses to federal, state, and local governments (from reduced tax base)
- Reduction of economic development
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss

Loss to recreation and tourism industry—

- Loss to manufacturers and sellers of recreational equipment
- Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.

Energy-related effects—

- Increased energy demand and reduced supply because of drought-related power curtailments
- Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power

Water suppliers—

- Revenue shortfalls and/or windfall profits
- Cost of water transport or transfer
- Cost of new or supplemental water resource development

Transportation industry—

- Loss from impaired navigability of streams, rivers, and canals

Decline in food production/disrupted food supply—

- Increase in food prices
- Increased importation of food (higher costs)

Checklist of Potential Drought Impacts

Environmental:

Damage to animal species—

- Reduction and degradation of fish and wildlife habitat
- Lack of feed and drinking water
- Greater mortality due to increased contact with agricultural producers as animals seek food from farms and producers are less tolerant of the intrusion
- Disease
- Increased vulnerability to predation (from species concentrated near water)
- Migration and concentration (loss of wildlife in some areas and too many wildlife in other areas)
- Increased stress to endangered species
- Loss of biodiversity

Hydrological effects—

- Lower water levels in reservoirs, lakes, and ponds
- Reduced flow from springs
- Reduced streamflow
- Loss of wetlands
- Estuarine impacts (e.g., changes in salinity levels)
- Increased groundwater depletion, land subsidence, reduced recharge
- Water quality effects (salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)

Damage to plant communities—

- Loss of biodiversity
- Loss of trees from urban landscapes, shelterbelts, wooded conservation areas
- Increased number and severity of fires
- Wind and water erosion of soils, reduced soil quality
- Air quality effects (e.g., dust, pollutants)
- Visual and landscape quality (e.g., dust, vegetative cover, etc.)

Social:

Health—

- Mental and physical stress (e.g., anxiety, depression, loss of security, domestic violence)
- Health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced firefighting capability, etc.)
- Reductions in nutrition (e.g., high-cost food limitations, stress-related dietary deficiencies)
- Loss of human life (e.g., from heat stress, suicides)
- Public safety from forest and wildland fires
- Increased respiratory ailments
- Increased disease caused by wildlife concentrations

Increased conflicts—

- Water user conflicts
- Political conflicts
- Management conflicts
- Other social conflicts (e.g., scientific, media based)

Reduced quality of life, changes in lifestyle—

- Population migrations (rural to urban areas, migrants into the United States)
- Loss of aesthetic values
- Disruption of cultural belief systems (e.g., religious and scientific views of natural hazards)
- Reevaluation of social values (e.g., priorities, needs, rights)
- Public dissatisfaction with government drought response
- Perceptions of inequity in relief, possibly related to socioeconomic status, ethnicity, age, gender, seniority
- Loss of cultural sites
- Increased data/information needs, coordination of dissemination activities
- Recognition of institutional restraints on water use

Source: National Drought Mitigation Center, University of Nebraska-Lincoln, http://drought.unl.edu/Home.aspx

Exposure Analysis

Properties, people, historic resources, and critical facilities in the CRCOG region are exposed to drought impacts. As an initial screening of exposure to drought risk, the areas likely to be served by a private well (i.e. parcels with structures but with no public water connection) 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 45. This exposure analysis does not directly provide insight into agricultural exposure, but previous discussions (above) related to USDA payments can be used to characterize agricultural drought losses.

Table 45. Exposure analysis for Drought in the CRCOG region.

Town	Number of Parcels Impacted by Drought Risk	Estimated Value for Parcels Impacted by Drought Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and Drought Risk	Estimated Value for Parcels with Historic Resources and Drought Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and Drought Risk	Estimated Value for Parcels with Critical Facilities and Drought Risk (Based on Grand List Avg.)
Andover	1,674	$367,836,993	40	$8,789,414	3	$659,206
Avon	1,919	$802,890,832	1	$418,390	3	$1,255,171
Berlin	1,427	$436,519,428	8	$2,447,201	0	$-
Bloomfield	575	$185,042,159	0	$-	0	$-
Bolton	2,254	$536,861,124	9	$2,143,634	2	$476,363
Canton	2,659	$914,016,360	59	$20,280,920	1	$343,744
Columbia	2,544	$688,791,841	34	$9,205,551	2	$541,503
Coventry	5,520	$1,070,867,304	20	$3,879,954	4	$775,991
East Granby	1,700	$439,062,060	70	$18,079,026	2	$516,544
East Hartford	221	$62,401,889	0	$-	0	$-
East Windsor	1,449	$341,414,452	20	$4,712,415	0	$-
Ellington	2,345	$710,473,139	1	$302,974	1	$302,974
Enfield	844	$217,061,465	1	$257,182	3	$771,545
Farmington	2,106	$869,679,271	8	$3,303,625	4	$1,651,812
Glastonbury	5,876	$2,101,851,546	5	$1,788,505	3	$1,073,103
Granby	4,145	$1,044,601,180	48	$12,096,708	2	$504,030
Hartford	39	$9,973,333	0	$-	0	$-
Hebron	3,356	$954,412,269	33	$9,384,864	0	$-
Manchester	931	$329,855,516	3	$1,062,907	0	$-
Mansfield	3,676	$1,106,772,616	83	$24,989,697	1	$301,081
Marlborough	2,334	$657,911,934	0	$-	4	$1,127,527
New Britain	61	$12,288,223	0	$-	0	$-
Newington	120	$32,527,619	0	$-	0	$-
Plainville	457	$117,283,836	44	$11,292,098	0	$-
Rocky Hill	244	$133,772,314	1	$548,247	0	$-
Simsbury	2,584	$771,539,299	30	$8,957,500	1	$298,583

Town	Number of Parcels Impacted by Drought Risk	Estimated Value for Parcels Impacted by Drought Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and Drought Risk	Estimated Value for Parcels with Historic Resources and Drought Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and Drought Risk	Estimated Value for Parcels with Critical Facilities and Drought Risk (Based on Grand List Avg.)
Somers	2,502	$730,106,043	0	$-	2	$583,618
South Windsor	2,005	$633,311,891	21	$6,633,192	0	$-
Southington	1,968	$579,174,272	2	$588,592	0	$-
Stafford	4,126	$756,623,281	0	$-	1	$183,379
Suffield	2,529	$732,803,419	13	$3,766,882	1	$289,760
Tolland	4,874	$1,185,582,905	1	$243,246	2	$486,493
Vernon	1,975	$667,409,973	11	$3,717,220	0	$-
West Hartford	40	$18,239,635	0	$-	0	$-
Wethersfield	177	$52,922,304	1	$298,996	0	$-
Willington	2,359	$517,748,437	47	$10,315,463	10	$2,194,779
Windsor	1,030	$323,447,800	1	$314,027	0	$-
Windsor Locks	31	$10,568,909	0	$-	0	$-
Total	**74,676**	**$21,123,646,871**	**615**	**$169,818,430**	**52**	**$14,337,206**

Dam Failure (Climate Driver: Changing Precipitation)

Dams provide vital benefits to our region such as water supply, power generation, flood control, and recreation, but in the event of failure, they can pose a threat to lives and property. Dam failure can happen for a number of reasons including as a result of natural disasters such as structural failure due to earthquakes or overtopping due to heavy precipitation. Failure due to material fatigue is also possible, but regular maintenance and dam inspections can detect leaks and other signs of material fatigue before the problem escalates.

Location

Dam failure can only occur at and along the watercourses and low-lying areas downstream of dams. Although the effects of dam failure can impact any of the Capitol Region communities, the actual level of impact can differ based on the number and hazard classification of the dams within and upstream of the community. In the case of a lower hazard dam, the effect of the failure would likely be constrained within the 1% annual chance floodplain or the 0.2% annual chance floodplain. The failure of a higher hazard dam could produce effects far greater than the 0.2% annual chance flood and could also cause a chain reaction where downstream dams also overtop and fail.

The location of state-identified dam inundation areas in the Capitol Region are presented on Map 17.

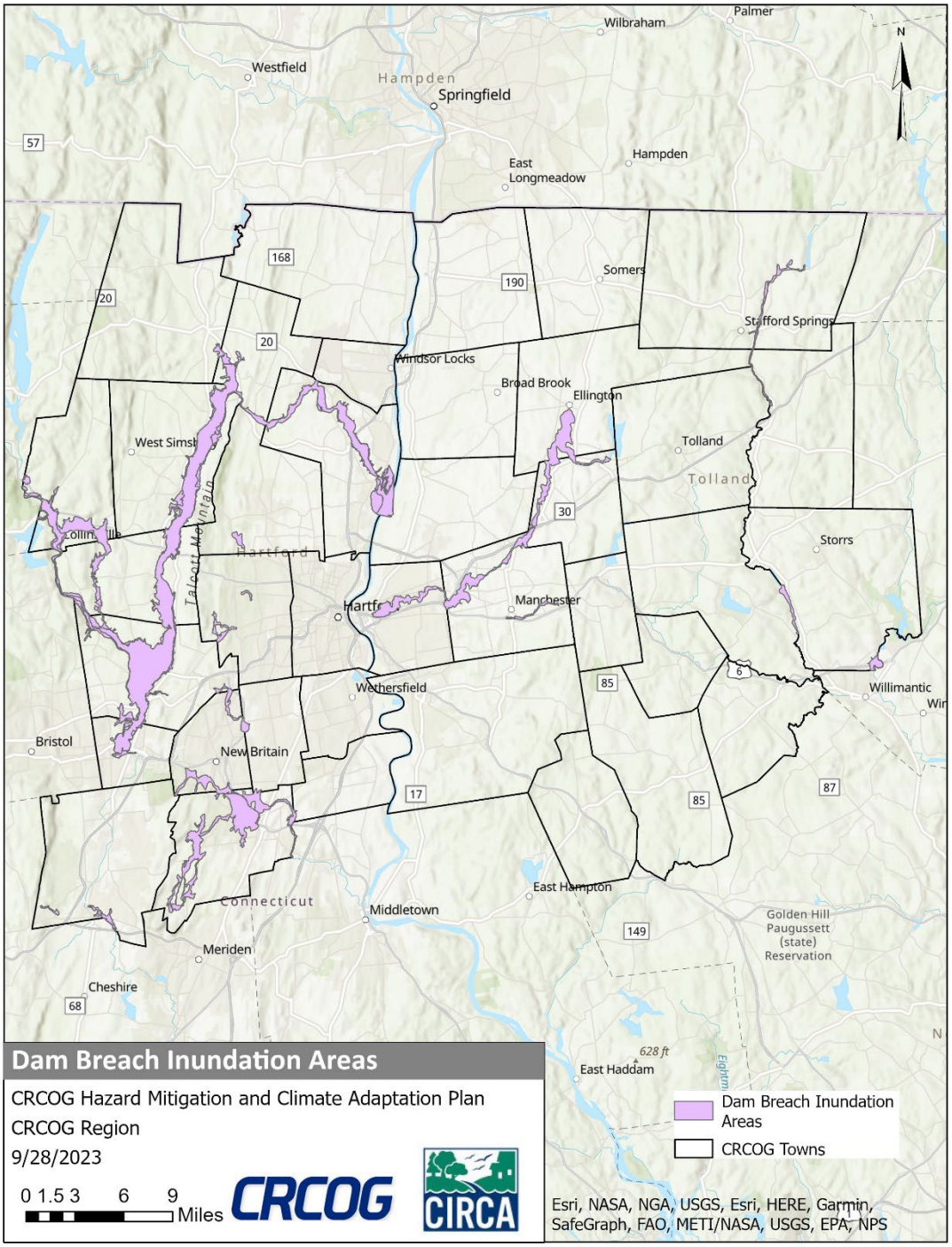
Extent

Dams in Connecticut are regulated by the Department of Energy & Environmental Protection (DEEP). Dams are rated by their hazard potential as outlined in the table below. According to DEEP's *Guidelines for Inspection and Maintenance of Dams*, owners of Class B and C dams are required to prepare and implement an emergency operations plan (EOP), which would include an identification of the area inundated by a dam failure, establishment of a procedure for monitoring the dam during heavy rainfall and runoff, and formalizing a warning system to alert local emergency management officials. The hazard classifications are described in Table 46.

Table 46. Dam Hazard Categories

Hazard Classification	Hazard Potential
Class C:	**High** hazard potential dam which, if it were to fail, would result in the probable loss of life; major damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to main highways; or great economic loss
Class B:	**Significant** hazard potential dam which, if it were to fail, would result in possible loss of life; minor damage to habitable structures, residences, hospitals, convalescent homes, schools, etc.; damage to or interruption of the use or service of utilities; damage to primary roadways and railroads; or significant economic loss
Class BB:	**Moderate** hazard potential dam which, if it were to fail, would result in damage to normally unoccupied storage structures, damage to low-volume roadways, or moderate economic loss
Class A:	**Low** hazard potential dam which, if it were to fail, would result in damage to agricultural land, damage to unimproved roadways, or minimal economic loss
Class AA:	**Negligible** hazard potential dam which, if it were to fail, would result in no measurable damage to roadways, land and structures, and negligible economic loss

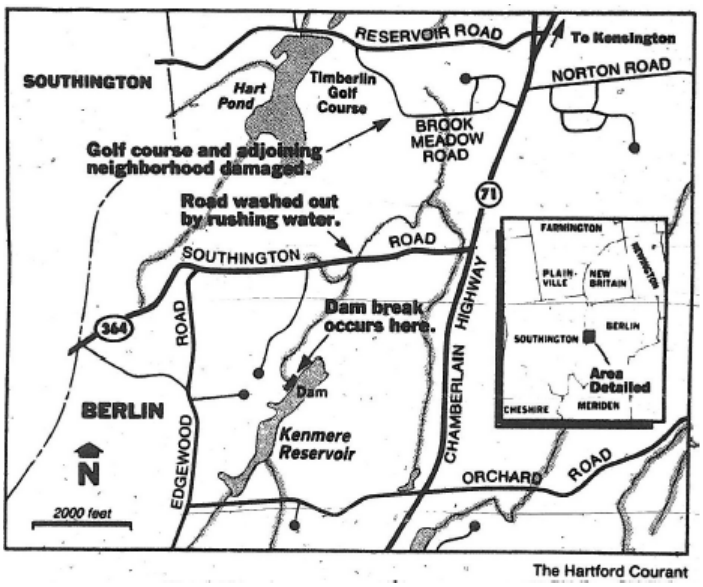
Source: *Guidelines for Inspection and Maintenance of Dams,* Connecticut Department of Environmental Protection, September 2001, available for download at http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325634&deepNav_GID=1654



Map 17. State-Identified Dam Inundation Areas in the Capitol Region

Previous Occurrences

There have been a few dam failures in the Capitol Region in recorded history:



- March 31, 1987: The Kenmere Reservoir Dam (Class C dam) in Berlin collapsed on March 31, 1987, during a reconstruction effort. According to the *Hartford Courant*, torrential rains overwhelmed the dam and sent roughly 80 million gallons of water into surrounding Berlin where it destroyed a bridge, inundated homes and businesses, and did extensive damage to a municipal golf course. No serious injuries resulted from the dam failure, and the property damage incurred was estimated to be approximately $187,000 (1987 dollars).

Other major dam failures in Connecticut have occurred in 1938 and 1955 due to hurricanes, 1961 (Crystal Lake Dam in Middletown), 1963 (Spaulding Pond Dam in Norwich), and June 5-6, 1982 (Bushy Hill Pond Dam in Deep River). The October 7-15, 2005, heavy rainfall caused 10 complete or partial dam failures in Hartford and Tolland Counties and damage to another 30 dams across the state, demonstrating the region's vulnerability to localized storm impacts on dams. Several low and moderate hazard potential dams suffered some impact from localized major flooding. The table below shows a list of dams that were breached or damaged in October 2005; six of these occurred within the Capitol Region.

Table 47. Dams Impacted by October 2005 Flooding

Number	Name	Location	Class	Damage Type	Ownership
-----	Somerville Pond Dam	Somers	--	Partial Breach	DEEP
4701	Windsorville Dam	East Windsor	BB	Minor Damage	Private
10503	Mile Creek Dam	Old Lyme	B	Full Breach	Private
-----	Staffordville Reservoir #3	Union	--	Partial Breach	CT Water Co.
8003	Hanover Pond Dam	Meriden	C	Partial Breach	City of Meriden
-----	ABB Pond Dam	Bloomfield	--	Minor Damage	Private
4905	Springborn Dam	Enfield	BB	Minor Damage	DEEP
13904	Cains Pond Dam	Suffield	A	Full Breach	Private

Number	Name	Location	Class	Damage Type	Ownership
13906	Schwartz Pond Dam	Suffield	BB	Partial Breach	Private
14519	Sessions Meadow Dam	Union	BB	Minor Damage	DEEP

Probability of Future Events

Dam failures are most likely triggered by the occurrence of another natural disaster or hazard and are not likely to occur when regular maintenance and inspections are performed. Therefore, dam failures are less likely to occur than the natural disasters that may trigger them. For example, a 1% annual chance flood will not always cause a dam failure.

Impacts to Community Assets

Not all dams pose a serious threat; the vast majority of dams in the state impound water bodies that, either because of their size or location, would not cause major destruction in the event of a dam failure. DEEP's list of dams currently has 74% of all dams in the state classified as AA, A, or BB (dam classification can change as a result of downstream development) such that only a small percentage are classified as significant or high hazard dams. All dams are subject to inspection by DEEP although DEEP has recently shifted the onus of regular dam inspections to dam owners. High hazard and significant hazard dams are required to have Emergency Action Plans prepared to guide response personnel in the case a failure is imminent; these plans also identify downstream areas at risk in case of a failure.

According to the DEEP, there are hundreds of dams in the Capitol Region. The majority of these are either Class A (low hazard) or Class AA (negligible hazard); failure of a Class A dam would lead to minimal economic loss and may cause damage to agricultural land or unpaved roadways while failure of a Class AA dam would cause negligible loss or damage. Dams of concern for hazard mitigation are those in Classes BB, B, and C. In the Capitol Region, 49 dams are Class C, or high hazard, dams. Failure of a Class C dam would result in probable loss of life, major damage to habitable structures, damage to major highways, and great economic loss. There are 46 Class B, or significant hazard, dams in the Region. Failure in these dams would result in similar but less severe damage. Finally, there are 135 Class BB, or moderate hazard, dams in the region. Failure of one of these dams would result in damage to normally unoccupied structures or local roadways or would cause moderate economic loss; no loss of life would be expected.

Following is a list of the high hazard potential dams located within the Capitol Region; these dams pose the primary risks to the region. The CT DEEP, Metropolitan District Commission (MDC), or municipalities own the majority of these dams, which serve for recreation, flood control, or water supply. Significant and moderate hazard (Classes B and BB) dams are listed on the CT DEEP website at https://www.ct.gov/deep/dams. A list of low and negligible hazard dams is not maintained by the state.

Table 48. Capitol Region High Hazard Dams (Class C)

CT Dam #	Dam Name	Hazard Class	TOWN	Subregional Basin #	Owner
703	KENSINGTON DAM	C	BERLIN	4600	Local
1101	BLOOMFIELD FLOOD CONTROL SITE #3 DAM	C	BLOOMFIELD	4404	State
1103	WINTONBURY FLOOD CONTROL SITE #1 DAM	C	BLOOMFIELD	4404	State
1104	COLD SPRING FLOOD CONTROL SITE # DAM	C	BLOOMFIELD	4404	State

CT Dam #	Dam Name	Hazard Class	TOWN	Subregional Basin #	Owner
1105	BLUE HILLS FLOOD CONTROL SITE #2 DAM	C	BLOOMFIELD	4404	State
1106	BARBER POND DAM	C	BLOOMFIELD	4321	State
1138	BLUE HILLS FLOOD CONTROL SITE #2 DIKE	C	BLOOMFIELD	4404	State
3001	COLUMBIA LAKE DAM	C	COLUMBIA	3108	Local
3201	ROMAN POND DAM	C	COVENTRY	3105	Private
4313	EAST HARTFORD CT RIVER DIKE	C	EAST HARTFORD	4006	Private
4902	FRESHWATER POND DAM	C	ENFIELD	4003	Local
5201	BATTERSON PARK POND DAM	C	FARMINGTON	4401	Local
5202	FARMINGTON RESERVOIR DAM	C	FARMINGTON	4315	Local
5211	SOUTH RESERVOIR DAM	C	FARMINGTON	4403	State
6405	SOUTH MEADOWS PUMPING POND DAM	C	HARTFORD	4005	Local
6407	HARTFORD DIKE	C	HARTFORD	4000	Local
6408	NORTH MEADOW DIKE	C	HARTFORD	4000	Local
6409	SOUTH MEADOW DIKE	C	HARTFORD	4000	Local
6410	FOLLY BROOK DIKE	C	HARTFORD	4005	Local
6412	NORTH MEADOWS PUMPING POND	C	HARTFORD	4000	Local
7706	UNION POND DAM	C	MANCHESTER	4500	Local
7804	EAGLEVILLE DAM	C	MANSFIELD	3100	State
7829	MANSFIELD HOLLOW DAM	C	MANSFIELD	3200	Federal
8910	BATTERSON PARK POND DIKE	C	NEW BRITAIN	4401	Local
13101	PLAINVILLE RESERVOIR DAM	C	SOUTHINGTON	5200	Local
13102	SHUTTLE MEADOW RESERVOIR DAM	C	SOUTHINGTON	4602	Local
13122	SPRING LAKE DAM	C	SOUTHINGTON	5200	Private
13228	AVERY FLOOD CONTORL SITE #I DAM	C	SOUTH WINDSOR	4500	State
13229	AVERY FLOOD CONTROL SITE #2 DAM	C	SOUTH WINDSOR	4500	State
13401	WHITNEY RESERVOIR SITE #1	C	STAFFORD	3101	State
13402	ELLIS RESERVOIR SITE #2	C	STAFFORD	3101	State
13403	POMEROY RESERVOIR SITE #3	C	STAFFORD	3101	State
13405	ELLITHORPE RESERVOIR SITE #5	C	STAFFORD	3102	State
13406	SHENIPSIT RESERVOIR SITE #6	C	STAFFORD	3101	State
13408	STAFFORDVILLE RESERVOIR DAM	C	STAFFORD	3103	Local
13410	WARREN POND DAM	C	STAFFORD	3103	Private
13411	RIVERSIDE POND DAM	C	STAFFORD	3103	Private
14601	ANO COIL POND DAM	C	VERNON	4500	Private
15507	HARTFORD RESERVOIR DAM #1	C	WEST HARTFORD	4403	Utility
15512	BURNT HILL RESERVOIR DAM	C	WEST HARTFORD	4403	State
15513	TALCOTT RESERVOIR DAM #1	C	WEST HARTFORD	4404	State
15514	BUGBEE RESERVOIR	C	WEST HARTFORD	4403	State
15523	TALCOTT RESERVOIR DAM #2	C	WEST HARTFORD	4403	State
15529	SOUTH RESERVOIR DIKE	C	WEST HARTFORD	4403	State

CT Dam #	Dam Name	Hazard Class	TOWN	Subregional Basin #	Owner
15536	NEW PARK AVE FLOOD PROTECTION LEVEE	C	WEST HARTFORD	4400	Local
15538	HARTFORD RESERVOIR #6 SOUTH DAMS & DIKE	C	WEST HARTFORD	4404	Local
15539	HARTFORD RESERVOIR #3 DIKES (also see #15509)	C	WEST HARTFORD	4403	Utility
15540	HARTFORD RESERVOIR #5 DIKE (also see #15510)	C	WEST HARTFORD	4403	Utility
16401	RAINBOW RESERVOIR DAM	C	WINDSOR	4300	Utility

Source: CT DEEP, 2023

According to the *2023 Connecticut Natural Hazard Mitigation Plan Update:*

> "The most critical and hazardous dams are required to meet a spillway design standard much higher than passing the runoff from a 100-year rainfall event. Although not all the dams under CT DEEP jurisdiction have been measured to withstand the 100-year rainfall event, most of the dams meet this standard due to original design requirements or recent spillway upgrades. Therefore, when smaller rainfall events, such as 10-year and 25-year, occur more frequently there will be little impact on the ability of Connecticut dams to operate safely."

Once a dam collapses, the damage it does is largely dependent upon the sorts of land uses surrounding it. While the Kenmere Dam inflicted damage primarily upon a golf course, other dams in the region (notably the Shuttle Meadow Reservoir Dam, which overlooks densely developed New Britain) could do far more damage in a collapse. Not only can buildings downstream be inundated by resulting flooding, they can be damaged by the violent torrent of water as well, which impacts like a battering ram. Utility connections can be severed, in turn causing fires and power outages; people can be injured or even killed by rushing waters and the debris carried therein. Refer to the "Impacts to Community Assets" section for flooding for more information.

Due to the relatively minimal historical record of dam failure events in the CRCOG region with recorded damages, and because no new dam failures have occurred in the past five years, annualized loss estimates from dam failure in the CRCOG region were estimated based on the 2019-2024 CROCG Hazard Mitigation Plan (HMP). The 2019 HMP Dam failures were sourced in turn from the 2014 Connecticut Natural Hazard Mitigation Plan Update, with dam failure data supplemented by the National Performance of Dams Program and the Connecticut Department of Energy & Environmental Protection. The resulting annualized loss estimate from dam failure for the CRCOG region is $10,810.

Note that this method does not take into account site-specific details or particular dam failure damages that may have directly affected a particular community in the historic record. For example, the Connecticut DEP estimated the damage to the Columbia Lake Dam in Columbia from the June 1982 flood to be $20,000. Therefore, these annualized loss estimates should be used with caution and as a minimum loss estimate. Nevertheless, these figures provide useful planning numbers when considering the overall vulnerability of the Capitol Region to dam failure, suggesting that the annualized risk is relatively minimal for most communities. Annualized losses for each community are presented in each municipal annex.

The 2023 *Connecticut Natural Hazard Mitigation Plan Update* estimates there are nearly 67,500 people in Hartford County and nearly 5,000 people in Tolland County within the mapped dam inundation areas

of high and significant hazard dams. The Capitol Region includes most of, although not all, the municipalities in Hartford and Tolland Counties, thus the regional population exposed to this risk is likely less than 7.5 percent.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the CRCOG region are exposed to the risk of dam failure. As an initial screening of exposure to dam failure, the state dam inundation area (provided by the Connecticut Department of Energy and Environmental Protection) 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 49.

Table 49. Exposure analysis for Dam Inundation Areas in the CRCOG region.

Town	Average Appraised Parcel Value	Number of Parcels in Dam Inundation Zones	Average Appraised Parcel Value in Dam Inundation Zone	Number of Historical Resources (SHPO) in Dam Inundation Zones	Average Appraised Parcel Value of SHPO in Dam Inundation Zone	Number of Critical Facilities in Dam Inundation Zones	Average Appraised Parcel Value of Critical Facilities in Dam Inundation Zone
Andover	$219,735	0	$0	0	$0	0	$0
Avon	$418,390	955	$399,562,664	0	$0	1	$418,390
Berlin	$305,900	1,939	$593,140,278	7	$2,141,301	3	$917,700
Bloomfield	$321,812	82	$26,388,621	2	$643,625	0	$0
Bolton	$238,182	0	$0	0	$0	0	$0
Canton	$343,744	830	$285,307,852	165	$56,717,826	4	$1,374,978
Columbia	$270,752	0	$0	0	$0	0	$0
Coventry	$193,998	25	$4,849,942	0	$0	1	$193,998
East Granby	$258,272	109	$28,151,626	0	$0	0	$0
East Hartford	$282,361	354	$99,955,969	12	$3,388,338	0	$0
East Windsor	$235,621	0	$0	0	$0	0	$0
Ellington	$302,974	146	$44,234,148	1	$302,974	0	$0
Enfield	$257,182	0	$0	0	$0	0	$0
Farmington	$412,953	1,997	$824,667,378	171	$70,614,983	5	$2,064,766
Glastonbury	$357,701	0	$0	0	$0	0	$0
Granby	$252,015	13	$3,276,192	0	$0	0	$0
Hartford	$255,726	0	$0	0	$0	0	$0
Hebron	$284,390	0	$0	0	$0	0	$0
Manchester	$354,302	281	$99,558,968	24	$8,503,257	2	$708,605
Mansfield	$301,081	91	$27,398,343	0	$0	0	$0
Marlborough	$281,882	0	$0	0	$0	0	$0
New Britain	$201,446	980	$197,417,359	0	$0	1	$201,446
Newington	$271,063	25	$6,776,587	0	$0	0	$0
Plainville	$256,639	566	$145,257,442	0	$0	3	$769,916
Rocky Hill	$548,247	1	$548,247	0	$0	0	$0
Simsbury	$298,583	1,098	$327,844,490	73	$21,796,583	3	$895,750

Town	Average Appraised Parcel Value	Number of Parcels in Dam Inundation Zones	Average Appraised Parcel Value in Dam Inundation Zone	Number of Historical Resources (SHPO) in Dam Inundation Zones	Average Appraised Parcel Value of SHPO in Dam Inundation Zone	Number of Critical Facilities in Dam Inundation Zones	Average Appraised Parcel Value of Critical Facilities in Dam Inundation Zone
Somers	$291,809	0	$0	0	$0	0	$0
South Windsor	$315,866	14	$4,422,128	0	$0	0	$0
Southington	$294,296	199	$58,564,878	2	$588,592	1	$294,296
Stafford	$183,379	263	$48,228,775	1	$183,379	2	$366,759
Suffield	$289,760	0	$0	0	$0	0	$0
Tolland	$243,246	7	$1,702,725	0	$0	0	$0
Vernon	$337,929	463	$156,461,171	76	$25,682,611	2	$675,858
West Hartford	$455,991	164	$74,782,505	0	$0	0	$0
Wethersfield	$298,996	0	$0	0	$0	0	$0
Willington	$219,478	21	$4,609,036	0	$0	0	$0
Windsor	$314,027	513	$161,095,847	20	$6,280,540	1	$314,027
Windsor Locks	$340,933	0	$0	0	$0	0	$0
Total	$11,310,662	11,136	$3,624,203,173	554	$196,844,008	29	$9,196,488

Climate Driver #4: Rising Temperature

According to the Fourth National Climate Assessment, the average temperature has increased by 1.2 degrees Fahrenheit between 1986 and 2016. Additionally, temperature records from the past twenty years show the number of high temperature records exceeding the number of low temperature records, in addition to an extended frost-free season over the years.

It is projected that over the next few decades that annual temperature across the United States will increase by about 2.2 degrees Fahrenheit, with increase between 2.3 and 6.7 degrees under low emission scenarios and 5.4 and 11.0 degrees under high emission scenarios by late century.

It was noted that particularly in the northeast temperatures tend to be slightly higher due to the abundance of concrete and asphalt, and relative lack of vegetation. This in turn increases the urban heat island effect. During heat waves and extreme heat events, these highly impervious areas that have an increased urban heat island effect experience higher nightly temperatures than surrounding, more vegetated areas. Increased temperatures can translate to increased heat stress, poor air quality, greater risk of wildfires, and increased vulnerability due to health, occupation, and lack of air conditioning. Rising temperatures will also increase demand on electric supply as heat wave frequency increases and so does the demand for energy and air conditioning.

The greatest impact of rising temperatures is likely to be associated with human health. Air quality will likely degrade as temperatures rise, and climate change is expected to increase levels of ground-level ozone. Increased temperatures are expected to lead to an increase in heat related death, illness, emergency department visits, and hospitalizations.

Extreme Heat (Climate Driver: Rising Temperature)

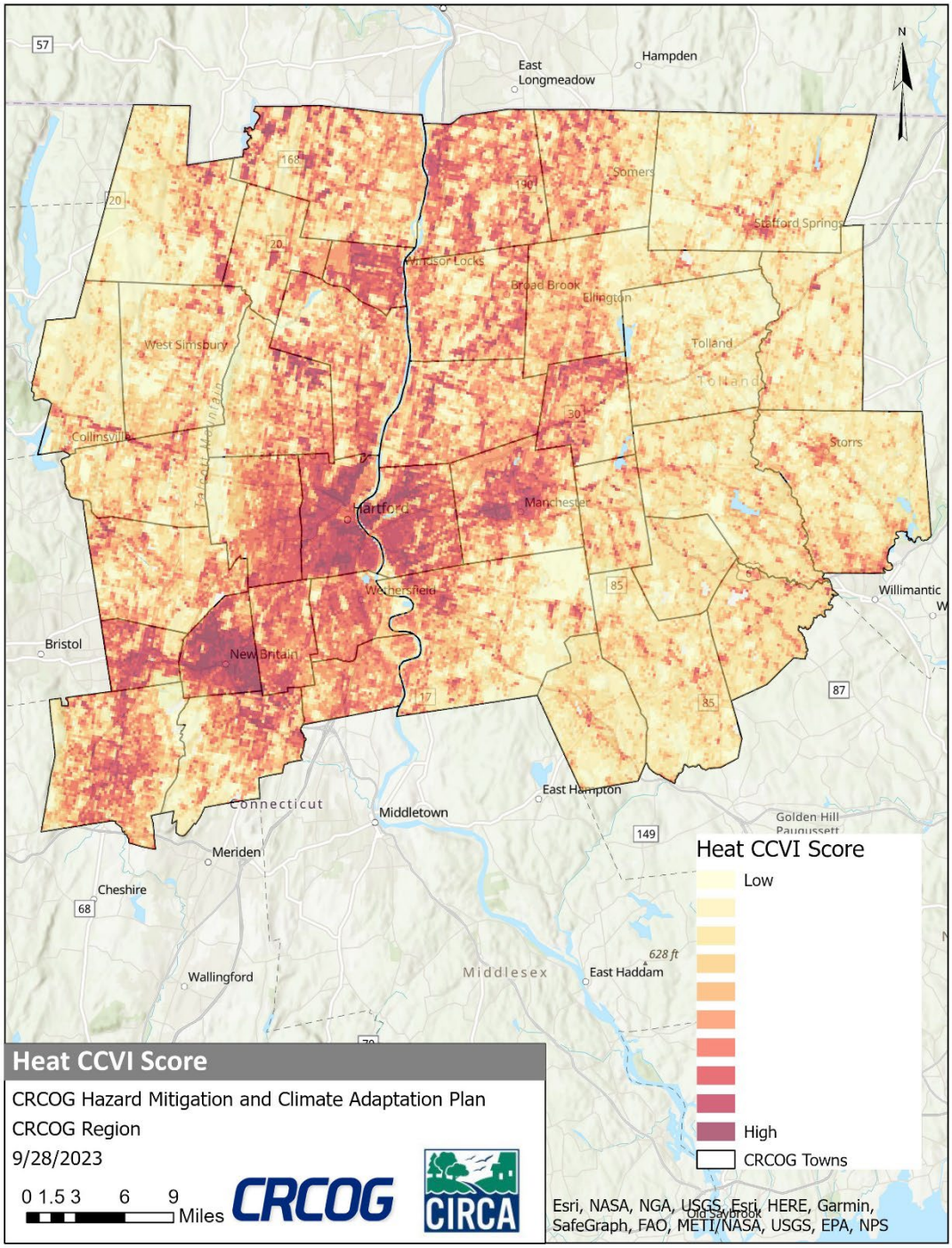
According to the National Weather Service, extreme temperature (including extreme heat, humidity, and extreme cold) is the number one weather-related killer in the United States.

Extreme heat may be generally defined as temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity. At certain levels the human body cannot maintain proper internal temperatures and may experience severe health disorders including heat cramps, heat exhaustion or heatstroke (a life-threatening condition).

Location

The entire CRCOG region is vulnerable to extreme heat, but particularly the urban communities with high levels of impervious surfaces and little vegetation. This combination can produce a "heat island" effect with increased temperatures and few opportunities to seek respite from heat.

CIRCA has developed a Climate Change Vulnerability Index that combines built, social, and ecological factors to identify areas that are vulnerable to the extreme heat impacts of climate change. This statewide tool can be used to view vulnerability at a regional scale. More information about the CIRCA Climate Change Vulnerability Index can be found here: https://resilientconnecticut.uconn.edu/ccvi/ The CCVI Extreme Heat Vulnerability map for the CRCOG region is displayed in Map 18.



Map 18. Climate Change Vulnerability Index Extreme Heat Vulnerability Scores for the CRCOG Region

Extent

The National Weather Service's Heat Index is a measure of the effects of the combined elements of air temperature and relative humidity on the human body, particularly for people in higher risk groups

(elderly persons, young children, persons with respiratory difficulties, and those who are sick or overweight). Table 50 summarizes the extent of these effects.

Table 50. Effects of Extreme Heat on the Human Body

Heat Index	Heat Disorder
80–89° F	Fatigue possible with prolonged exposure and/or physical activity.
90–104° F	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity.
105–129° F	Sunstroke, heat cramps or heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity.
130° F and Higher	Heatstroke/sunstroke highly higher likely with continued exposure.
Source: National Oceanic and Atmospheric Administration NWS	

An extreme heat wave is when temperatures and humidity are higher than normal for two to three days. This threshold is considered 90 degrees or more for the region. As temperatures and humidity rise above that threshold the risk of heat-related illness or death increases, ultimately increasing the severity of the heat wave.

Previous Occurrences

NOAA historical records indicate that there have been no fatalities in the planning area due to extreme heat from 1995 through 2022. It is clear, however, that temperatures in Connecticut are increasing: the Yale Center on Climate Change and Health reports that six of the hottest years in the last 125 years have occurred since 2005, and there were on average 422 emergency department visits and 45 hospitalizations per year for heat stress from 2007 to 2016 in the state of Connecticut.

Notable past occurrences in the planning area include:

- June 21 to June 23, 2012: An early summer heat wave set records across the northeast with extremely high temperatures. The National Weather Service's NOWData online records reported a high of 97 degrees in the Hartford area.
- July 5 to July 21, 2013: According to the National Weather Service's NOWData online records, over the course of 17 days, 12 had a high of at least 90 degrees in the Hartford area. On July 18, Governor Malloy issued a press release urging residents to conserve energy as energy demands were reaching a seven year record per ISO-New England.
- July 21 to July 30, 2016: According to the National Weather Service's NOWData online records, the Hartford Area had a ten day stretch with daily temperatures over 90 degree.
- June 11 to 13, 2017: According to the National Weather Service's NOWData online records, the Hartford area experienced 3 days with highs above 90 degrees.
- June 29 to July 5, 2018: The NWS issued an excessive heat warning for inland communities in the state. Temperatures in the Hartford area surpassed 90 degrees for 7 days.
- July 20-21, 2019 – The NWS issued an excessive heat watch for all counties in the state. Temperatures reached 100 degrees in the Hartford area.

- July 18 – August 14, 2020: According to the National Weather Service's NOWData online records, over this 28 day stretch, 21 days surpassed 90 degrees in the Hartford Area.
- June 5-9, 2021: According to the National Weather Service's NOWData online records, the Hartford area experienced 5 days with highs above 90 degrees.
- July 18-25, 2022 – On July 18 Governor Lamont activated a statewide extreme heat protocol in preparation for a heat wave. The next six days all had highs over 90 degrees in the Hartford Area.
- August 2-9, 2022: The Governor activated the state extreme hot weather protocol. The next eight days all had highs over 90 degrees in the Hartford Area.
- September 5-7, 2023: Temperatures in the Hartford Area surpassed 90 degrees for three days during this fall heat wave.

Probability of Future Events

The likelihood of heat hazard impacts is increasing. CIRCA has previously published a fact sheet with several projections for increased heat within Connecticut, including:

- Heat Wave Days (6 or more consecutive days with daily maximum temperature above the 90th percentile.) to rise from 4 to 48.
- Tropical Nights (annual number of days when the daily minimum is above 68°F) to rise from 10 to 40.
- Summer Days (annual number of days when the daily maximum temperature is above 77°F) to rise from 81 to 118.
- Number of Days above 90°F (annual number of days with maximum temperatures above the threshold value) to rise from 5 to 25.

For more information on these estimates, please see resilientconnecticut.uconn.edu

Impacts to Community Assets

The impacts of extreme heat are primarily public health, or agriculturally related. During extreme heat waves individuals may suffer from heat related conditions or death such as heat stroke, or cardiovascular disease or disorders, respiratory disease and disorders, or kidney disorders. Hospitalizations, typically in urbanized areas or among the elderly, often increase during heat waves due to these conditions. Agricultural operations face challenges as during extreme heat waves crops may become stressed and require increased irrigation, and livestock operations may face challenges in keeping animals cool and hydrated. In addition, critical infrastructure such as roadways or rail lines, can become stressed during extreme, extended heat waves.

Impacts also include stress on power grids during periods when there is an increased demand for heating and cooling, a rise in food prices if damage occurs to crops livestock operations, and extreme temperature events can put a strain on community resources when having to respond to individuals that are not actively mitigating personal impacts from heat or cold.

Loss estimates related to extreme heat are challenging to quantify, and not as consistently documented as other natural hazards. Based on the National Risk Index, the annualized loss estimate for the Capitol

Region from extreme heat is $972,438. Annualized losses for each community are presented in each municipal annex.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to extreme heat. As an initial screening of exposure to hazards, areas of risk (in this case, the entire CRCOG region) 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 51.

Table 51. Exposure analysis for extreme heat in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Extreme Heat Risk Area	Approx. Appraised Parcel Value in Extreme Heat Risk Area	Number of Historical Resources (SHPO) in Extreme Heat Risk Area	Approx. Appraised Parcel Value of SHPO in Extreme Heat Risk area	Number of Critical Facilities in Extreme Heat Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Extreme Risk area
Andover	$219,735	1,704	$374,429,046	40	$8,789,414	2	$439,471
Avon	$418,390	7,932	$3,318,671,261	11	$4,602,292	13	$5,439,073
Berlin	$305,900	9,017	$2,758,301,127	91	$27,836,908	3	$917,700
Bloomfield	$321,812	8,510	$2,738,623,920	5	$1,609,062	9	$2,896,312
Bolton	$238,182	2,366	$563,537,451	9	$2,143,634	6	$1,429,089
Canton	$343,744	3,964	$1,362,602,800	289	$99,342,131	5	$1,718,722
Columbia	$270,752	2,615	$708,015,200	37	$10,017,806	4	$1,083,006
Coventry	$193,998	6,610	$1,282,324,786	126	$24,443,710	8	$1,551,982
East Granby	$258,272	2,653	$685,195,086	111	$28,668,170	8	$2,066,174
East Hartford	$282,361	14,331	$4,046,522,571	226	$63,813,698	9	$2,541,253
East Windsor	$235,621	4,960	$1,168,678,871	25	$5,890,519	9	$2,120,587
Ellington	$302,974	6,100	$1,848,139,057	65	$19,693,285	5	$1,514,868
Enfield	$257,182	16,651	$4,282,334,586	552	$141,964,368	15	$3,857,727
Farmington	$412,953	11,221	$4,633,746,946	357	$147,424,263	15	$6,194,297
Glastonbury	$357,701	15,300	$5,472,826,486	457	$163,469,392	36	$12,877,239
Granby	$252,015	5,167	$1,302,160,286	83	$20,917,225	7	$1,764,103
Hartford	$255,726	19,160	$4,899,719,451	4,237	$1,083,513,117	10	$2,557,265
Hebron	$284,390	4,011	$1,140,687,600	51	$14,503,881	4	$1,137,559
Manchester	$354,302	16,252	$5,758,122,239	1,301	$460,947,393	10	$3,543,024
Mansfield	$301,081	4,640	$1,397,014,420	106	$31,914,554	8	$2,408,646
Marlborough	$281,882	2,732	$770,100,857	0	$0	6	$1,691,290
New Britain	$201,446	15,736	$3,169,958,733	129	$25,986,571	8	$1,611,570
Newington	$271,063	12,416	$3,365,524,343	21	$5,692,333	10	$2,710,635
Plainville	$256,639	7,472	$1,917,603,547	72	$18,477,979	5	$1,283,193

Town	Average Appraised Parcel Value	Parcel Count in Extreme Heat Risk Area	Approx. Appraised Parcel Value in Extreme Heat Risk Area	Number of Historical Resources (SHPO) in Extreme Heat Risk Area	Approx. Appraised Parcel Value of SHPO in Extreme Heat Risk area	Number of Critical Facilities in Extreme Heat Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Extreme Risk area
Rocky Hill	$548,247	4,922	$2,698,472,686	277	$151,864,473	10	$5,482,472
Simsbury	$298,583	10,795	$3,223,206,986	153	$45,683,249	14	$4,180,167
Somers	$291,809	3,865	$1,127,841,671	181	$52,817,424	14	$4,085,326
South Windsor	$315,866	11,129	$3,515,275,849	210	$66,331,919	13	$4,106,262
Southington	$294,296	18,395	$5,413,572,556	18	$5,297,326	10	$2,942,959
Stafford	$183,379	5,384	$987,314,543	3	$550,138	6	$1,100,276
Suffield	$289,760	6,417	$1,859,390,877	184	$53,315,867	13	$3,766,882
Tolland	$243,246	6,562	$1,596,182,814	49	$11,919,073	12	$2,918,957
Vernon	$337,929	7,990	$2,700,053,470	861	$290,956,951	10	$3,379,291
West Hartford	$455,991	19,953	$9,098,386,094	327	$149,109,019	14	$6,383,872
Wethersfield	$298,996	9,958	$2,977,402,886	1,074	$321,121,781	7	$2,092,973
Willington	$219,478	2,453	$538,379,359	66	$14,485,543	14	$3,072,691
Windsor	$314,027	12,177	$3,823,906,683	127	$39,881,428	14	$4,396,378
Windsor Locks	$340,933	4,391	$1,497,034,814	6	$2,045,595	7	$2,386,528
Total	**$11,310,662**	**325,911**	**$100,021,261,958**	**11,937**	**$3,617,041,492**	**373**	**$115,649,817**

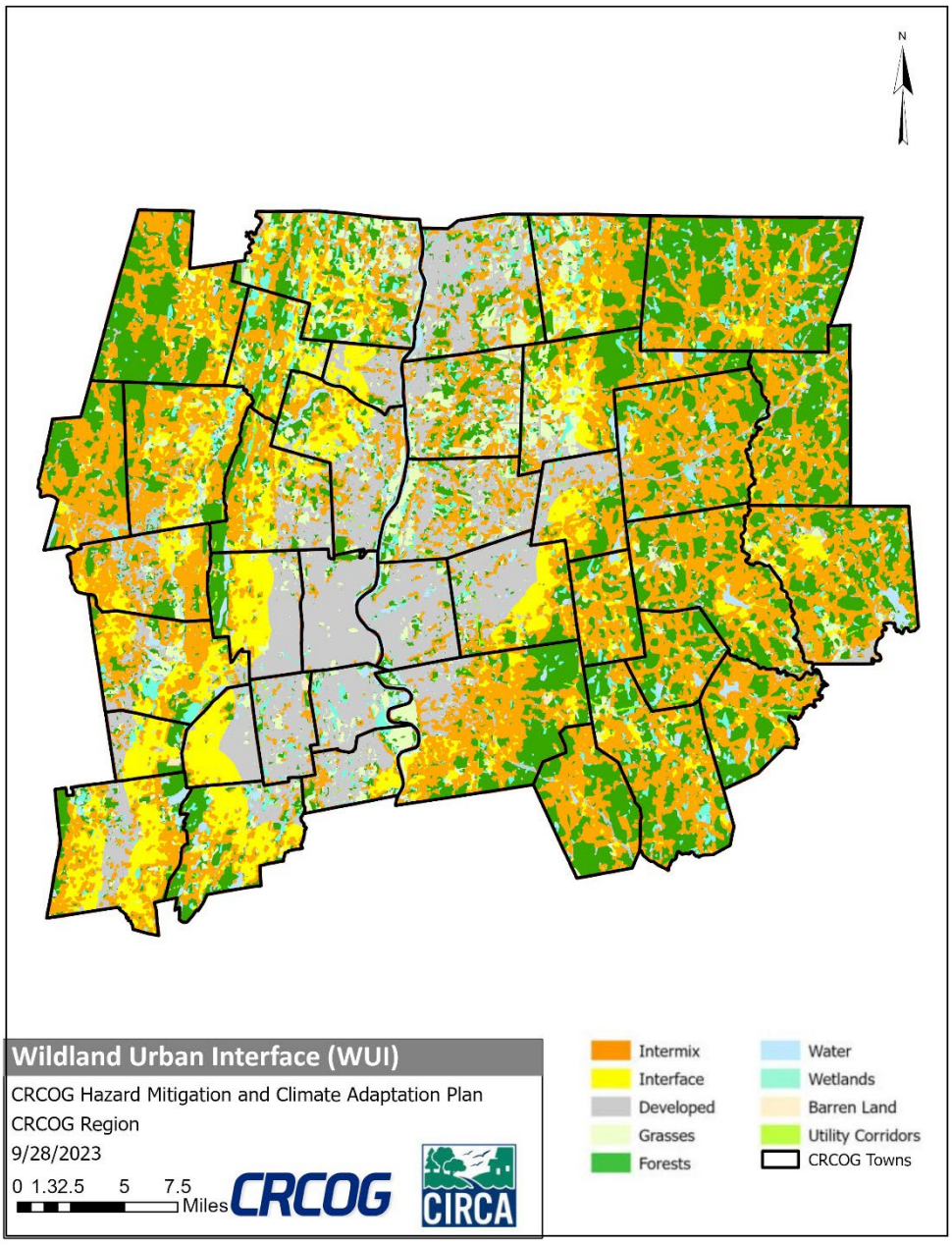
Forest and Wildland Fires (Climate Driver: Rising Temperature)

Wildfires are a relatively common occurrence in Connecticut but are typically small and cause little to no damage to populated areas. Structural fires in higher-density areas of the region are not considered herein.

Location

Wildfires typically occur in undeveloped rural or forested areas although smaller fires can also occur along highway medians. Wildfire damage is typically greatest at the wildland interface where low-density suburban/rural developed areas border undeveloped wooded and shrubby areas. Wildfires are of particular concern for areas with limited firefighting access such as outlying areas without public water service and large contiguous forest parcels with limited access. All Capitol Region communities are susceptible to lightning. Unlike the other hazards described in this Plan, the likelihood of damage due to wildfires in Connecticut typically decreases with increasing population density, meaning that less developed communities such as Willington have a greater risk than heavily developed communities such as New Britain.

Areas of wildfire risk in the Capitol Region, represented by the wildland-urban interface (WUI) are depicted in Map 19.

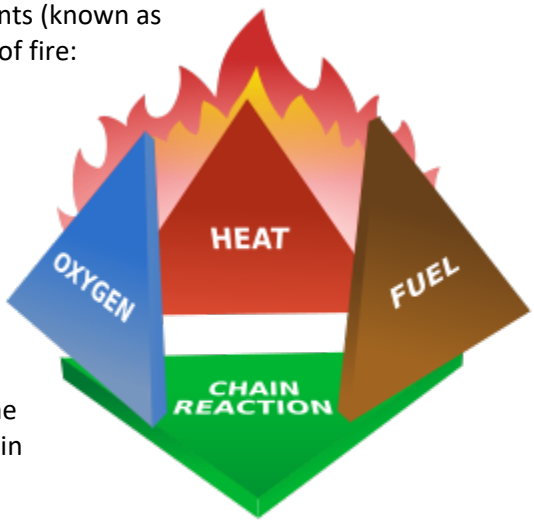


Map 19. Wildland Urban Interface in the CRCOG Region.

Extent

Wildfires are any nonstructure fire, other than a prescribed burn, that occurs in undeveloped areas. They are considered to be highly destructive, uncontrollable fires. Although the term brings to mind images of tall trees engulfed in flames, wildfires can occur as brush and shrub fires, especially under dry conditions. Wildfires are also known as "wildland fires."

According to the National Fire Protection Agency, several elements (known as the fire tetrahedron) must be present in order to have any type of fire:



The Fire Tetrahedron
Image Provided Wikimedia Commons

- **Fuel**: Without fuel, a fire will stop. Fuel can be removed naturally (when the fire has consumed all burnable fuel) or manually by mechanically or chemically removing fuel from the fire. In structure fires, removal of fuel is not typically a viable method of fire suppression. Fuel separation is important in wildfire suppression and is the basis for controlling prescribed burns and suppressing other wildfires. The type of fuel present in an area can help determine overall susceptibility to wildfires. According to the Forest Encyclopedia Network, four types of fuel are present in wildfires:
    - Ground Fuels: organic soils, forest floor duff, stumps, dead roots, buried fuels
    - Surface Fuels: the litter layer, downed woody materials, dead and live plants to 2 meters tall
    - Ladder Fuels: vine and draped foliage fuels
    - Canopy Fuels: tree crowns
- **Heat**: Without sufficient heat, a fire cannot begin or continue. Heat can be removed through the application of a substance, such as water, powder, or certain gases, that reduces the amount of heat available to the fire. Scraping embers from a burning structure also removes the heat source.
- **Oxygen**: Without oxygen, a fire cannot begin or continue. In most wildland fires, this is commonly the most abundant element of the fire triangle and is therefore not a major factor in suppressing wildfires.
- **Uninhibited Chain Reaction**: The chain reaction is the feedback of heat to the fuel to produce the gaseous fuel used in the flame. In other words, the chain reaction provides the sustained heat necessary to maintain the fire. Fire suppression techniques, such as dry chemical extinguishers, break up the uninhibited chain reaction of combustion to stop a fire.

The Connecticut Department of Energy & Environmental Protection Division of Forestry issues forest fire danger ratings. The ratings are low, moderate, high, very high, and extreme. These are based on an index of how quickly a fire is likely to spread and measures of drought. In addition, the National Weather Service issues "Red Flag" warnings. A Red Flag warning means that if a fire occurs, firefighters can expect it to behave erratically due to weather conditions.

Previous Occurrences

According to the Connecticut DEEP Forestry Division, much of Connecticut was deforested by settlers and turned into farmland during the colonial period. A variety of factors in the 19th century caused the decline of farming in the state, and forests reclaimed abandoned farm fields. In the early 20th century, deforestation again occurred in Connecticut, this time for raw materials needed to ship goods

throughout the world. Following this deforestation, shipping industries in Connecticut began to look to other states for raw materials, and the deciduous forests of today began to grow in the state.

During the early 20th century, wildfires regularly burned throughout Connecticut. Many of these fires began accidentally by sparks from railroads and industry while others were deliberately set to clear underbrush in the forest and provide pasture for livestock. A total of 15,000 to 100,000 acres of land was burned annually during this period. This destruction of resources led to the creation of the position of the State Forest Fire Warden and led to a variety of improved coordination measures described in Section IV.

In the last 30 years, a handful of notable fires have occurred in the Capitol Region. Statewide droughts in 1999 and 1995 resulted in fires in the region and in other locations in the state. Several fires from the Capitol Region were reported on in the *Hartford Courant*:

> **May 1995:** A forest fire burned nearly 40 acres on a ridge near the Sweetheart Lake area of Tolland. Officials believed the fire was started accidentally. Unusually dry conditions contributed to the fire's spread. Approximately 50 firefighters from seven departments laid nearly 2,000 feet of hose to contain the fire at its perimeter.
>
> **September 1995:** During a drought, a blaze started in Southington that burned over 25 acres of land for 3 days before being contained. No homes or businesses were affected.
>
> **April 1999:** A brush fire in the Talcotville section of Vernon burned about 40 acres. Eight fire departments battled the blaze, hauling water in tanker trucks. The fire came within 100 feet of houses in a nearby neighborhood.
>
> **August 1999**: A forest fire burned over 18 acres of woodland along the Berlin/Meriden border for 7 days before being extinguished. The Berlin Fire Chief suspected that the blaze originated from a campfire. No homes or businesses were affected. This was just one fire in what is considered the worst wildfire year in Connecticut, where over 1,733 acres burned in 345 separate wildfires, or an average of 5 acres per fire.
>
> **April 2005:** A fire burned about 8 acres near the Farmington River in Avon. About 30 firefighters from five departments put the fire out. The DEP (predecessor of DEEP) Division of Forestry reported a "high" forest fire danger level for that day.

Throughout Connecticut, 1999 was a particularly busy fire year because of drought conditions. The state's 2023 *Natural Hazard Mitigation Plan Update* notes that the most recent large wildland fire in Connecticut occurred in September 2016, burning 384 acres. The 2023 state plan goes on to note that in 2020 Connecticut experienced 603 separate wildland fire events, the most of any year in the last five years.

Probability of Future Events

Nationwide, humans have caused approximately 90% of all wildfires in the last decade. Accidental and negligent acts include unattended campfires, sparks, burning debris, children playing with matches, and irresponsibly discarded cigarettes. The remaining 10% of fires are caused primarily by lightning.

There are three fire seasons in Connecticut. The spring season runs from mid-March to mid-May. Prior to leaf-out, fuels such as grasses, dead leaves, branches, and twigs on the forest floor are heated and

dried out by the sun. These fuels cause spring fires that tend to spread quickly although they tend to cause little long-term damage to the forest. The summer fire season lasts from mid-May through September and is largely dependent on precipitation, or lack thereof. Summer fires tend to spread less quickly than spring fires because they burn deeper into the ground. However, the burning of organic material in the soil makes summer fires more difficult to suppress. Summer fires are the most destructive to vegetation. Consequently, erosion usually follows summer forest fires. The fall fire season runs from October through the first snowfall. Fall fires can spread rapidly because of drying leaves that have fallen.

Table 52. Wildland Fire Statistics for Connecticut

Year	Total Number of Fires	Total Acres Burned
2022	150	347
2021	60	127
2020	586	383
2019	88	72
2018	52	40
2017	100	274
2016	271	930
2015	80	184
2014	32	103
2013	80	275
2012	184	459
2011	203	286
2010	99	314
2009	270	322
2008	336	961
2007	368	348
2006	328	475
2005	326	393
2004	86	279
2003	105	234
2002	114	290
Total	**3,918**	**7,096**

Source: National Interagency Fire Center

The 2023 *Connecticut Natural Hazard Mitigation Plan Update* notes that wildland fires burn less than a fraction of one-percent of the total forested acreage in the state. In general, the wildland fires in Connecticut are small and detected quickly. While the overall incidence of forest fires is relatively low (with 2,430 events reported to the National Interagency Fire Center between 2013 and 2022, an average of 243 fires per year, or less than two fires per Connecticut municipality per year), wildfires are a hazard communities must be prepared for each year. Fire risk in CRCOG region is believed to be roughly the same as in the rest of the state.

Based on the historic record, the average wildfire in Connecticut in a very dry year (1999) burned an average of 5 acres per fire while the average acres burned per fire is 1.2 acres according to the 2023 *Connecticut Natural Hazard Mitigation Plan Update.* These averages are also reasonable for the Capitol Region communities although it is expected that larger wildfires could occur, particularly in relatively undeveloped areas such as parts of Berlin, Southington, Vernon, and Willington.

Impacts to Community Assets

The Connecticut DEEP also states that the primary cause of wildland fires in seven of the eight counties is undetermined, with the secondary cause being arson or debris burning. Forest fires can cause not only long-term damage to vegetation and ecosystems but also damage to developments, especially as residential development has increased in woodland areas.

Overall, the annualized losses for the Capitol Region due to wildfire are relatively modest. Based on the National Risk Index, the annualized loss estimate for the Capitol Region from wildfires is $78,333. Annualized losses for each community are presented in each municipal annex.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to wildfire risk. As an initial screening of exposure to hazards, areas of risk (in this case, the land within the USGS Wildland-Urban Interface) 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 53.

Table 53. Exposure analysis for wildfire in the CRCOG region.

Town	Number of Parcels Impacted by Wildfire Risk	Estimated Value for Parcels Impacted by Wildfire Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and Wildfire Risk	Estimated Value for Parcels with Historic Resources and Wildfire Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and Wildfire Risk	Estimated Value for Parcels with Critical Facilities and Wildfire Risk (Based on Grand List Avg.)
Andover	1,647	$361,904,138	40	$8,789,414	2	$439,471
Avon	6,022	$2,519,545,905	9	$3,765,512	9	$3,765,512
Berlin	7,495	$2,292,721,175	76	$23,248,407	4	$1,223,600
Bloomfield	3,939	$1,267,619,241	4	$1,287,250	2	$643,625
Bolton	2,325	$553,772,011	9	$2,143,634	6	$1,429,089
Canton	3,445	$1,184,199,458	301	$103,467,064	5	$1,718,722
Columbia	2,469	$668,485,478	29	$7,851,794	3	$812,255
Coventry	6,356	$1,233,049,381	124	$24,055,715	8	$1,551,982
East Granby	2,489	$642,838,510	110	$28,409,898	8	$2,066,174
East Hartford	618	$174,499,401	7	$1,976,530	0	$-
East Windsor	1,934	$455,690,511	5	$1,178,104	2	$471,241
Ellington	4,368	$1,323,388,772	63	$19,087,338	5	$1,514,868
Enfield	2,817	$724,481,215	40	$10,287,273	5	$1,285,909
Farmington	7,958	$3,286,280,929	355	$146,598,358	10	$4,129,531
Glastonbury	8,768	$3,136,323,069	268	$95,863,889	15	$5,365,516

Town	Number of Parcels Impacted by Wildfire Risk	Estimated Value for Parcels Impacted by Wildfire Risk (Based on Grand List Avg.)	Number of Parcels with Historic Resources and Wildfire Risk	Estimated Value for Parcels with Historic Resources and Wildfire Risk (Based on Grand List Avg.)	Number of Parcels with Critical Facilities and Wildfire Risk	Estimated Value for Parcels with Critical Facilities and Wildfire Risk (Based on Grand List Avg.)
Granby	4,953	$1,248,229,106	83	$20,917,225	7	$1,764,103
Hartford	78	$19,946,665	15	$3,835,897	1	$255,726
Hebron	3,927	$1,116,798,862	51	$14,503,881	4	$1,137,559
Manchester	6,871	$2,434,411,653	559	$198,055,030	4	$1,417,210
Mansfield	4,177	$1,257,614,042	104	$31,312,392	8	$2,408,646
Marlborough	2,670	$752,624,192	0	$-	6	$1,691,290
New Britain	9,274	$1,868,212,801	119	$23,972,107	6	$1,208,678
Newington	508	$137,700,253	4	$1,084,254	4	$1,084,254
Plainville	5,218	$1,339,140,163	1	$256,639	5	$1,283,193
Rocky Hill	1,206	$661,186,111	62	$33,991,326	1	$548,247
Simsbury	8,206	$2,450,174,724	139	$41,503,081	14	$4,180,166
Somers	3,315	$967,346,736	181	$52,817,424	10	$2,918,090
South Windsor	2,377	$750,814,148	73	$23,058,238	5	$1,579,331
Southington	12,929	$3,804,951,303	13	$3,825,846	6	$1,765,775
Stafford	5,239	$960,724,519	3	$550,138	6	$1,100,276
Suffield	3,843	$1,113,548,256	131	$37,958,580	12	$3,477,122
Tolland	5,773	$1,404,261,409	22	$5,351,421	11	$2,675,710
Vernon	4,050	$1,368,612,855	76	$25,682,612	4	$1,351,716
West Hartford	7,755	$3,536,209,274	37	$16,871,663	3	$1,367,973
Wethersfield	196	$58,603,230	38	$11,361,851	0	$-
Willington	2,388	$524,113,297	66	$14,485,543	14	$3,072,691
Windsor	4,884	$1,533,707,819	50	$15,701,350	8	$2,512,216
Windsor Locks	1,326	$452,076,561	3	$1,022,798	3	$1,022,798
Total	**163,813**	**$49,585,807,175**	**3,270**	**$1,056,129,475**	**226**	**$66,240,267**

Non-Climate Driven: Earthquakes

Earthquakes (Climate Driver: N/A)

Although damaging earthquakes are rare in Connecticut, low-magnitude earthquakes occur regularly in the state. In addition, very strong, damaging earthquakes have occurred in Connecticut, and the state can also feel the effects of earthquakes that occur several hundred miles away.

Location

All areas of the Capitol Region communities are susceptible to earthquakes although the likelihood of an earthquake occurring directly below the region is relatively small. In general, the Capitol Region communities are likely to be part of a larger regional area affected by an earthquake as opposed to being individually affected.

Extent

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 without warning.

The underground point of origin of an earthquake is called its focus; the point on the surface directly above the focus is the epicenter. Earthquakes are described based on their magnitude and intensity.

Magnitude is an estimate of the relative size or strength of an earthquake and is related to the amount of seismic energy released at the hypocenter of the earthquake. It is based on the amplitude of earthquake waves recorded on instruments that have a common calibration. The magnitude of an earthquake is thus represented by a single instrumentally determined value recorded by a seismograph, which records the varying amplitude of ground oscillations.

The Richter scale was developed in 1935 and was used exclusively until the 1970s. It set the magnitude of an earthquake based on the logarithm of the amplitude of recorded waves. Being logarithmic, each whole number increase in magnitude represents a tenfold increase in measured strength. Earthquakes with a magnitude of about 2.0 or less are usually called "microearthquakes" and are generally only recorded locally. Earthquakes with magnitudes of 4.5 or greater are strong enough to be recorded by seismographs all over the world.

As more seismograph stations were installed around the world following the 1930s, it became apparent that the method developed by Richter was valid only for certain frequency and distance ranges, particularly in the southwestern United States. New magnitude scales that are an extension of Richter's original idea were developed for other areas[2]. In particular, the Moment magnitude scale (Mw) was developed in the 1970s to replace the Richter scale and has been in official use by the USGS since 2002.

According to USGS, these multiple methods are used to estimate the magnitude of an earthquake because no single method is capable of accurately estimating the size of all earthquakes. Some magnitude types are calculated to provide a consistent comparison to past earthquakes, and these scales are calibrated to the original Richter scale. However, differences in magnitude of up to 0.5 can be calculated for the same earthquake through different techniques. In general, Moment magnitude provides an estimate of earthquake size that is valid over the complete range of magnitudes and so is commonly used today.

Although Moment magnitude is the most common measure of earthquake size for medium and larger earthquakes, the USGS does not calculate Mw for earthquakes with a magnitude of less than 3.5. Localized Richter scales or other scales are used to calculate magnitudes for smaller earthquakes. This is often the case in Connecticut.

Regionally, the Weston Observatory utilizes two scales to track the magnitude of earthquakes. These include the Nuttli magnitude (Mn) for North America east of the Rocky Mountains and is more appropriate for the relatively harder continental crust in Connecticut compared to California. Weston Observatory also utilizes the Coda Duration magnitude (Mc), which is based on the duration of shaking at a particular station. The advantages of the Coda Duration magnitude is that this method can quickly estimate the magnitude before the exact location of the earthquake is known.

Earthquakes in Connecticut are intraplate or intratectonic as opposed to occurring at fault lines. In these types of earthquakes, soil composition determines the magnitude of the impact. Soft soils and filled wetlands conduct energy better than bedrock. A magnitude 5.1 earthquake near Plattsburgh, New York, in April 2002 was felt in Hartford and lower-lying areas in western Connecticut because of ground-motion amplification resulting from the soft soils located in these areas. Many of the strongest earthquakes felt in Connecticut had epicenters in upstate New York, New Hampshire, and Massachusetts.

The effect of an earthquake on the earth's surface is called the intensity. The Modified Mercalli Intensity Scale consists of a series of key responses such as people awakening, movement of furniture, damage to chimneys, and total destruction. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It is an arbitrary ranking based on observed effects. A comparison of Richter magnitude to typical Modified Mercalli intensity is presented in Table 54 while a description of each intensity level is presented as Table 55.

Table 54. Comparison of Earthquake Magnitude and Intensity

Moment Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 to 3.0	I
3.0 to 3.9	II to III
4.0 to 4.9	IV to V
5.0 to 5.9	VI to VII
6.0 to 6.9	VII to IX
7.0 and above	VIII or higher

Source: USGS

Table 55. Modified Mercalli Intensity

Modified Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

Modified Mercalli Intensity	Description
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry), structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown in the air.

Source: USGS

Magnitude 3.0 to 3.9 earthquakes are often felt by people up to a hundred miles away from the epicenter but rarely cause damage. Magnitude 4.0 to 4.9 earthquakes cause shaking of objects indoors but generally cause none to slight damage. Magnitude 5.0 to 5.9 earthquakes can cause moderate to major damage to poorly constructed buildings but none to slight damage to other buildings.

Previous Occurrences

Connecticut has a moderate risk of earthquakes based on the frequency of their occurrence, not the intensity of individual earthquakes. Between 1568 and 1989, the state had 137 recorded earthquakes. According to records kept by Weston Observatory, between 1837 and 2023, 18 earthquakes were recorded in the Capitol Region. These were mainly centered in Hartford or east of the Connecticut River, except for one in the Kensington section of Berlin in 2017 and one in Newington in 2021. Of those where the magnitude was known, all were under magnitude 4.0. Additional instances of seismic activity occurring in and around the region are noted below based on information in USGS documents and from the Weston Observatory, the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, other municipal hazard mitigation plans, and newspaper articles. Map 20 depicts the locations of historical earthquakes across the New England region.

February 5, 1663: A devastating earthquake near Three Rivers, Quebec, on February 5, 1663, caused moderate damage in parts of Connecticut.

November 1727 and November 1755: Strong earthquakes in Massachusetts were felt strongly in Connecticut.

May 16, 1791: The strongest earthquake in Connecticut history occurred in East Haddam in 1791 and is recorded with intensity VII. According to USGS, the earthquake, which was felt in Boston and New York City, caused stone walls and chimney tops to fall and latched doors to open. Weston Observatory estimates that this quake had a 4.4 magnitude.

August 1840: A moderate tremor with its epicenter 10 to 20 miles north of New Haven shook Hartford buildings but caused little damage. This quake is estimated as having a 3.8 magnitude.

October 1845: An intensity V earthquake occurred in Bridgeport and approximated at 4.3 on the Richter scale.

July 28, 1875: An early morning tremor caused intensity V damage throughout Connecticut and Massachusetts.

November 1935: The Timiskarning, Ontario earthquake caused minor damage as far south as Cornwall, Connecticut. This earthquake affected 1 million square miles of Canada and the United States.

September 1944: An earthquake near Massena, New York, produced mild effects in Hartford, Marion (Southington), and New Haven, Connecticut.

June 23, 2010: A magnitude 5.0 earthquake struck at the Ontario-Quebec border region of Canada. This earthquake did not cause damage in Connecticut but was felt by residents in Hartford and New Haven Counties.

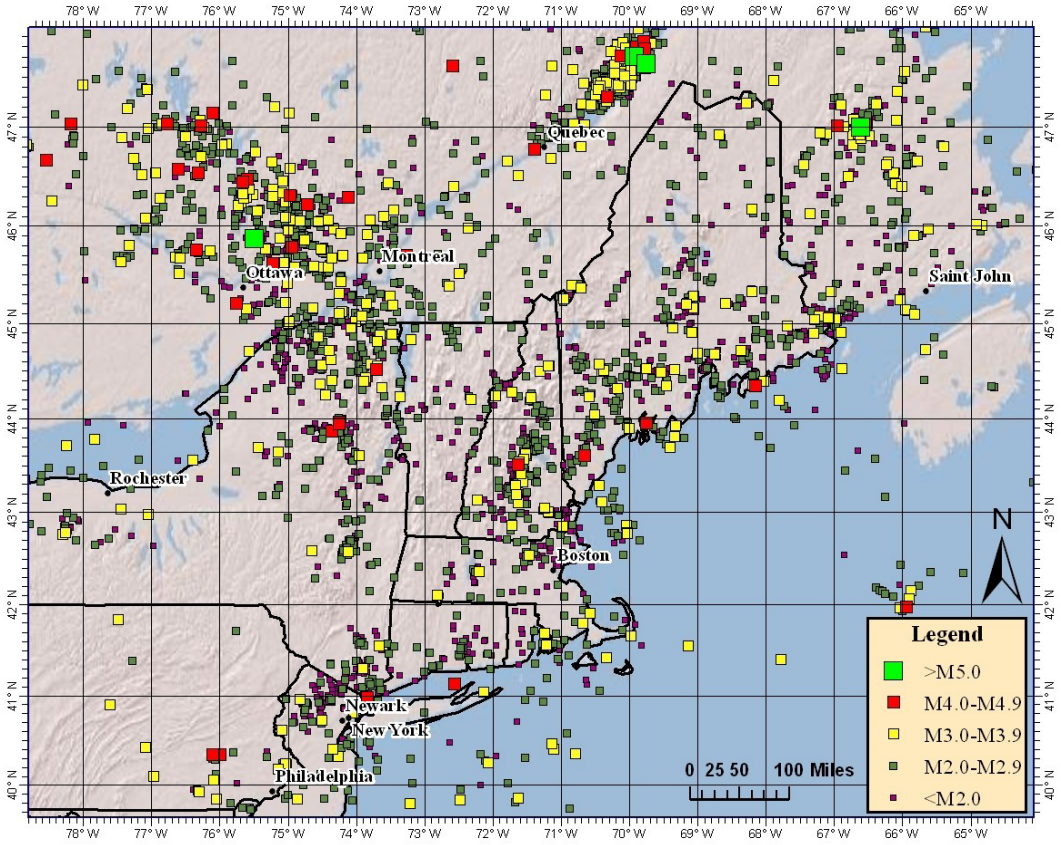
August 21, 2011: A magnitude 5.8 earthquake struck 38 miles from Richmond, Virginia. The quake was felt from Georgia to Maine and reportedly as far west as Chicago. Many residents of Connecticut experienced the swaying and shaking of buildings and furniture during the earthquake. According to Cornell University, the quake was the largest event to occur in the east-central United States since instrumental recordings have been available to seismologists.

October 16, 2012: A magnitude 4.6 earthquake that struck near Portland, Maine, was felt in Connecticut, including the Capitol Region. However, no damage was reported.

January 8-12, 2015: A series of quakes hit Plainfield, Connecticut. These events registered magnitudes of 2.0, 0.4, and 3.1. Residents in the Moosup section of Plainfield reported minor damage such as the tipping of shelves and fallen light fixtures.

December 17, 2017: A small event struck near Kensington in Berlin, Connecticut, registering Mn 1.0 and Mc 1.6.

March 5, 2021: A small event struck near Newington, Connecticut, registering Mn 1.7 and Mc 2.5.



Map 20. Earthquakes in New England, January 1975 – October 2013

This map, produced by Boston College's Weston Observatory, shows the epicenter of every earthquake detected in New England between 1975 and 2013.

Source: Weston Observatory, https://www.bc.edu/bc-web/schools/mcas/sites/weston-observatory.html

Connecticut: Earthquake History

According to the USGS, the lack of historical and instrumental reports of strong earthquakes in Connecticut suggests that the state is a region of very minor seismic activity, even when compared to other states in the Northeast region. Connecticut has, however, a history of earthquakes. The cause of earth noises or "rumblings" in the area near Moodus, a few miles north of East Haddam, have been a matter of scientific speculation for years. Native Indians called East Haddam *Morehemoodus*, or place of noises, and the town name "Moodus" is derived from the Indian word.

The most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. Describing that earthquake, an observer said, "It began at 8 o'clock p.m., with two very heavy shocks in quick succession. The first was the most powerful; the earth appeared to undergo very violent convulsions. The stone walls were thrown down, chimneys were untopped, doors which were latched were thrown open, and a fissure in the ground of several rods in extent was afterwards discovered. Thirty lighter ones followed in a short time and upwards of one hundred were counted in the course of the night."

Historical records show the next moderate tremor occurred at Hartford in April 1837. "It jarred loose articles, set lamps swinging, and rang bells. Alarmed residents rushed from their homes into the streets." In August 1840, an earthquake of similar intensity centered apparently 10 to 20 miles north of New Haven shook Hartford strongly and was felt at many points in Connecticut. No damage resulted however. At Chester, not far from East Haddam, observers compared the tremor "to the rumble of thunder."

The strongest tremor since that in 1791 hit near Hartford on November 14, 1925, at about 8:00 a.m. Plaster was knocked from walls, and many residents were frightened. At Windham, dishes were shaken from shelves, and at East Haddam, the familiar "Moodus" rumblings were noted. More recently, in March 1953, Stamford sustained a minor tremor that alarmed many. "Radiators beat a weird tattoo against the floor of the police station," notes one report. Houses were jarred, and earth noises were heard. The tremor caused no damage. An intensity V earthquake in southern Connecticut occurred on November 3, 1968, at about 3:30 in the morning. Plaster cracked at Madison, furniture shifter at Chester, and small items fell and broke. Loud earth noises accompanied the tremor. The Moodus noises were noted once again at East Haddam.

A few damaging shocks centered in neighboring states and several Canadian tremors have been felt in Connecticut over the past 300 years. A devastating earthquake near Tros-Rivieres (Three Rivers), Quebec, on February 5, 1663, caused moderate effects in some areas of Connecticut. Massachusetts quakes in November 1727 and November 1755 were felt strongly by some in Connecticut. Both resulted in collapsed walls, toppled chimneys, and other damage common to most strong earthquakes at their epicenters.

The Timiskaming, Ontario, earthquake in November 1935 was quite noticeable in Connecticut and other New England states. Several cracked windowpanes were noted at Cornwall, Connecticut. Because of the sparse population, damage at the epicenter of this tremor was insignificant. However, an indication of its severity was the large felt area – one million square miles of Canada and the United States. An earthquake near Massena, New York, in September 1944 was also felt over a wide region. Mild effects were noticed by residents of Hartford, Marion, New Haven, and Meriden, Connecticut. At its epicenter, the shock destroyed nearly all chimneys, crippled several buildings, and caused $2 million property damage in that region.

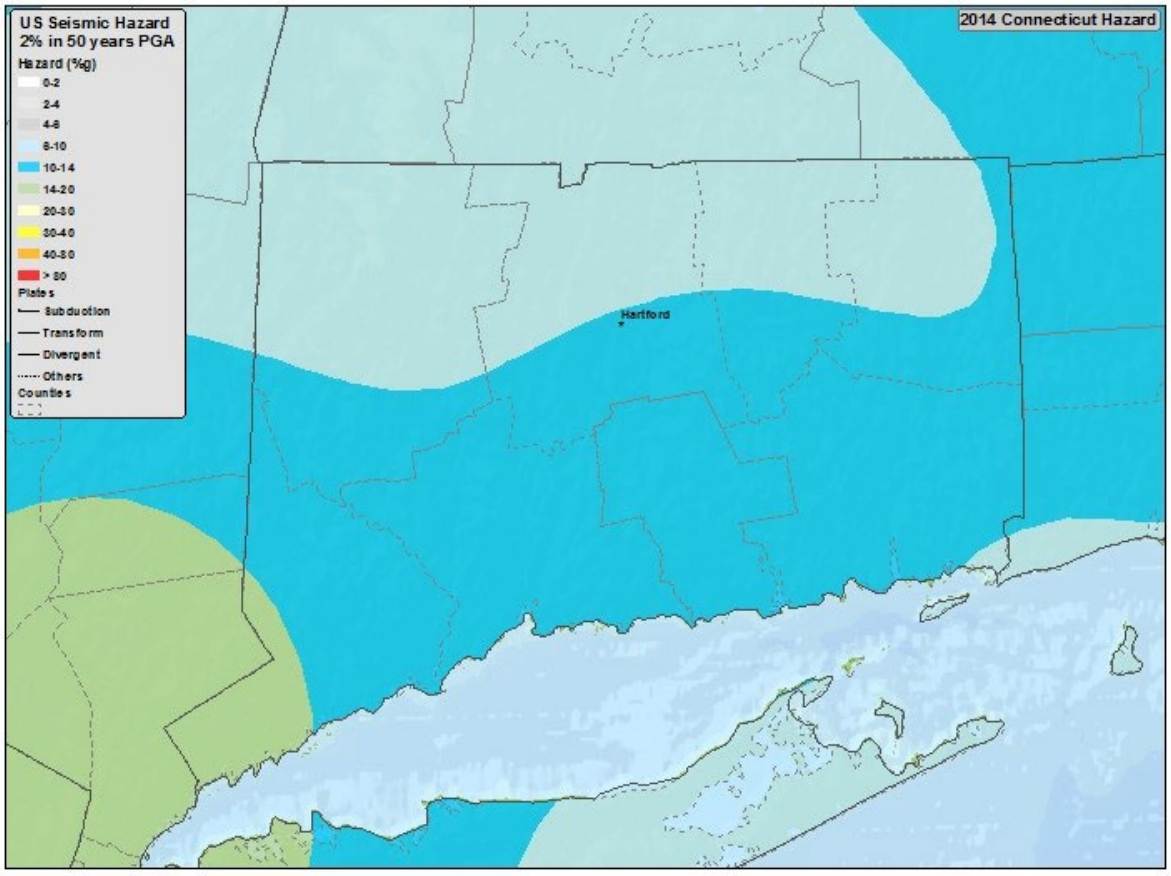
Source: Abridged from Earthquake Information Bulletin, January - February 1971. Taken from USGS

Probability of Future Events

According to the 2023 *Connecticut Natural Hazard Mitigation Plan Update*, Connecticut experiences less than one earthquake event per year and "is categorized as having a low or moderate risk for an earthquake > 3.5 occurring in the future and a moderate risk of an earthquake < 3.0 occurring in the

future." When earthquakes are reported in Connecticut, they have most frequently occurred in the southern and eastern parts of the state.

According to the USGS, Connecticut is in an area of moderate to low risk for earthquakes. Central Connecticut has a 2% chance of seeing an earthquake with peak ground acceleration exceeding 8% to 10% of gravity in 50 years (corresponding to a return period for an earthquake of this intensity of over 2,000 years, Map 21). An earthquake in exceedance of 10% of gravity is generally considered one that would damage older dwellings and those not resistant to earthquakes.



Map 21. Earthquake Hazard Map for Connecticut

This map shows the peak ground acceleration (a measure of earthquake intensity) that has a 2% chance of occurring over the course of a 50-year period in Connecticut. Note that the southern half of the Capitol Region has a slightly higher exposure to earthquake hazards than the northern half. Overall risk is low.

Source: USGS, https://earthquake.usgs.gov/earthquakes/byregion/connecticut-haz.php

Impacts to Community Assets

Unlike seismic activity in California, earthquakes in Connecticut are not associated with specific known faults. Instead, earthquakes with epicenters in Connecticut are referred to as intraplate activity. Bedrock in Connecticut and New England in general is highly capable of transmitting seismic energy; thus, the area impacted by an earthquake in Connecticut can be four to 40 times greater than that of California. For example, the relatively strong earthquake that occurred in Virginia in 2011 was felt in Connecticut because the energy was transmitted over a great distance through hard bedrock. In addition, population density is up to 3.5 times greater in Connecticut than in California, potentially putting a greater number of people at risk.

Areas of artificial fill, finer textured soils, and steep slopes are particularly at risk of earthquakes, especially when saturated with water, due to liquefaction and landslides.
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. In addition, artificial fill material has the potential for liquefaction. Liquefaction is a phenomenon in which the strength and stiffness of a soil are reduced by earthquake shaking or other rapid loading. It occurs in soils at or near saturation and especially in finer textured soils as well as artificial fill. When liquefaction occurs, the ability of soil to support building foundations and bridges is reduced. Increased shaking and liquefaction can cause greater damage to buildings and structures and a greater loss of life.

Areas of steep slopes can collapse during an earthquake, creating landslides. Seismic activity can also break utility lines such as water 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.

The built environment in Connecticut includes old nonreinforced masonry that is not seismically designed. Connecticut incorporated building codes for seismic activity into the state building code in 1992. There were no requirements prior to that. So, while the risk for a very damaging earthquake is relatively low in the region, some structures may be impacted by less intense earthquakes depending on the soil and integrity of the structure. Those who live or work in nonreinforced masonry buildings, especially those built on filled land or unstable soils, are at the highest risk for injury due to the occurrence of an earthquake.

According to the 2023 *Connecticut Natural Hazard Mitigation Plan*, Hartford County is considered to have a low-to-medium earthquake hazard rating, and Tolland County is considered to have a low earthquake hazard ranking. Of the towns in the region, Hartford and New Britain would have the highest risk from earthquakes simply because their buildings and infrastructure are tightly packed, and many structures may have been erected before seismic impacts were incorporated into the state building code in 1992. However, due to a variety of factors, including distance from fault lines, building types, and settlement patterns, risk to the region in general from earthquake damage is quite small.

Loss Estimates

The most severe earthquake in Connecticut's history occurred at East Haddam on May 16, 1791. A HAZUS earthquake scenario based on this historical event was used to simulate potential damages in the CRCOG region, shown in Table 56. Simulation details include:

- Longitude of Epicenter: -72.40
- Latitude of Epicenter: 41.50
- Magnitude: 6.4
- Depth (km): 10

Table 56. HAZUS Loss Estimates for Earthquake (in millions of dollars)

Town	Total Economic Loss ($millions)	People Seeking Shelter
Andover	$ 89.00	18
Avon	$ 205.52	32
Berlin	$ 832.02	103
Bloomfield	$ 384.80	75

Town	Total Economic Loss ($millions)	People Seeking Shelter
Bolton	$ 149.78	7
Canton	$ 62.83	11
Columbia	$ 264.40	45
Coventry	$ 299.06	38
East Granby	$ 61.47	5
East Hartford	$ 1,426.69	472
East Windsor	$ 211.91	39
Ellington	$ 206.64	60
Enfield	$ 276.53	52
Farmington	$ 650.43	102
Glastonbury	$ 1,485.88	323
Granby	$ 43.25	5
Hartford	$ 3,151.55	1859
Hebron	$ 609.29	109
Manchester	$ 2,038.10	672
Mansfield	$ 1,244.61	362
Marlborough	$ 444.00	68
New Britain	$ 1,631.51	976
Newington	$ 871.75	229
Plainville	$ 364.41	87
Rocky Hill	$ 953.31	270
Simsbury	$ 151.15	31
Somers	$ 73.43	3
South Windsor	$ 715.25	116
Southington	$ 771.97	153
Stafford	$ 84.95	15
Suffield	$ 83.52	10
Tolland	$ 214.99	17
Vernon	$ 526.27	230
West Hartford	$ 1,189.86	298
Wethersfield	$ 701.02	194
Willington	$ 64.79	27
Windsor	$ 382.68	77
Windsor Locks	$ 176.11	25
Total	$ 23,094.73	7215

Copies of the HAZUS Earthquake Event Reports are included in Appendix O.

Based on our history and geology, the Capitol Region's overall risk of damaging earthquakes is low. The damages we are likely to face here from earthquakes are much lower than in other parts of the nation and world. Annualized losses help express this low-risk profile. Based on the National Risk Index, the annualized loss estimate for the Capitol Region from earthquakes is $2,337,892. The magnitude of this

figure stems from the fact that the Capitol Region has a large building inventory that could be damaged in a severe earthquake. The location of the epicenter holds great significance for the damages that could be expected. A moderately strong earthquake centered near a more populated, built-up area would be expected to result in considerably more damage than one located in a more remote area. Annualized losses for each community are presented in each municipal annex.

Exposure Analysis

Properties, people, historic resources, and critical facilities in the entire CRCOG region are exposed to earthquakes. As an initial screening of exposure to hazards, areas of risk (in this case, the entire CRCOG region) 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 57.

Table 57. Exposure analysis for earthquakes in the CRCOG region.

Town	Average Appraised Parcel Value	Parcel Count in Extreme Heat Risk Area	Approx. Appraised Parcel Value in Extreme Heat Risk Area	Number of Historical Resources (SHPO) in Extreme Heat Risk Area	Approx. Appraised Parcel Value of SHPO in Extreme Heat Risk area	Number of Critical Facilities in Extreme Heat Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Extreme Risk area
Andover	$219,735	1,704	$374,429,046	40	$8,789,414	2	$439,471
Avon	$418,390	7,932	$3,318,671,261	11	$4,602,292	13	$5,439,073
Berlin	$305,900	9,017	$2,758,301,127	91	$27,836,908	3	$917,700
Bloomfield	$321,812	8,510	$2,738,623,920	5	$1,609,062	9	$2,896,312
Bolton	$238,182	2,366	$563,537,451	9	$2,143,634	6	$1,429,089
Canton	$343,744	3,964	$1,362,602,800	289	$99,342,131	5	$1,718,722
Columbia	$270,752	2,615	$708,015,200	37	$10,017,806	4	$1,083,006
Coventry	$193,998	6,610	$1,282,324,786	126	$24,443,710	8	$1,551,982
East Granby	$258,272	2,653	$685,195,086	111	$28,668,170	8	$2,066,174
East Hartford	$282,361	14,331	$4,046,522,571	226	$63,813,698	9	$2,541,253
East Windsor	$235,621	4,960	$1,168,678,871	25	$5,890,519	9	$2,120,587
Ellington	$302,974	6,100	$1,848,139,057	65	$19,693,285	5	$1,514,868
Enfield	$257,182	16,651	$4,282,334,586	552	$141,964,368	15	$3,857,727
Farmington	$412,953	11,221	$4,633,746,946	357	$147,424,263	15	$6,194,297
Glastonbury	$357,701	15,300	$5,472,826,486	457	$163,469,392	36	$12,877,239
Granby	$252,015	5,167	$1,302,160,286	83	$20,917,225	7	$1,764,103
Hartford	$255,726	19,160	$4,899,719,451	4,237	$1,083,513,117	10	$2,557,265
Hebron	$284,390	4,011	$1,140,687,600	51	$14,503,881	4	$1,137,559
Manchester	$354,302	16,252	$5,758,122,239	1,301	$460,947,393	10	$3,543,024
Mansfield	$301,081	4,640	$1,397,014,420	106	$31,914,554	8	$2,408,646
Marlborough	$281,882	2,732	$770,100,857	0	$0	6	$1,691,290
New Britain	$201,446	15,736	$3,169,958,733	129	$25,986,571	8	$1,611,570
Newington	$271,063	12,416	$3,365,524,343	21	$5,692,333	10	$2,710,635

Town	Average Appraised Parcel Value	Parcel Count in Extreme Heat Risk Area	Approx. Appraised Parcel Value in Extreme Heat Risk Area	Number of Historical Resources (SHPO) in Extreme Heat Risk Area	Approx. Appraised Parcel Value of SHPO in Extreme Heat Risk area	Number of Critical Facilities in Extreme Heat Risk Area	Approx. Appraised Parcel Value of Critical Facilities in Extreme Risk area
Plainville	$256,639	7,472	$1,917,603,547	72	$18,477,979	5	$1,283,193
Rocky Hill	$548,247	4,922	$2,698,472,686	277	$151,864,473	10	$5,482,472
Simsbury	$298,583	10,795	$3,223,206,986	153	$45,683,249	14	$4,180,167
Somers	$291,809	3,865	$1,127,841,671	181	$52,817,424	14	$4,085,326
South Windsor	$315,866	11,129	$3,515,275,849	210	$66,331,919	13	$4,106,262
Southington	$294,296	18,395	$5,413,572,556	18	$5,297,326	10	$2,942,959
Stafford	$183,379	5,384	$987,314,543	3	$550,138	6	$1,100,276
Suffield	$289,760	6,417	$1,859,390,877	184	$53,315,867	13	$3,766,882
Tolland	$243,246	6,562	$1,596,182,814	49	$11,919,073	12	$2,918,957
Vernon	$337,929	7,990	$2,700,053,470	861	$290,956,951	10	$3,379,291
West Hartford	$455,991	19,953	$9,098,386,094	327	$149,109,019	14	$6,383,872
Wethersfield	$298,996	9,958	$2,977,402,886	1,074	$321,121,781	7	$2,092,973
Willington	$219,478	2,453	$538,379,359	66	$14,485,543	14	$3,072,691
Windsor	$314,027	12,177	$3,823,906,683	127	$39,881,428	14	$4,396,378
Windsor Locks	$340,933	4,391	$1,497,034,814	6	$2,045,595	7	$2,386,528
Total	**$11,310,662**	**$325,911**	**$100,021,261,958**	**$11,937**	**$3,617,041,492**	**$373**	**$115,649,817**

Hazards Summary

The outline below summarizes the risks faced throughout the Capitol Region to the natural hazards evaluated in this plan update. The frequencies, potential impacts, vulnerable locations, and likely economic losses of each natural hazard are presented. Following this outline is Table 58, which summarizes the annualized loss estimates for each hazard. Table 59 then summarizes the regional exposure analysis, and Table 60 summarizes the concerns local officials identified during the plan update process relating to the impacts natural hazards and climate change have on the critical facilities, vulnerable locations and populations, and cultural assets of their communities.

Hurricanes and Tropical Storms

Frequency: According to the state's Hazard Mitigation Plan, a Category 3 hurricane has a calculated return period of 63 to 120 years along the coastline of Connecticut, and hurricanes in general have calculated return period ranges from 17-24 years for Connecticut. A major category 3 or 4 hurricane may hit before 2040 based on 20th century trends. Hurricanes are often downgraded to Tropical Storm status by the time they reach

	inland Connecticut. Multiple tropical storms have hit the state since the last plan update in 2019.
Potential Impacts:	Street closures, power outages, tree damage, utilities damage, property and content damage, bodily harm, and death
Vulnerable Locations:	Entire region but especially floodprone and poorly drained areas
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Tornadoes and Other Severe Weather

Frequency:	According to the 2023 Connecticut Natural Hazard Mitigation Plan Update, it is estimated that the state will experience one to two tornado events per year. Two tornadoes have occurred in the Capitol Region since the prior plan was approved in 2019. The 2023 State Natural Hazard Mitigation Plan update notes that thunderstorms typically occur on 18 to 27 days each year in Connecticut, with a statewide average of 9.34 lightning density events/km2/year. Many have occurred in the Capitol Region since the prior plan was approved in 2019.
Potential Impacts:	Bodily harm and death, tree damage, utilities damage, crop damage, and property and content damage
Vulnerable Locations:	Entire region although Hartford County is at highest risk
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Severe Winter Storms

Frequency:	The 2023 Connecticut Natural Hazard Mitigation Plan Update notes that 4.42 annualized winter storm events are expected for both Hartford County and Tolland County. One blizzard occurred in the state, including the Capitol Region, since the prior plan was approved in 2019.
Potential Impacts:	Street closures, power outages, schools closures, utility damage, property and content damage, car accidents, tree damage, bodily harm, and death
Vulnerable Locations:	Entire region
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Tidal Connecticut River Flooding

Frequency:	Likely to increase as sea levels rise. See Flood summary for additional information on flooding in the Capitol Region.
Potential Impacts:	Breached dams, street closures, power outages, utility damage, property and content damage, basement flooding, bodily harm, and death
Vulnerable Locations:	Floodprone and poorly drained areas along the tidally influenced stretch of the Connecticut River in Hartford, East Hartford, Wethersfield, Glastonbury, and Rocky Hill.
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Floods

Frequency:	According to the state's Hazard Mitigation Plan, multiple flood events can be expected to occur each year across the state, with one to six flood events of some significance occurring in each county each year. Climate change is expected to increase the intensity of rain events, amplifying pluvial flooding impacts. Only localized floods have occurred in the Capitol Region since the prior plan was approved in 2019, including flooding associated with tropical storms in 2021.
Potential Impacts:	Breached dams, street closures, power outages, utility damage, property and content damage, basement flooding, bodily harm, and death
Vulnerable Locations:	Floodprone and poorly drained areas
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Drought

Frequency:	The 2023 Connecticut Natural Hazard Mitigation Plan Update indicates that Connecticut is likely to experience a drought every two to three years. Since the prior plan was approved in 2019, droughts impacted the Capitol Region in 2020 and 2022.
Potential Impacts:	Water shortages, environmental and human health issues, and increased risk of wildfires, especially in low-density, forested areas
Vulnerable Locations:	Entire region
Economic Loss:	Agricultural and water-dependent businesses may incur losses.

Dam Failure

Frequency:	The likelihood of dam failure is greatest in conjunction with floods, hurricanes, and earthquakes. A dam failure has not occurred in the Capitol Region since the prior plan was approved in 2019.
Potential Impacts:	Bodily harm and loss of life and property. A water shortage may occur if a dam failure impacts an active reservoir.
Vulnerable Locations:	Stream reaches below dams
Economic Loss:	Repair and replacement costs, business disruption, debris removal and cleanup costs

Extreme Heat

Frequency:	Most years involve at least one extreme heat event. Likely to increase due to the rising temperatures associated with climate change. Heat Wave Days (6 or more consecutive days with daily maximum temperature above the 90th percentile) are projected to rise from 4 to 48.
Potential Impacts:	Primarily public health and agriculture. Possible impacts on roadways, rail lines, and power grids.
Vulnerable Locations:	Entire region, particularly the urban communities with high levels of impervious surfaces and little vegetation.
Economic Loss:	Agricultural businesses may incur losses. Possibly repair and replacement costs for infrastructure and power grids.

Forest and Wildland Fires

Frequency:	Very low likelihood of damaging wildfires. Small wildfires occur frequently. Only small wildfires have occurred in the Capitol Region since the prior plan was approved in 2019.
Potential Impacts:	Property and content damage, bodily harm, and death
Vulnerable Locations:	At the woodland/suburban interface
Economic Loss:	Repair and replacement costs, business disruption, debris removal, and cleanup costs

Earthquake

Frequency:	According to the 2023 Connecticut Natural Hazard Mitigation Plan Update, Connecticut experiences less than one earthquake event per year. One very low-magnitude earthquake occurred in the Capitol Region since the prior plan was approved in 2019.
Potential Impacts:	Minimal property and content damage
Vulnerable Locations:	Entire region
Economic Loss:	Repair and replacement costs

A summary of Average Annualized Loss (AAL) estimates for the CRCOG region for each of these hazards can be found in Table 58 below. Average Annualized Loss (AAL) figures are useful tools for comparison of the risks faced from different hazards with different likelihoods of occurring in a given time period. National Centers for Environmental Information (NCEI) data, from the last 20 years, was categorized by hazard and averaged based on the proportion of population within each town in the CRCOG Region. National Flood Insurance Program (NFIP) losses were calculated based on the 50-year span of the program. FEMA Public Assistance (PA) data from the past 11 years was categorized based on hazard and used to compute AAL. United States Department of Agriculture (USDA) from the past 10 years was calculated to get AAL for drought. Expected Annual Loss data from the National Risk Index (NRI) was downloaded and categorized to get AAL for the below hazards. Dam failure data was taken from the 2019-2024 CROCG Hazard Mitigation Plan (HMP) plan since no new dam failures have occurred in the past five years. The 2019 HMP Dam failures were sourced in turn from the 2014 Connecticut Natural Hazard Mitigation Plan Update, with dam failure data supplemented by the National Performance of Dams Program and the Connecticut Department of Energy & Environmental Protection

Table 58. Average Annualized Loss Estimates By Hazard

Hazard	Source	Average Annualized Losses (AAL)
Hurricanes/Tropical storms	NCEI	$2,508,790.00
	NRI	$39,018,299.84
	FEMA PA	$733,703.24
Tornados/High Winds	NCEI	$939,245.00
	NRI	$9,065,692.40
Winter Storms	NCEI	$744,050.00
	NRI	$1,159,569.19
	FEMA PA	$655,889.03
Flood	NCEI	$760,450.00
	NRI	$1,551,942.26
	NFIP	$248,900.68
Drought	NRI	$3,422,783.48
	USDA	$1,272,516.61

Hazard	Source	Average Annualized Losses (AAL)
Extreme Heat	NRI	$972,438.48
Wildfire	NRI	$78,333.32
Earthquakes	NRI	$2,337,892.73
Dam Failure	HMP	$10,810.00

Details regarding these loss estimates are provided in each municipal annex of this plan. Specific annualized loss estimates from changes to the Connecticut River tidal range due to sea level rise cannot be distinguished from the general flooding estimates.

A summary of the exposure analysis is below. Properties, people, historic resources, and critical facilities in the region are exposed to natural hazards affected by climate change (i.e., severe storms, 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 59.

Table 59. CRCOG Regional Exposure Analysis

Hazard	At-Risk Parcels		At-Risk Historic Assets		At-Risk Critical Facilities	
	Value	Number	Value	Number	Value	Number
Hurricanes & Tropical Storms	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Tornadoes & Other Severe Weather	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Severe Winter Storms	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Tidal Connecticut River Flooding	$71,769,901	184	$6,675,948	16	$715,402	2
Flood (1% Annual Chance)	$7,507,499,059	24,622	$285,903,095	909	$25,818,761	81
Drought	$21,123,646,871	74,676	$169,818,430	615	$14,337,206	52
Dam Failure	$3,624,203,173	11,136	$196,844,008	554	$9,196,488	29
Extreme Heat	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373
Wildfires	$49,585,807,175	163,813	$1,056,129,475	3,270	$66,240,267	226
Earthquake	$100,021,261,958	325,911	$3,617,041,492	11,937	$115,649,817	373

During local planning meetings, municipal staff were also asked to identify the top climate-related challenges faced by their communities. Town-reported concerns are listed below in Table 60. Common emerging themes from municipal responses included streams crossings roads, power back-up for critical facilities, areas with limited egress, tree management, and vulnerable populations.

Table 60. Top Climate Concerns Reported by CRCOG Municipalities

Town	Primary Climate Concern #1	Primary Climate Concern #2	Primary Climate Concern #3
Andover	Stream crossings	Generators for critical facilities	Limited egress for senior housing
Avon	Critical facilities in a floodplain	Tree management	Generators for critical facilities
Berlin	Critical facilities in a floodplain	Generators for critical facilities	Hotels that people are living in
Bloomfield	Drainage-related flooding	Generator for cooling center	Maintenance of flood control system
Bolton	Power outages from storms	Stream crossings (access for Mark Anthony Lane)	DEEP-owned and privately owned dams
Canton	Tree management	Microgrid for critical facilities	Dams
Columbia	Stream crossings	Stormwater infrastructure	Limited egress for specific subdivision (tree obstruction risk, not flooding)
Coventry	Harmful algae in Coventry Lake	Tree management	Stream Crossings and Stormwater Management
East Granby	Generators for critical facilities	Wind corridor	Stream crossings
East Hartford	Shelter capacity	Flash flooding - Hockanum River	Generators for critical facilities
East Windsor	Generators for critical facilities	Stream crossings	Agricultural fields (tobacco)
Ellington	Stream crossings	Generators for critical facilities	Limited egress for specific neighborhood
Enfield	Stream crossings	Agriculture	Historic resources
Farmington	Riverbank stabilization	Stream crossings	Backup EOC
Glastonbury	Stream crossings	Vulnerable populations (assisted living, low-income)	Uranium
Granby	Riverbank stabilization	Power outages from storms	Tree management
Hartford	Stormwater infrastructure	Combined sewers	Shelter coordination
Hebron	Water quality	Private wells	Sewer system
Manchester	Stream crossings	Stormwater infrastructure	Tree management
Mansfield	Power outages from storms	Road flooding/washouts	Public water and sewer systems
Marlborough	Stream crossings	Tree management	Vulnerable populations (elderly)
New Britain	Stormwater management	Riverbank stabilization	Water reservoir levels during droughts
Newington	Stream crossings over railroad	Stormwater infrastructure	Hotels that people are living in
Plainville	Power outages from storms	Unpredictable high-density short-duration storms	WWTP

Town	Primary Climate Concern #1	Primary Climate Concern #2	Primary Climate Concern #3
Rocky Hill	Shelter capacity	Vulnerable populations (assisted living, elderly)	Road elevation (Beach Rd)
Simsbury	Riverbank stabilization	Stream crossings	Stormwater infrastructure
Somers	Power outages from storms	Stream crossings	Tree management
South Windsor	Stream crossings	Power outages from storms	Generators for critical facilities
Southington	Flash flooding on roads	Repetitive loss properties in Quinnipiac River flood zones	Hotels without generators
Stafford	Stream crossings	Generators for critical facilities -- elderly housing	Fire station in floodplain
Suffield	Limited egress for specific neighborhood (tree obstruction risk, not flooding)	Power outages from storms	Sewer system
Tolland	Unpaved roads	Stream crossings	Geographically-influenced winter weather
Vernon	Stormwater management	Generators for critical facilities	Sewer system
West Hartford	Stream crossings	Power outages from storms	Winter storms
Wethersfield	Stream Crossings and Stormwater Management	Generators for critical facilities	Hotels that people are living in
Willington	Stream crossings	Generators for critical facilities	Treetop debris on ground
Windsor	Erodible soils with increasing precipitation		
Windsor Locks	Stream Crossings and Stormwater Management	Host location for many critical regional assets and infrastructure	Hotels that people are living in

Section IV: Mitigation Strategies

Natural Hazard Mitigation in the Capitol Region

In most cases, a severe natural hazard will affect several municipalities at once although significant variations with highly localized damage can occur. In addition to the inevitable regional effect of natural hazards, CRCOG staff recognized common existing strategies, concerns, and mitigation needs in the course of working with individual member municipalities on this plan. Therefore, this section reviews existing mitigation strategies common to most if not all municipalities and the region and discusses the challenges that are common throughout the region. Because of the regional nature of natural hazards and common concerns, some mitigation activities are better addressed at the regional level; however, the means to carry out certain activities may not be available to regional agencies but are available to municipalities.

This section discusses the capabilities and effectiveness of the existing authorities, policies, programs, and resources available to accomplish hazard mitigation. This section also examines the municipal and regional strategies proposed and evaluates the costs and benefits associated with the myriad actions considered. This section also establishes our regional goals and objectives for addressing natural hazards and sets out the mitigation strategies and actions that may best be undertaken on a regional level. Finally, summaries and analyses of the mitigation activities and projects proposed by the municipalities are presented.

Our Capabilities for Implementing Mitigation Actions

The Capitol Region Council of Governments (CRCOG) is the largest of Connecticut's regional planning organizations. CRCOG was established in 1968 under the Connecticut General Statutes as a voluntary association of municipal governments serving the City of Hartford and 28 surrounding suburban and rural communities. The Town of Stafford joined CRCOG in September 2010, bringing the total membership to 30 municipalities. Under the reorganization of the state's councils of governments in 2015, eight additional municipalities joined CRCOG.

The Capitol Region Council of Governments is governed by a Policy Board comprised of the mayors, first selectmen, and town council chairs of its 38 member municipalities. Our members have collaborated on a wide range of projects to benefit our towns individually and the region as a whole. CRCOG serves the Capitol Region and its member municipalities by:

- Helping members improve governmental efficiency and save tax dollars through shared services and other direct service initiatives
- Promoting efficient transportation systems, responsible land use and preservation of land and natural resources, and effective economic development
- Strengthening the Capitol City of Hartford as the core of a strong region and as our economic, social, and cultural center
- Strengthening our regional community by helping coordinate regional agencies and programs;
- Advocating for the region and its towns with the state and federal governments

- Assisting local governments and citizens in articulating, advocating, and implementing the vision, needs, and values of their regional community
- To accomplish this work, CRCOG relies primarily on grants and member dues. CRCOG is not permitted to borrow money or issue debt in any form. As a regional planning organization, CRCOG does not have the ability to enact regulations, levy taxes, or undertake construction projects.

Each of CRCOG's member municipalities has a broad scope of government authorities and powers including the ability to tax; establish laws, ordinances, and regulations; exercise eminent domain; provide police protection; and establish, construct, and maintain public facilities including roads, sewers, drainage, and utilities. Municipal powers are outlined in the Connecticut General Statutes Sec. 7-148 (https://www.cga.ct.gov/2015/pub/chap_098.htm#sec_7-148). The table below outlines the governing structures of CRCOG's 38 municipal members.

Table 61. Capitol Region Member Communities' Municipal Governmental Structures

Municipality	Legislative Body	Chief Executive Officer
Andover	Board of Selectmen	1st Selectman
Avon	Town Council	Town Manager
Berlin	Town Council	Town Manager
Bloomfield	Town Council	Town Manager
Bolton	Board of Selectmen	1st Selectman
Canton	Board of Selectmen	1st Selectman
Columbia	Board of Selectmen	1st Selectman
Coventry	Board of Selectmen	Town Manager
East Granby	Board of Selectmen	1st Selectman
East Hartford	Town Council	Mayor
East Windsor	Board of Selectmen	1st Selectman
Ellington	Board of Selectmen	1st Selectman
Enfield	Town Council	Town Manager
Farmington	Town Council	Town Manager
Glastonbury	Town Council	Town Manager
Granby	Board of Selectmen	1st Selectman
Hartford	City Council	Mayor
Hebron	Board of Selectmen	Chairman
Manchester	Board of Directors	General Manager
Mansfield	Town Council	Town Manager
Marlborough	Board of Selectmen	1st Selectman
New Britain	City Council	Mayor
Newington	Town Council	Mayor
Plainville	Town Council	Town Manager
Rocky Hill	Town Council	Town Manager
Simsbury	Board of Selectmen	1st Selectman
Somers	Board of Selectmen	1st Selectman

Municipality	Legislative Body	Chief Executive Officer
South Windsor	Town Council	Town Manager
Southington	Town Council	Town Manager
Stafford	Board of Selectmen	1st Selectman
Suffield	Board of Selectmen	1st Selectman
Tolland	Town Council	Town Manager
Vernon	Town Council	Mayor
West Hartford	Town Council	Town Manager
Wethersfield	Town Council	Town Manager
Willington	Board of Selectmen	1st Selectman
Windsor	Board of Selectmen	1st Selectman
Windsor Locks	Town Council	Town Manager

Existing Capabilities and Strategies

Regional Cooperation and Services

The 38 municipalities participating in this planning process are members of the Capitol Region Council of Governments, a regional agency in which member communities have collaborated for over 30 years on a range of projects to benefit the municipalities individually and the region as a whole. This institutional experience and capacity allows CRCOG to provide services that can advance hazard mitigation throughout the region such as service sharing, cooperative purchasing, and bidding services; public safety planning, training, and collaboration; data analysis and sharing; transportation studies and planning and traffic incident management; and land use and natural resources conservation planning. Through these services, CRCOG helps member municipalities save tax dollars, coordinate efforts, and enhance operating efficiencies.

Regional Emergency Support Plan (RESP)

The purpose of the Regional Emergency Support Plan (RESP) is to provide a framework for the 42 DEMHS Region 3 communities and agencies to collaborate in planning, communication, information sharing, and coordination activities before, during, or after a regional emergency. The goal of this effort is to enhance the ability of each municipality to meet their emergency management objectives, which can be described as the following:

- Maximize the preservation of life and property.
- Correct or alleviate, as expeditiously as possible, serious disaster or emergency-related conditions that present continued threats to the health or welfare of the residents of Region 3.
- Facilitate a return to normalcy by all practical means.

Emergency Alerting and Notification Systems

All of the CRCOG communities currently have a reverse notification system. This may be part of or an addition to the CT Alert Emergency Alerting and Notification System offered by the State of Connecticut. This emergency notification system, which relies on GIS technologies, will allow communities in the region to alert residents to impending natural hazards thereby reducing risks to life and property. According to the CTALERT.gov website, all Capitol Region municipalities currently subscribe to the

CTAlert system. All citizens in Connecticut can register with CTAlert to receive emergency notifications that are sent statewide.

National Flood Program, FEMA Flood Maps, and Floodplain Regulations

The 38 Capitol Region municipalities have participated in FEMA's National Flood Insurance Program (NFIP) for at least 30 years, and all are in good standing in the program. It is the intention of all municipalities in the region to continue participation in the NFIP, including continued compliance and enforcement on the local level of all NFIP requirements. See Table 62 for the latest information on current flood insurance rate maps.

All 38 municipalities have adopted floodplain management regulations that have helped to prevent increased flood risks from new developments. Most municipalities in the region incorporate floodplain regulations in their zoning regulations; others provide separate ordinances for floodplain regulation. Refer to Table 64 for a summary of floodplain management in the CRCOG jurisdictions. Connecticut DEEP periodically reviews these municipal regulations for conformance to the latest Flood Insurance Studies, FEMA flood maps, and model flood hazard regulations. The 2018 Connecticut State Building Code, adopted October 1, 2018, includes model floodplain regulation language. Chapter 124, Section 8-2 l of the Connecticut General Statutes governs the municipal regulation of development within floodplains as defined by the National Flood Insurance Program.

Table 62. Community Participation in National Flood Program

Community ID	Municipality	County	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date
090161#	ANDOVER	TOLLAND	04/18/75	02/03/82	02/03/82*
090021#	AVON	HARTFORD	01/23/74	05/16/77	09/16/11**
090022#	BERLIN	HARTFORD	08/16/74	07/16/80	09/26/08
090122#	BLOOMFIELD	HARTFORD	02/01/74	08/15/77	09/16/11**
090109#	BOLTON	TOLLAND	06/07/74	06/01/81	06/01/81*
090135#	CANTON	HARTFORD	08/02/74	08/01/79	09/16/11**
090160#	COLUMBIA	TOLLAND	11/08/74	09/16/82	09/16/82*
090110#	COVENTRY	TOLLAND	06/09/74	06/04/80	06/11/82*
090025#	EAST GRANBY	HARTFORD	05/31/74	01/06/82	09/16/11**
090026#	EAST HARTFORD	HARTFORD	12/28/73	12/18/79	09/16/11
090027#	EAST WINDSOR	HARTFORD	11/16/73	04/03/78	09/16/11
090158#	ELLINGTON	TOLLAND	11/01/74	03/15/82	02/05/97*
090028#	ENFIELD	HARTFORD	04/05/74	03/28/80	09/16/11
090029#	FARMINGTON	HARTFORD	06/28/74	08/15/77	09/16/11**
090125#	GRANBY	HARTFORD	07/19/74	02/15/80	09/16/11**
090124#	GLASTONBURY	HARTFORD	04/20/73	06/15/78	09/16/11
095080#	HARTFORD	HARTFORD	07/01/70	07/01/74	09/16/11
090162#	HEBRON	TOLLAND	11/29/74	10/15/81	03/18/91*
090031#	MANCHESTER	HARTFORD	05/24/74	08/16/82	09/16/11
090128#	MANSFIELD	TOLLAND	01/09/74	01/02/81	01/02/81*
090148#	MARLBOROUGH	HARTFORD	07/19/74	05/17/82	09/16/11
090032C	NEW BRITAIN	HARTFORD	05/24/74	07/16/81	05/16/17**

Community ID	Municipality	County	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date
090033#	NEWINGTON	HARTFORD	07/26/74	10/16/79	09/16/11
090034C	PLAINVILLE	HARTFORD	05/31/74	11/19/80	05/16/17**
090142#	ROCKY HILL	HARTFORD	06/07/74	08/01/80	09/16/11
090035#	SIMSBURY	HARTFORD	08/02/74	05/16/77	09/16/11**
090112#	SOMERS	HARTFORD	08/02/74	02/17/82	08/16/06
090036#	SOUTH WINDSOR	HARTFORD	08/16/74	05/01/80	09/16/11
090037C	SOUTHINGTON	HARTFORD	05/10/74	07/16/81	05/16/17**
090152#	STAFFORD	TOLLAND	08/09/74	06/01/82	06/01/82*
090038#	SUFFIELD	HARTFORD	08/02/74	08/15/79	09/16/11**
090171#	TOLLAND	TOLLAND	01/31/75	04/01/82	04/01/82*
090131#	VERNON	TOLLAND	01/04/74	12/04/79	08/09/99*
095082#	WEST HARTFORD	HARTFORD	NA	07/01/74	09/16/11**
090040#	WETHERSFIELD	HARTFORD	05/11/73	05/02/77	09/16/11
090159#	WILLINGTON	TOLLAND	12/20/74	06/15/82	06/15/82*
090042#	WINDSOR LOCKS	HARTFORD	06/28/74	01/03/79	09/16/11**
090041#	WINDSOR	HARTFORD	10/05/73	09/29/78	09/16/11**

***Effective maps projected for March 2026**

**** Effective maps projected for September 2025**

Source: FEMA National Flood Insurance Program Community Status Book, 4/3/2018

The National Flood Insurance Program offers an additional voluntary program, the Community Rating System (CRS), which provides discounts on flood insurance premiums to property owners. The CRS recognizes a community's efforts that go beyond the minimum standards for floodplain management by reducing flood insurance premiums from 5% to 45%, depending on the number and type of activities undertaken in the community. These activities may include issuing elevation certificates for new construction in floodplains, outreach to property owners, maintaining flood and property data digitally, stormwater management regulations, open space preservation, and a host of other activities, many of which may be currently undertaken in a community. In the Capitol Region, only West Hartford currently participates in the CRS.

Table 63. Participating CRS Communities in CRCOG

Community #	Community	Current Class	Discount for SFHA	Discount for Non-SFHA	Status
95082	Town of West Hartford	8	10%	5%	C

Substantial Improvement (SI) is defined as any reconstruction, rehabilitation, addition, or other improvement of a structure which costs 50% or more of the market value of the structure prior to the start of construction of the improvement, without regard for the timing of the construction. Triggering this threshold requires the project to meet all current floodplain management requirements. Each community in the region has mechanisms in place to determine substantial damage, and to implement substantial improvement requirements (Table 3-46). Thus, under the minimum standard it is possible for

multiple improvements to be made to a property without addressing flood risk, thereby increasing the overall risk to a property. Communities sometimes strengthen this requirement by attaching a timeframe and counting the total costs of improvements to that property within that timeframe against the substantial improvement threshold.

Table 64. Municipal Floodplain Regulations

Municipality	Regulation/ Ordinance	Reference	Substantial Improvement Timeframe	Freeboard Requirement?
Andover	Zoning Regulations	Section 10	1-year window	No
Avon	Zoning Regulations	Section III G	10-year window	Lowest floor must be at or above 500-year flood
Berlin	Code of Ordinances	August 23, 2008	1-year window	No
Bloomfield	Zoning Regulations	Article 5.1	10-year window	No
Bolton	Zoning Regulations	Section 3.A.18	Life of structure	BFE +1 for residential
Canton	Zoning Regulations	Article V, Section 53	10-year window	BFE +1 for residential
Columbia	Zoning Regulations	Section 53	Life of structure	No
Coventry	Zoning Regulations	Section 5.06	Life of structure	No
East Granby	Zoning Regulations	Section III E	10-year window	No
East Hartford	Zoning Regulations	Article VI, Section 601	10-year window	BFE +1 for residential
East Windsor	Zoning Regulations	Chapter VIII, Section 810	Life of structure	BFE +1 for residential
Ellington	Zoning Regulations	Article 5	Life of structure	BFE +1 for residential
Enfield	Zoning Regulations	Article VIII, Section 8.50	Not specified	BFE +1 for residential
Farmington	Zoning Regulations	Article II, Sections 15, 16, 17	Life of structure	BFE +1 for residential
Glastonbury	Zoning Regulations	Section 4.11	1-year window	Lowest floor must be at or above 500-year flood
Granby	Zoning Regulations	Section 8.18	10-year window	No

Municipality	Regulation/ Ordinance	Reference	Substantial Improvement Timeframe	Freeboard Requirement?
Hartford	Zoning Regulations	Article III, Division 21 FP	Life of structure	No
Hebron	Zoning Regulations	Section 8.10	10-year window	No
Manchester	Zoning Regulations	Article II Section 19	Not specified	No
Mansfield	Zoning Regulations	Article 10, Section E	1-year window	BFE +1 for residential
Marlborough	Code of Ordinances	Ordinance J. Flood Plain Management	10-year window	No
New Britain	Code of Ordinances	Chapter 9	Life of structure	BFE +2 for residential
Newington	Zoning Regulations	Section 6.3	10-year window	BFE +1 for residential
Plainville	Zoning Regulations Code of Ordinances	Section 3.01, Pages II-68-1 to 22	10-year window	BFE +1 for residential
Rocky Hill	Zoning Regulations Town Code	Section 5.2, Chapter 141	10-year window	BFE +2 for residential
Simsbury	Zoning Regulations	Article 7, Section M	Life of structure	BFE +2 for residential
Somers	Zoning Regulations	Article XV, Section 214.84	10-year window	BFE +1 for residential
South Windsor	Zoning Regulations	Article 5, Section 5.2	10-year window	No
Southington	Zoning Regulations	Section 06	Life of structure	BFE +1 for residential
Stafford	Zoning Regulations	Section 5.20	1-year window	No
Suffield	Zoning Regulations	Section 5. K.	Not specified	No
Tolland	Zoning Regulations	Article XII, Section 12	Life of structure	No
Vernon	Zoning Regulations	Section 5	10-year window	No
West Hartford	Code of Ordinances	Chapter 177 – Zoning, Section 177-8	Not specified	BFE +2

Municipality	Regulation/ Ordinance	Reference	Substantial Improvement Timeframe	Freeboard Requirement?
Wethersfield	Zoning Regulations	Article IV, Section 4.2	1-year window	BFE +1 for residential
Willington	Zoning Regulations	Section 4.17	Life of structure	No
Windsor	Code of Ordinances	Chapter 3, Article III	25-year window	No
Windsor Locks	Zoning Regulations	Section 223	Life of structure	BFE +1 for residential

Table 65. Substantial Damage and Improvement Requirement Implementation

Municipality	SI and SD Implementation
Andover	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Avon	The Planning and Community Development Department reviews site plan applications and development proposals, and works with the building department to determine SI/SD.
Berlin	The Building Inspector, working with the Town Engineer, reviews all building permit applications to determine SI/SD.
Bloomfield	The Building Inspector, working with the Town Engineer, reviews all building permit applications to determine SI/SD.
Bolton	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Canton	The Director of Planning oversees the review of applications and permits, along with the Building Official.
Columbia	The Town Engineer or Architect reviews all applications and building permits to determine SI/SD.
Coventry	All proposed development within designated Flood Hazard Zones requires approval by the Planning & Zoning Commission. The Building Official reviews building permits to determine SI/SD.
East Granby	The Building Inspector, working with the Planning & Zoning Commission, reviews all building permit applications to determine SI/SD.
East Hartford	The Town Engineer or Architect, working with the Planning & Zoning Commission, reviews all applications and building permits to determine SI/SD.
East Windsor	The Town Engineer or Architect, working with the Planning & Zoning Commission, reviews all applications and building permits to determine SI/SD.
Ellington	The Town Engineer or Architect, working with the Zoning Enforcement Officer, reviews all applications and building permits to determine SI/SD.
Enfield	The Building Inspector, working with the Planning & Zoning Commission, reviews all building permit applications to determine SI/SD.

Municipality	SI and SD Implementation
Farmington	The Town Engineer or Architect, working with the Zoning Enforcement Officer, reviews all applications and building permits to determine SI/SD.
Glastonbury	The Office of Community Development oversees the review of applications.
Granby	The Town Engineer or Architect, working with the Director of Community Development, reviews all applications to determine SI/SD.
Hartford	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Hebron	The Zoning Enforcement Officer reviews all applications and building permits to determine SI/SD.
Manchester	The Zoning Enforcement Officer reviews all applications and building permits to determine SI/SD.
Mansfield	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Marlborough	The Town Engineer reviews all applications and building permits to determine SI/SD.
New Britain	The City Engineer reviews all applications and building permits to determine SI/SD.
Newington	The Building Inspector, working with the Planning & Zoning Commission, reviews all building permit applications to determine SI/SD.
Plainville	The Town Engineer reviews all applications and building permits to determine SI/SD.
Rocky Hill	The Town Engineer is responsible for enforcing the flood ordinance, which includes SI/SD.
Simsbury	The Floodplain Administrator is responsible for determining SI/SD.
Somers	The Floodplain Manager is responsible for determining SI/SD.
South Windsor	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Southington	The Town Planner reviews all applications and building permits to determine SI/SD.
Stafford	The Zoning Enforcement Officer reviews all applications and building permits to determine SI/SD.
Suffield	The Town Engineer reviews all applications and building permits to determine SI/SD.
Tolland	The Building Official is authorized to review all applications and building permits to determine SI/SD, and for consistency with flood hazard regulations.
Vernon	The Building Inspector, working with the Planning & Zoning Commission, reviews all building permit applications to determine SI/SD.
West Hartford	The Director of Community Development oversees the review of applications
Wethersfield	The Town Engineer or Architect, working with the Zoning Enforcement Officer, reviews all applications and building permits to determine SI/SD.
Willington	The Building Inspector, working with the Planning & Zoning Commission, reviews all building permit applications to determine SI/SD.
Windsor	The Town Engineer reviews all applications and building permits to determine SI/SD.
Windsor Locks	The Town Engineer or Architect, working with the Zoning Enforcement Officer, reviews all applications and building permits to determine SI/SD.

Options for Mitigating Flood Losses

Floods are inevitable, but there are many different approaches that can help reduce flood losses. One common approach in the past has been to intensively manage river channels by armoring and dredging and through the construction of berms, levees, and floodwalls. In addition to being very costly, these traditional engineering solutions often fail, leading to even more extensive and costly flood damages. This approach has been shown to be unsustainable and has led to the situation we are in today, trapped in an escalating cycle of increasing flood damages and costly repairs. In addition, this engineering approach has negative impacts on the ecological health of river systems and the wildlife they support.

In recent decades, more environmentally friendly river restoration techniques (including "natural channel design") have gained popularity. While these techniques still try to control riverine processes, they attempt to employ a more natural channel configuration. These restoration techniques can be an effective tool for mitigating fluvial erosion hazards by slowing bank erosion or limiting lateral channel migration. The high cost of designing and installing restoration projects limits the usefulness of restoration as a general approach to flood hazard mitigation. In addition, restoration projects are prone to failure, either during high flow events or because the design may not have been compatible with river processes.

Another approach to mitigate flood losses is to remove or relocate existing structures that are threatened by flood hazards. Removal of structures from hazardous areas can be an effective approach when it is feasible. While removal or relocation is effective, it is generally far too costly to be applied at a broad scale. In addition, many large structures, particularly transportation infrastructure or public facilities, are rarely feasible to remove or relocate. Retrofitting, another engineering approach (which includes elevating and floodproofing), is appropriate for mitigating inundation hazards but is ineffective in addressing fluvial erosion hazards.

In sum, river management alternatives include stabilization practices, retrofit or removal of existing structures, active restoration, and avoidance. **The most cost-effective way to mitigate flood hazards is *avoidance*: limiting human investments in river corridors.** In addition to preventing future flood losses to structures built in hazardous areas, this approach limits constraints on a river, allowing them over time to achieve a more stable, equilibrium condition.

Source: Municipal Guide to Fluvial Erosion Hazard Mitigation, River Management Program Vermont Agency of Natural Resources

Stormwater and Erosion Control

By statute (Section 22a-325 – 22a-329 of the CGS), all municipalities in Connecticut are required to adopt regulations pertaining to soil erosion and sediment control, and all applications for proposed development that will disturb more than a half-acre must include a soil erosion and sediment control plan. The DEEP has guidelines that serve as the technical standard for compliance with the statute. The *Connecticut Stormwater Quality Manual* provides guidance on site planning, source control, and stormwater practices, including the design, construction, and maintenance of stormwater systems, to protect the quality of Connecticut waters. The practices detailed in the manual aim to reduce the volume of urban runoff and pollutant discharges, recharge groundwater, and control peak flows. These types of stormwater best practices not only protect water quality but also minimize flooding risks. The *Connecticut Guidelines for Erosion and Sedimentation Control* also detail specific measures that can reduce the damages and pollution associated with erosion and sedimentation while simultaneously reducing flooding risks.

In 2012, the state DEEP updated the manual and guidelines to incorporate appendices on Low Impact Development (LID). LID manages stormwater by designing with nature in mind. LID techniques seek to retain stormwater close to where it falls thus keeping runoff out of pipes that drain to waterways. CRCOG encourages its member municipalities to adopt and enforce regulations that would require new development to implement these types of best practices in as far as is possible.

LID and the use of green infrastructure are often considered first by the urban and suburban communities of a region. The City of Hartford has advanced the use of green infrastructure and modified its Zoning Regulations to reduce areas of impervious surfaces. LID is also useful for rural communities. With funding from CIRCA, the Northwest Hills Council of Governments conducted a study of how LID can be used for advancing resilience in rural communities and commissioned the development of a LID design manual.

Updated versions of the *Connecticut Stormwater Quality Manual* and the *Connecticut Guidelines for Soil Erosion and Sediment Control* are scheduled to take effect in March 2024, to be phased in through September 2024. Revisions for this most recent update include updated information on best management practices for structural stormwater management, updated consideration of climate change and climate resiliency for stormwater systems, updates to make these two documents more consistent with each other and with Connecticut state permitting processes, an updated section on stormwater retrofits, and a new consolidated chapter on LID.

Open Space Acquisition

The permanent preservation of undeveloped land can help support natural hazard mitigation efforts by preventing development in areas prone to natural hazards such as floodplains and wildland/urban interfaces. The State of Connecticut has established a goal of preserving 21 percent (or 673,210 acres) of the state's land area for open space for public recreation and natural resource conservation and preservation by 2023. According to the Connecticut Council on Environmental Quality (CEQ), as of 2022, the state has preserved 264,500 acres throughout Connecticut as state land. In addition, the CEQ also estimates that “conservation partners” such as land trusts and municipalities approximately 301,000 acres. According to the 2014-2024 Capitol Region Plan of Conservation and Development, of the Capitol

Region's 66,830 total acres, approximately 18.8% (98,695.5 acres) is open space, and 1.5% (7,789.8 acres) is preserved farmland.

The statute governing open space preservation, CGS Section 23-8, divides responsibility for meeting this goal between the state (10% or 320,576 acres) and municipalities, nonprofit land conservation organizations, and water utilities (11% or 352,634 acres). The state provides financial assistance to municipalities, conservation organizations, and water utilities to help them acquire land under a competitive grant program. Funding through the DEEP Open Space and Watershed Land Acquisition Grant Program is usually available every 2 years. According to the Connecticut Council on Environmental Quality (CEQ) *2022 Annual Report*, in 2022, State grants helped municipalities and land trusts acquire 1,613 acres, while the Connecticut Department of Energy and Environmental Protection acquired 888 acres. Past awards in the Capitol Region have included municipalities or organizations in Bloomfield, Bolton, Canton, Ellington, Enfield, Hebron, Manchester, Mansfield, Simsbury, Somers, Tolland, Vernon, and Windsor. CRCOG assists municipalities and land trusts in their efforts to secure grants by writing letters of support on their behalf to the DEEP. The state grant program requires a local match be provided. Some municipalities have passed bond referenda, and some local trusts have established fund-raising programs to provide local resources for open space acquisition. At times these resources are used to provide the local match for the state grant; at other times they are used to acquire lands without state assistance.

Open space acquisition can be an effective means of preventing development in vulnerable areas; however, the CEQ *2022 Annual Report* states that Connecticut is not on track for meeting its open space preservation goal.

Conservation easements can also be granted to land trusts and municipalities for the purpose of preserving and preventing development on environmentally sensitive lands. Municipalities often acquire conservation easements through the land development approval process. Conservation easements constitute a legally binding agreement that limits certain types of uses or prevents development on land that remains privately held.

Regulation of Wetlands and Watercourses

Activities in wetlands areas and watercourses are regulated under Chapter 440 (Sec. 22a-28 – Sec. 22a-45d) of the Connecticut General Statutes. Under this statute, each municipality is required to establish an inland wetlands agency, identify boundaries of inland wetlands and watercourse areas, promulgate regulations to protect the inland wetlands and watercourses within its boundaries, and require that no regulated activities shall be conducted without a permit. All municipalities in the region have established inland wetlands agencies (refer to Table 66 below) and have enacted inland wetlands and watercourses regulations. According to the CEQ, between 60 and 90 acres of inland wetlands were altered statewide by development from 2004 until 2011 when the rate spiked to more than 200 acres. (Detailed data are not available to the public or CEQ; CEQ has not updated this data since 2011.) Also according to CEQ, municipal agencies, which issue 95 percent of all inland wetlands permits, have become more conserving of wetlands in recent years. CEQ attributes this increased protectiveness to the completion of wetlands training programs by municipal agency members and staff. CEQ notes that remaining barriers to effective implementation of wetland laws include a lack of enforcement of municipal staff training, a lack of funding for municipal staff training, and a continued reliance on paper forms.

Plans of Conservation and Development

Regional planning agencies and municipalities are required by state law (Chapter 127, Section 8-35a and Chapter 126, Sec. 8-23, respectively) to update plans of conservation and development every 10 years. These plans outline the policies and goals for physical and economic development of the region or municipality. Table 66 lists the status of each plan of conservation and development for the 38 municipalities in the Capitol Region along with the responsible agencies for enacting zoning regulations and inland wetlands protection.

Table 66. Municipal Land Use Agencies and Plans

Municipality	Current Plan of Conservation & Development	Agency Responsible for Enacting Zoning Regulations	Designated Inland Wetlands Agency
Andover	5/16/2016	Planning & Zoning Commission	Inland Wetlands Commission
Avon	11/15/2016	Planning & Zoning Commission	Inland Wetlands Commission
Berlin	6/15/2023	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Bloomfield	8/15/2012	Plan & Zoning Commission	Inland Wetlands and Watercourses Commission
Bolton	10/1/2015	Planning & Zoning Commission	Inland Wetlands Commission
Canton	11/20/2019	Zoning Commission	Inland Wetlands and Watercourses Commission
Columbia	6/27/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Coventry	6/22/2020	Planning & Zoning Commission	Inland Wetlands Agency
East Granby	12/13/2016	Planning & Zoning Commission	Conservation Commission
East Hartford	3/8/2022	Planning & Zoning Commission	Inland Wetlands/Environment Commission
East Windsor	10/25/2016	Planning & Zoning Commission	Inland Wetlands Watercourse Agency
Ellington	10/28/2019	Planning & Zoning Commission	Inland Wetlands Agency
Enfield	3/30/2023	Planning & Zoning Commission	Inland Wetlands and Watercourses Agency
Farmington	11/15/2017	Planning & Zoning Commission	Inland Wetland Commission
Glastonbury	10/30/2018	Town Council	Conservation Commission/Inland Wetlands and Watercourses Agency
Granby	9/27/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Hartford	5/12/2020	Planning & Zoning Commission	Planning & Zoning Commission
Hebron	6/10/2014	Planning & Zoning Commission	Conservation Commission/ Inland Wetland Agency
Manchester	6/21/2023	Planning & Zoning Commission	Planning & Zoning Commission/Inland Wetlands Commission

Municipality	Current Plan of Conservation & Development	Agency Responsible for Enacting Zoning Regulations	Designated Inland Wetlands Agency
Mansfield	9/8/2015	Planning & Zoning Commission	Inland Wetlands Agency
Marlborough	4/1/2020	Zoning Commission	Conservation Commission
New Britain	11/17/2021	Common Council	Conservation Commission
Newington	8/26/2020	Planning & Zoning Commission	Conservation Commission/ Inland Wetlands Commission
Plainville	11/12/2019	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Rocky Hill	6/8/2015	Planning & Zoning Commission	Open Space & Conservation Commission
Simsbury	9/26/2017	Zoning Commission	Conservation Commission/ Inland Wetlands Agency
Somers	6/11/2015	Zoning Commission	Conservation Commission
South Windsor	6/23/2013	Planning & Zoning Commission	Inland Wetlands Agency/Conservation Commission
Southington	5/17/2016	Planning & Zoning Commission	Inland Wetlands and Watercourses Agency
Stafford	11/3/2022	Planning & Zoning Commission	Inland Wetlands Commission
Suffield	12/19/2022	Zoning & Planning Commission	Conservation Commission
Tolland	9/23/2019	Planning & Zoning Commission	Inland Wetlands & Watercourses Commission
Vernon	11/4/2021	Planning & Zoning Commission	Inland Wetlands Commission
West Hartford	5/12/2020	Town Plan & Zoning Commission	Town Plan & Zoning Commission
Wethersfield	5/7/2013	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Willington	1/16/2018	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Windsor	9/29/2015	Town Planning & Zoning Commission	Inland Wetlands and Watercourses Commission
Windsor Locks	12/14/2020	Planning & Zoning Commission	Inland Wetlands and Watercourses Commission

Communities are required to incorporate elements of hazard mitigation into their comprehensive plans, and most in Connecticut have complied over several cycles of hazard mitigation planning. Table 67 describes if – and how – the Capitol Region communities have incorporated hazard mitigation into their plans of conservation and development. Most have emphasized flood risk in some way, and many have directly referenced the hazard mitigation plan that was effective at the time of the POCD development.

Table 67. Incorporation of Hazard Mitigation into Plans of Conservation and Development

Municipality	Current POCD	Is hazard mitigation incorporated?	Incorporation by reference (the POCD recognizes the NHMP as a municipal plan)	Incorporation by element or chapter (a chapter of the POCD addresses natural hazards and disaster response)	Incorporation by goal or action (the POCD includes natural hazards and disaster response as goals or actions)
Andover	5/16/2016	Yes - minor	No	No	Yes - flood control at one property
Avon	11/15/2016	Yes	No	Yes - flood	No
Berlin	6/15/2023	Yes	Yes	Yes	Yes
Bloomfield	8/15/2012	Yes	No	No	Yes - flood
Bolton	10/1/2015	Yes	Yes	Yes	Yes
Canton	11/20/2019	Yes	No	Yes - flood	No
Columbia	6/27/2016	Yes	Yes	Yes - flood	Yes
Coventry	6/22/2020	No	No	No	No
East Granby	12/13/2016	Yes	No	Yes - flood	No
East Hartford	3/8/2022	Yes	Yes	Yes - flood	Yes - flood
East Windsor	10/25/2016	Yes	No	No	Yes
Ellington	10/28/2019	Yes, minor	No	No	Yes - flood
Enfield	3/30/2023	Yes, minor	No	Yes - flood	No
Farmington	11/15/2017	Yes	No	Yes - flood, drought	No
Glastonbury	10/30/2018	Yes	No	Yes - flood, erosion	No
Granby	9/27/2016	Yes	Yes	Yes - flood	Yes - climate change, flood
Hartford	5/12/2020	Yes	No	Yes	No
Hebron	6/10/2014	Yes	Yes	No	No
Manchester	6/21/2023	Yes	No	Yes	No
Mansfield	9/8/2015	Yes	Yes	Yes	Yes
Marlborough	4/1/2020	Yes	No	No	Yes - flood, fire, erosion
New Britain	11/17/2021	Yes	No	No	Yes - flood
Newington	8/26/2020	Yes	No	No	Yes - flood
Plainville	11/12/2019	Yes	No	No	Yes - flood
Rocky Hill	6/8/2015	Yes	No	No	Yes - flood
Simsbury	9/26/2017	Yes	Yes	No	Yes
Somers	6/11/2015	Yes	Yes	No	Yes
South Windsor	6/23/2013	Yes	Yes	Yes	Yes
Southington	5/17/2016	Yes	No	No	Yes - flood
Stafford	11/3/2022	Yes	No	No	Yes - dams and flood control

Municipality	Current POCD	Is hazard mitigation incorporated?	Incorporation by reference (the POCD recognizes the NHMP as a municipal plan)	Incorporation by element or chapter (a chapter of the POCD addresses natural hazards and disaster response)	Incorporation by goal or action (the POCD includes natural hazards and disaster response as goals or actions)
Suffield	12/19/2022	Yes, minor	No	No	Yes - flood
Tolland	9/23/2019	Yes	No	No	Yes - flood, drought
Vernon	11/4/2021	Yes, minor	No	Yes - flood	Yes - flood
West Hartford	5/12/2020	Yes, minor	No	Yes - flood	Yes - flood control
Wethersfield	5/7/2013	Yes, minor	No	No	Yes
Willington	1/16/2018	Yes	Yes	No	Yes
Windsor	9/29/2015	Yes	No	No	Yes
Windsor Locks	12/14/2020	Yes - minor	No	No	Yes - flood

State Building Code

Connecticut municipalities employ the State Building Code, which is periodically amended. The Code incorporates the standards in high-wind design and seismic activity appropriate for the state. Local building officials are bound by the state code. Through local implementation of the State Building Code, Capitol Region municipalities help reduce the risks associated with natural hazards in new developments.

The State Building Inspector and the Codes and Standards Committee have adopted the 2022 State Building Code, effective October 1, 2022. This code is based on the 2021 edition of the International Code Council (ICC) document. The 2022 SBC adopts the following model codes:

- 2021 International Building Code
- 2021 International Existing Building Code
- 2021 International Plumbing Code
- 2021 International Mechanical Code
- 2021 International Residential Code
- 2021 International Energy Conservation Code
- 2021 International Swimming Pool and Spa Code
- 2020 National Electrical Code (NFPA 70)
- 2017 ICC A117.1 Accessible and Usable Buildings & Facilities

The code is significant relative to flood mitigation. It requires 1 foot of freeboard in all A, AE, and VE zones (VE zones have a risk of significant wave action and tend to be found along coastlines; there are no VE zones in the Capitol Region); coastal A zones (A or AE zones occurring in coastal areas; there are no coastal A zones in the Capitol Region) are regulated like VE zones in certain cases; flood openings are required in breakaway walls; and essential facilities must be elevated 2 feet above the BFE or to the 0.2% annual chance flood elevation.

Connecticut State Historic Preservation Office (SHPO)
Recognizing that historic and cultural resources are increasingly at risk to natural hazards and climate change, SHPO embarked on a resiliency planning study for historic and cultural resources beginning in 2016. Working with the state's Councils of Government and municipalities throughout the planning process, numerous examples were identified where historic and cultural resources were specifically at risk now, could be at risk in the future, and could help generate consensus for resiliency actions. Historic resources are difficult to floodproof, elevate, or relocate without potential loss of their historicity. Therefore, a thorough understanding of the site-specific options for each set of historic resources is necessary prior to disasters that could damage these resources in order to avoid damage during recovery.

The five coastal COGs in Connecticut hosted historic resources resiliency planning meetings in June 2016. During winter 2016-2017, individual meetings were held with the shoreline communities. Reports were issued to these communities in late 2017 based on the COG meetings and the local meetings. These reports outline eight strategies that can be employed to make historic and cultural resources more resilient. They are:

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

A best practices guide for planning techniques to make historic resources more resilient was distributed in 2019. This guide can be used by all jurisdictions in Connecticut, including those in the Capitol Region, when undertaking development of hazard mitigation plans. Resiliency concepts were added to the update of the *Statewide Historic Preservation Plan* for 2018-2023 with the goal of helping all of the state's communities making historic resources more resilient.

In 2022, SHPO released an up-to-date GIS inventory of historic resource sites within Connecticut. During the 2023 HMCAP planning process, multiple municipalities within the CRCOG region set an intention to obtain and review the new SHPO inventory to guide the identification of vulnerable historic resources during the 2024-2029 planning period. This intention has been incorporated into the action tables in the municipal annexes for these municipalities.

Connecticut Institute for Resilience and Climate Adaptation (CIRCA)
CIRCA is a multidisciplinary center of excellence that brings together experts in the natural sciences, engineering, economics, political science, finance, and law to provide practical solutions to problems arising as a result of a changing climate. The institute helps coastal and inland floodplain communities in Connecticut and throughout the Northeast better adapt to changes in climate and also make their

human-built infrastructure more resilient while protecting valuable ecosystems and the services they offer to human society. Initiatives focus on living shorelines, critical infrastructure, inland flooding, coastal flooding, sea level rise, and policy and planning.

Resilient Connecticut is CIRCA's chief climate adaptation and resiliency planning program. The *Resilient Connecticut* program is described on CIRCA's web site at https://resilientconnecticut.uconn.edu/ and the expansion of the program into the Capitol Region of Connecticut is described at https://circa.uconn.edu/2022/02/23/resilient-connecticut-expands-statewide/. CRCOG is participating in the Resilient Connecticut program by working with CIRCA to identify unmet climate-related needs related to flooding and extreme heat, and CRCOG elected to align the Resilient Connecticut planning process with this update of the region's Hazard Mitigation Plan. This alignment has resulted in development of a combined Hazard Mitigation and Climate Adaptation Plan ("HMCAP").

CIRCA also runs a research program as well as an external grants program for Connecticut municipalities and partners in resilience. To date, CIRCA has awarded 23 projects through its Municipal Resilience Grants Program to 17 municipalities and the state's regional planning organizations, councils of governments. An additional 11 grants were awarded to municipalities, nonprofits, academic researchers, a land trust, and a conservation district to assist them with meeting the match requirement for federal or foundation grants programs. The pilot round of CIRCA's Climate & Equity Grant program awarded grants to six community-based organizations in environmental justice (EJ) communities for a variety of projects related to climate resilience. The CIRCA research program has received funding from CT DEEP, CT DOT, the Connecticut Department of Housing, and NOAA. Research projects cover sea level rise and storm flooding statistics, green infrastructure and living shorelines evaluation, economic modeling, and policy analysis and planning.

Through its first 10 years as an institute, CIRCA projects and products provided significant support to municipalities and the state for resilience planning. In October 2017, CIRCA released localized sea level rise scenarios for the state and recommended that Connecticut plan for the upper end of the likely range of 20 inches/50 centimeters of sea level rise by 2050. In 2023, CIRCA released the statewide Climate Change Vulnerability Index, a GIS-based tool modeling vulnerability due to flooding and extreme heat. CIRCA also partnered with CT DEEP to develop the Connecticut Environmental Justice Screening Tool (CT EJ Screen): https://connecticut-environmental-justice.circa.uconn.edu/

Dam Safety

The Connecticut DEEP Dam Safety Program has jurisdiction over all nonfederally owned or licensed dams in the state that would by failing or otherwise endanger life or property. The program staff maintain an inventory for nearly 4,800 dams in Connecticut. Smaller dams determined to be of Negligible Hazard and other small dams of undetermined hazard classification, while inventoried, are not presently being closely monitored. CT DEEP does not monitor or have jurisdiction over dams that are federally owned including U.S. Army Corps of Engineers (USACE) flood control dams and hydropower dams licensed by the Federal Energy Regulatory Commission (FERC). As of November 2023, the CT DEEP dam inventory includes:

- 189 total and 181 DEEP jurisdictional High Hazard (Class C) dams
- 246 total and 246 DEEP jurisdictional Significant Hazard (Class B) dams
- 724 total and 723 DEEP jurisdictional Moderate Hazard (Class BB) dams
- Approximately 1,895 Low Hazard (Class A) dams

The Dam Safety Program's ultimate responsibility is to ensure all jurisdictional dams in the state are being operated and maintained in a safe condition. The owners of high and significant hazard dams are required by statute to regularly inspect, maintain, and repair their dams and have current Emergency Action Plans (EAPs) ready for implementation should hazardous conditions arise. The program's major responsibilities include:

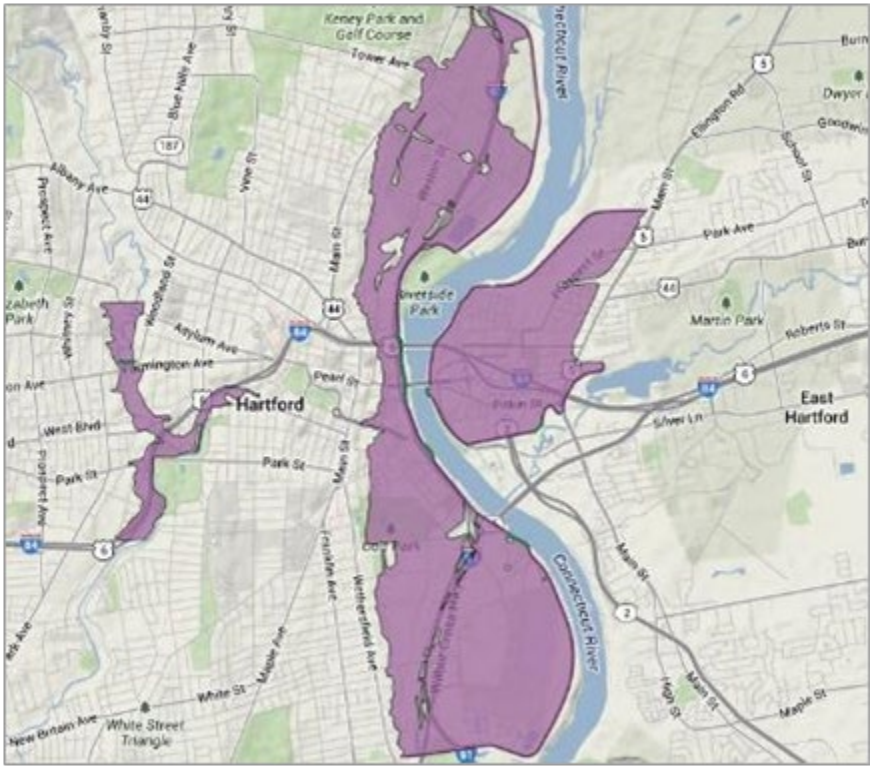
- *Inspections*. The responsibility to undertake regulatory inspections was transferred from the state DEEP to dam owners through legislation in 2013. Program staff still perform inspections of all types, but all regulatory inspections are required to be performed by engineers hired by the dam owner. In rare cases, DEEP has the authority to perform these inspections and charge the property owner. Regulatory Inspections must meet the requirements of Section 22a-409 of the regulation.
- *Emergency Action Plans (EAP) for B and C dams*. Program staff review all EAPs for conformance with Section 22a-411a of the regulation. Staff attend EAP tabletops and drills. The owners of the larger flood control levees in the state, which are DEEP jurisdictional and have more recently been accredited by FEMA and certified by the USACE, are not presently being required to submit an EAP pursuant to 22a-411a of the regulations as an appropriate guideline for writing an EAP for these levee structures does not exist at this time. The need to have updated EAPs for this small subset of dams was put on hold until guidelines could be written and because the existing levee operations plans written by the USACE are the presiding documents for these structures.

    - A total of 181 Class C High hazard dams are expected to have DEEP-reviewed EAPs that conform to Section 22a-411a of the regulation.
    - A total of 246 Class B Significant hazard dams are expected to have DEEP-reviewed EAPs that conform to Section 22a-411 of the regulation.
- *Permitting*. Program staff attend preapplication technical meetings, review general and individual permit applications, issue permits and approvals, and follow up on repair projects.
- *Enforcement*. When a dam is found to be in need of repairs and the dam owner is not responsive, program staff initiate enforcement as needed. Informal enforcement such as Notices of Violation or Non-Compliance and formal enforcement such as unilateral and consent orders are available to ensure that critical issues such as regulatory inspections requirements, EAP preparation requirements, and critical needed repairs are undertaken by the dam owners.
- *Technical Support*. Program staff provide technical support to the staff of the DEEP state-owned dams program and other state agencies. There are over 300 state-owned dams in Connecticut. Program staff also respond to calls and emails and FOIA requests submitted to the program from dam owners, consultants, elected officials, other state officials, and the general public.
- *Inventory*. Program staff maintain an inventory of dams in Connecticut in a database that is regularly updated with dam owner information, inspection report data, EAPs and status, dam physical size and shape data, and communications data. Program staff also maintain an electronic document archive of *Word* and PDF documents and an email archive for each dam along with the original paper files.
- *GIS Data.* Program staff maintain a GIS data layer that has an old dam failure inundation shapefile, which was obtained by digitizing the dam failure inundations maps prepared for the 1980-1982 era Phase I and II dam inspection reports. While outdated, they remain a useful resource in a flood event.
- *Critical Facilities*. DEEP state-owned dams program staff maintain Critical Facilities mapping.

- *DamWatch*. The DEEP subscribes to the U.S. Engineering DamWatch program for DEEP-owned dams. DamWatch is an online real-time Nexrad radar precipitation-based monitoring application for dams. All DEEP-owned dams are monitored by DamWatch. DamWatch will notify DEEP staff whenever a preset precipitation threshold has been surpassed within the drainage area to one of the monitored dams. The notice allows staff to know as early as possible when precipitation intensity and duration may create flood conditions at a monitored dam.

Levees

There are levees in the city of Hartford and the town of East Hartford that provide invaluable flood protection for the residents and businesses of those municipalities. In East Hartford, a nearly 4-mile-long levee runs along the east side of the Connecticut River and north of the Hockanum River, keeping floodwaters from over 728 acres of land generally west of Main Street. In Hartford, a 7.27-mile-long levee runs along the west side of the Connecticut River, providing coverage for over 2,176 acres of land. Also in Hartford, a .14-mile-long levee runs along the Park River, providing flood coverage for over 200 acres on the west side of the city (see the map below). These levees were constructed by the USACE and are overseen by the USACE Levee Safety Program, but the municipalities are responsible for operations and maintenance. The levee systems are periodically inspected.



Map 22. Leveed Areas in East Hartford and Hartford

Source: USACE National Levee Database, https://levees.sec.usace.army.mil/#/

USDA Assistance

Several towns within the region have used the technical and financial assistance of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) to minimize damages from natural disasters. The Emergency Watershed Program provides financial and technical assistance to the state and towns to address dangerous problems that result from natural hazards. The Watershed Protection

and Flood Prevention program provides technical assistance in designing and planning for structural measures to reduce flooding damage. The CT DEEP then assists in the actual installation of planned measures.

Forest Fire Aid

There are procedures in place for requesting assistance or other resources to aid in responding to all hazards including forest and wildland fires. In the State of Connecticut, the first responding authority would be the local jurisdiction. If there is a need for additional aid or resources beyond the local capabilities, the Intrastate Mutual Aid Compact (CGS Sec. 28-22a) outlines the process for requesting assistance. If regional resources are depleted, CT DEEP's Division of Forestry may be requested to assist local fire departments in suppressing wildland fires. The Forestry Division maintains an active forest fire prevention program and a specially trained force of firefighting personnel. During the spring fire season and at other times of high or above fire danger, the division broadcasts daily predictions of fire danger and issues advisories to state park staff, municipalities, fire departments, and the media. The division also has crews ready to assist the U.S. Forest Service in controlling large fires across the nation.

Summary of Effectiveness of Existing Strategies, Authorities, Policies, Programs, and Resources

The communities of the Capitol Region have a variety of tools and resources to draw upon to prepare for and mitigate the impacts of natural hazards. Connecticut municipalities are enabled with a broad scope of government authorities and powers including the ability to tax; establish laws, ordinances, and regulations; exercise eminent domain; provide police protection; and establish, construct, and maintain public facilities and infrastructure. The municipalities have established commissions and boards to undertake their planning, zoning, inland wetlands, development, and conservation responsibilities. These commissions and boards are supported by professional staff and/or consultants. Local communities also have either full-time or volunteer fire departments. Police services are provided by a local department in most communities; however, in smaller communities, a resident state trooper may provide police services. Most municipalities also have public works or highway departments and building inspection departments.

Several mitigation successes are evident in the Capitol Region in the six categories of property protection, prevention, natural resources restoration, structural projects, emergency services, and public education. These success stories were discussed in the presentations to local planning teams in each CRCOG municipality; slides for these presentations are available in Appendix A.

While much has been accomplished to implement natural hazard mitigation throughout the region, resources may not be applied to natural hazard mitigation at a level that allows the communities to accomplish all their proposed mitigation actions within the timeframes proposed. This is due to local governments' broad range of responsibilities and financial limitations. Networks for collaboration among government agencies at the local, state, and federal level, as well as with regional agencies and various organizations, also have been established and are effective in supporting and supplementing the capabilities of individual communities. The ability of communities and the CRCOG to receive state and federal grants and other assistance also improves the effectiveness of local and regional hazard mitigation efforts.

Resources

The following sources of funding and technical assistance may be available for the mitigation projects identified by each community.

General Hazard Mitigation

- ☐ FEMA Hazard Mitigation Grant Program (HMGP) – funding for hazard mitigation projects following a presidentially declared disaster. More information on the HMGP program can be found at: *http://www.fema.gov/hazard-mitigation-grant-program* and at *http://www.ct.gov/demhs/cwp/view.asp?a=4062&q=515030*

- ☐ FEMA Building Resilient Infrastructure and Communities Program (BRIC) -- funding for hazard mitigation projects on a nationally competitive basis. More information on the BRIC program can be found at *https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities*

- ☐ U.S. Small Business Administration – Disaster Loan Program – provides funding to individuals, businesses, and nonprofits including relocation loans. More information can be found at: *http://www.sba.gov/content/disaster-loan-program*

- ☐ U.S. Economic Development Administration-Disaster Recovery – EDA assists local governments affected by disasters. More information can be found at: *https://www.eda.gov/programs/disaster-recovery/*

- ☐ U.S. Department of Housing and Urban Development – CDBG Disaster Recovery Assistance-HUD provides flexible grants to help cities, counties, and states recover from presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. More information can be found at: *https://www.hudexchange.info/programs/cdbg-dr/*

- ☐ U.S. Department of Housing and Urban Development – CDBG Program – generally CDBG funds to municipalities can be used as local match for other federal assistance granted for disaster mitigation provided the activity meets all applicable CDBG requirements. More information can be found at: *http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs*

- ☐ Connecticut Department of Housing CDBG Small Cities Program – This federally funded program provides funding to municipalities with populations of less than 50,000 for a variety of activities including acquisition of property, relocation, public facilities and improvements, code enforcement, planning and capacity building, among other uses. More information can be found at: *https://www.ct.gov/doh/cwp/view.asp?a=4513&Q=596970&PM=1*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Open Space and Watershed Land Acquisition Grant Program – provides financial assistance to municipalities and

nonprofit land conservation organizations to acquire open space. More information can be found at: *http://www.ct.gov/deep///cwp/view.asp?q=323834&deepNav_GID=1642*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Nonpoint Source Management Grant Program – provides grants for the prevention, control, and/or abatement of nonpoint source pollution. Funded under Section 319(h) of the Federal Clean Water Act. More information can be found at: http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325594&deepNav_GID=1654

- ☐ Connecticut Department of Energy and Environmental Protection (DEEP) Climate Resilience Fund – provides grants for Connecticut municipalities for planning and project development to help communities be more resilient to the impacts of climate change. More information can be found at *https://portal.ct.gov/connecticutclimateaction/executive-order/deep-climate-resilience-fund*

- ☐ Connecticut Department of Emergency Services and Public Protection, Division of Emergency Management and Homeland Security – provides strategic planning and grant assistance. More information can be found at*: http://www.ct.gov/demhs/cwp/*

- ☐ Connecticut Land Conservation Council – can provide funding and advice on additional sources of funding to local land trusts for open space acquisition. More information can be found at: *http://www.ctconservation.org/funding-programs*

- ☐ AmeriCorps – service project teams may be available to assist with projects such as surveying, tree planting, restoration, construction, and environmental education. More information on AmeriCorps can be found at: *http://www.americorps.gov/for_organizations/overview/index.asp* and at *https://www.nationalservice.gov/impact-our-nation/state-profiles/ct*

- ☐ Capitol Region Council of Governments – Assistance to municipalities for road and bridge projects, brownfield remediation, and other projects that could include hazard mitigation outcomes. Funding for this assistance is through federal and state sources and subject to specific program requirements. More information can be found at *http://crcog.org/funding-opportunities-2/*

- ☐ Connecticut State Historic Preservation Office – grants available to support identification, preservation, protection, and restoration of historic buildings and sites. *https://www.ct.gov/cct/cwp/view.asp?a=3948&q=293806*

- ☐ Grants.gov: Lists of grant opportunities from federal agencies (HUD, DOT/FHWA, EPA, etc.) to support rural development, sustainable communities and smart growth, climate change and adaptation, historic preservation, risk analyses, wildfire mitigation, conservation, Federal Highways pilot projects, etc. *https://www.grants.gov/*

- ☐ GrantWatch: The website posts current foundation, local, state, and federal grants on one website, making it easy to consider a variety of sources for grants, guidance, and partnerships. Grants listed include The Partnership for Resilient Communities, the Institute for Sustainable Communities, the Rockefeller Foundation Resilience, The Nature Conservancy, The Kresge Climate-Resilient Initiative, the Threshold Foundation's Thriving Resilient Communities funding, the RAND Corporation, and ICLEI Local Governments for Sustainability. *https://www.grantwatch.com/*

- ☐ USDA Natural Resource Conservation Service (NRCS) and Rural Development Grants: NRCS provides conservation technical assistance, financial assistance, and conservation innovation grants. USDA Rural Development operates over fifty financial assistance programs for a variety of rural applications. *https://www.nrcs.usda.gov/* and *https://www.rd.usda.gov/programs-services*

Flood Mitigation

- ☐ FEMA Flood Mitigation Assistance (FMA) Program – grants for flood hazard mitigation planning and projects such as property acquisition, relocation of residents, and flood retrofitting. More information can be found at: *http://www.fema.gov/flood-mitigation-assistance-program*

- ☐ FEMA National Flood Insurance Program Community Rating System, *http://www.fema.gov/national-flood-insurance-program-community-rating-system*

- ☐ U.S. Army Corps of Engineers Flood Risk Management Program – 50/50 match funding for floodproofing and flood preparedness projects. More information can be found at: *http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram.aspx*

- ☐ U.S. Department of Agriculture Natural Resources Conservation Service Emergency Watershed Protection and Watershed and Flood Prevention Operations Programs – technical and financial assistance to reduce or prevent flood damage, reduce soil erosion, and improve water quality. More information can be found at: *http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/* and at *http://www.nrcs.usda.gov/wps/portal/nrcs/main/ct/programs/financial/ewp/*

Hurricane Mitigation

- ☐ FEMA Mitigation Assessment Team Program – technical assistance to state and local governments provided through reports and technical manuals based on assessments of building performance in response to disasters. More information can be found at: *http://www.fema.gov/mitigation-assessment-team-program*

Wildfire Mitigation

- ☐ Assistance to Firefighters Grant Program – grants are provided to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards**.** More information can be found at: *http://www.fema.gov/welcome-assistance-firefighters-grant-program*

Dams and Levees

- ☐ Association of State Dam Safety Officials – website with advice and information on dam safety. More information can be found at: *http://www.damsafety.org/*

- ☐ Connecticut Department of Energy & Environmental Protection (DEEP) Dam Safety Program – more information can be found at: *http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325634&deepNav_GID=1654*

- ☐ U.S. Army Corps of Engineers Levee Program – information on levee safety, risk assessment, and risk reduction. More information can be found at: *http://www.usace.army.mil/Missions/CivilWorks/LeveeSafetyProgram/USACEProgramLevees.aspx*

Power Outages

- ☐ State of Connecticut, Microgrid Program – originally created in 2012 upon passage of Public Act 12-148, the Connecticut Microgrid Program supports local distributed energy generation for critical facilities. Grants can be awarded to any number of recipients and are generally split between small, medium, and large municipalities. Grants are not to exceed $15 million a year. The state closed the window of its fourth round of applications in January 2018 with eight applicants. More information can be found at: *http://www.ct.gov/deep/cwp/view.asp?a=4405&Q=508780*

Implementation Challenges

The following challenges faced by local communities in implementing hazard mitigation measures are common to most municipalities in the region. In the listing of municipal mitigation strategies that follows, some additional challenges unique to certain communities may be included; however, the following challenges apply to most Capitol Region municipalities. These challenges can impact the effectiveness of existing authorities, policies, programs, and resources; however, it should be noted that local governments have a number of procedures and tools available that can allow them to adjust, over time, their programs, procedures, and resources to more effectively mitigate natural hazards.

Limited Resources

Local communities, as well as state and federal governments, private enterprise, nonprofit organizations, and households, all face financial limitations, which can restrict their ability to fully implement measures and activities that are in their best interest. At the local level, most financial resources are provided through property tax revenue with additional support from state and federal governments through various programs and grants. The lingering effects of the Great Recession have severely tightened most local budgets. State budget limitations also affect local resources.

Through the local political and planning processes and budget deliberations, municipalities routinely reevaluate local programs and policies and adjust spending priorities. Expenditures on programs that support natural hazard mitigation may not always be considered by a community and its citizens as high priority as expenditures related to schools or other local initiatives as well as those related to mandated programs and expenditures. The lack of or limits on funding can lead to reduced effectiveness in a municipality's capability to accomplish hazard mitigation. At the regional level, CRCOG's ability to implement mitigation activities is also tied to financial limitations. Our funding is derived primarily from state and federal grants and programs and municipal dues. As these various levels of governments face financial cutbacks and changes in spending priorities, financial support to CRCOG can be impacted.

Multiple Jurisdictions

Hazard mitigation requires coordination among the multiple federal, state, and local agencies that influence development, maintenance, and emergency response activities. At the local level, some municipalities have difficulties getting their inland wetlands commissions and public works staff to agree on the appropriateness of drainage maintenance activities to reduce flooding risk. In addition, some communities face flooding risks from natural and/or man-made influences located in other communities, requiring interlocal coordination and communication. Finally, it can be difficult for a community to take full advantage of available federal and state resources for mitigation activities because programs are spread among different departments and agencies such as FEMA, the U.S. Department of Agriculture, DEEP, and DEMHS.

Most communities are active in regional organizations such as CRCOG, the Connecticut Conference of Municipalities (CCM), and the Connecticut Council of Small Towns (COST), which provide a variety of services such as management and technical assistance, training, and coordination among various agencies; lobbying for changes in state legislation; use of shared resources; and negotiating for competitive contracts for a variety of goods and services. These organizations can help improve the effectiveness of many local efforts including hazard mitigation.

State Infrastructure

When the initial plan was developed, most Capitol Region municipalities identified stormwater management as a high priority natural hazard mitigation concern. This concern continues. Many communities have specific locations subject to periodic flooding that result from state road drainage systems. Resolving minor flooding problems on state roads is difficult for towns because they have no purview over improvements on state infrastructure. Some such flooding areas pose emergency access risks while others present minor property damage concerns. Several towns also identified difficulties with the state's response to storm, snow, and accident cleanup on state roads.

In the aftermath of the two storms of 2011, Irene and Alfred, the Governor appointed a Two Storm Panel to review how the storms were handled and to make recommendations for future disaster preparedness and response. Among the panel's recommendations were a number calling for improvements in state infrastructure and disaster preparedness including developing "new engineering standards that will better protect the built environment from the effects of extreme weather," improved GIS mapping and analysis, and planning for the issues rising sea levels will have on combined sewer overflows and dam safety.

Vulnerability to Power Outages

The widespread and lengthy power outages resulting from downed wires and damages to transmission lines due to Irene and the October snowstorm in 2011 brought attention to the need for tree maintenance in utility rights-of-way and along roadways and the need for better coordination and communication between Eversource and municipal officials. Among the Two Storm Panel's recommendations were calls for improved coordination among electric and telecommunications utilities, municipalities, and state agencies in dealing with tree maintenance; a comprehensive study of the feasibility, cost, and reliability of undergrounding utilities; and the establishment of a state working group to improve municipal and utility collaborations.

Clean Water Project

The Metropolitan District Commission (MDC) provides water supply, water pollution control, mapping, and household hazardous waste collection to eight member municipalities – Bloomfield, East Hartford, Hartford, Newington, Rocky Hill, West Hartford, Wethersfield, and Windsor. The MDC also provides

water and/or sewer services to portions of several other towns in the region. The MDC has undertaken its Clean Water Project in response to both federal and state consent orders to achieve Federal Clean Water Act goals by 2029. The project, estimated at $2.4 billion, will reduce Combined Sewer Overflows (CSO), eliminate Sanitary Sewer Overflows (SSO), and increase nitrogen removal from system discharges. The challenge, and significant opportunity, presented by the Clean Water Project is for the MDC and its member municipalities to ensure that the design of infrastructure improvements reduces or at least, does not increase flooding risks. Because the MDC is pursuing funding for the project from several state and federal sources, FEMA Hazard Mitigation program funding is not a likely source of funding (federal funds cannot be used to match other federal funds). Nevertheless, it is important for MDC municipalities to remain active participants in Clean Water Project planning.

Region-wide Municipal Goals, Objectives, and Strategic Actions

Municipal Goals and Objectives

During the development of the 2014 edition of this plan, the municipalities in the Capitol Region collectively identified over 400 mitigation strategies to include in the plan. These 400+ mitigation actions were organized among municipal goals and objectives that largely originated in the 2008 edition of the plan and were carried forward to the 2014 edition of the plan with revisions as directed by the local planning teams. Many of the goals and objectives were similarly worded but contained slight differences, which created a situation where goals and objectives were redundant.

To promote uniformity throughout the update process in 2018-2019 and ensure that communities selected appropriate mitigation actions in light of the new initiatives and challenges described during meetings held in 2017-2018, CRCOG worked with its communities to develop a standard list of municipal goals from which each community would identify those that are locally relevant. Nine municipal hazard mitigation goals were identified and used to inform each community's respective hazard mitigation strategies and actions. The nine region-wide municipal goals in the 2019 plan are listed below.

- Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure: Mitigation actions that address this goal are intended to protect or adapt structures and infrastructures from the physical impacts of hazards. Actions might include floodproofing structures, elevating structures above flood elevations, constructing fire breaks, or assessing wind-load capacities of critical facilities.
- Goal 2: Ensure municipal codes and regulations support hazard mitigation: Mitigation actions that address this goal focus on strengthening the regulatory frameworks of communities to avoid the creation or exacerbation of hazardous conditions. Actions might include requiring buildings be elevated above the flood elevation or requiring new developments have multiple modes of egress.
- Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies: Mitigation actions that address this goal focus on education and training of municipal or regional staff, first responders, and elected officials.
- Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure: Mitigation actions that address this goal focus on utilizing the beneficial functions of natural systems and features. Actions might include wetland

protection, low impact development, and use of green infrastructure similar to recent actions in the City of Hartford.

- Goal 5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies: Mitigation actions that address this goal focus on maintaining critical services through hazard events. Actions might include burying power lines, developing microgrids, or protecting a wastewater treatment plant.
- Goal 6: Improve public outreach, education, and warning systems: Mitigation actions that address this goal focus on educating and alerting the public. Actions may include sending informational mailers, providing information on the municipal website, or implementing a reverse 9-1-1 system.
- Goal 7: Improve the emergency response capabilities of the region and its communities: Mitigation actions that address this goal focus on developing a community's ability to respond to a hazard event. Actions may include upgrading shelters or the Emergency Operations Center, reviewing evacuation routes, or improving the ability of emergency responders to communicate with one another during events.
- Goal 8: Ensure community character and social equity are addressed in mitigation activities: Mitigation actions that address this goal focus on protecting features of a community that may otherwise be overlooked when considering only the most critical features. Actions may include those that protect historic, cultural, and recreational resources or those that specifically address low-moderate income or underserved populations.
- Goal 9: Minimize the economic impact of hazard damages: Mitigation actions that address this goal focus on limiting economic impacts of damages that do occur regardless of actions taken to mitigate the physical impacts of the damages themselves. Actions may include educating landowners about flood insurance, joining CRS, improving the community CRS score, or setting up recovery funding mechanisms.

This HMCAP advocates for, and supports, new goal statements that are aligned with *Resilient Connecticut* and the efforts of the GC3. The five new goals developed for this HMCAP were developed with cooperation from CIRCA in the *Resilient Connecticut* planning process, and are:

1. Ensure that critical facilities are resilient, with special attention to shelters and cooling centers.
2. Address risks associated with extreme heat events, especially as they interact with other hazards.
3. Reduce flood and erosion risks by reducing vulnerabilities and consequences, even as climate change increases frequency and severity of floods.
4. Reduce losses from other hazards.
5. 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.

The previous nine goals are cross-referenced to the five new goals in the table below, demonstrating that demonstrating that the intent of each of the prior goals was preserved during the shift to new goals.

Table 68. Matrix of New Hazard Mitigation and Climate Adaptation Goals Compared to Previous Goals

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
Goal 1: Minimize the impact of natural hazards on physical buildings and infrastructure.	Critical facilities are an important subset of buildings and infrastructure.	Extreme heat is a hazard that may impact some buildings and infrastructure. Reducing heat exposure may help reduce losses to buildings and infrastructure.	Floods and erosion are hazards that will impact some buildings and infrastructure. Reducing flood and erosion risks will help reduce losses to buildings and infrastructure.	Hazards such as winter storms and severe wind events will impact some buildings and infrastructure. Reducing risks will help reduce losses to buildings and infrastructure.	Infrastructure includes roads and the utilities within roadways. Resilient corridor identification and development will help protect infrastructure.
Goal 2: Ensure municipal codes and regulations support hazard mitigation.	Codes and regulations are employed when developing or upgrading critical facilities.	Codes and regulations may help reduce the impacts of extreme heat.	Codes and regulations will help reduce the impacts of flood and erosion.	Codes and regulations will help reduce the impacts of hazards such as severe wind events and heavy snow.	---
Goal 3: Improve institutional awareness and understanding of natural hazard impacts and mitigation within municipal governments and other decision-making bodies.	Discussions about shelters and cooling centers will be helpful in advancing institutional awareness and community planning.	New discussions about extreme heat can be used in advancing institutional awareness and local planning.	New discussions about intense flooding can be used in advancing institutional awareness and local planning.	New discussions about droughts and other hazards can be used in advancing institutional awareness and local planning.	The concept of fostering resilient corridors may be helpful in advancing institutional awareness and local planning.
Goal 4: Increase the use of natural, "green," or "soft" hazard mitigation measures such as open space preservation and green infrastructure.	--	Some actions that help reduce extreme heat are aligned with green infrastructure natural resource restoration.	Flood risk reduction efforts may include setting aside open space and acquiring properties to remove structures, as well as the use of green infrastructure.	Natural and green infrastructure can help manage droughts and other hazards.	--

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
Goal 5: Improve the resilience of local and regional utilities and infrastructure using strategies including adaptation, hardening, and creating redundancies.	Critical facilities are an important subset of infrastructure.	Extreme heat is a hazard that may impact some utilities and infrastructure. Reducing heat exposure may help reduce losses to utilities and infrastructure.	Floods and erosion are hazards that will impact some utilities and infrastructure. Reducing flood and erosion risks will help reduce losses to utilities and infrastructure.	Hazards such as winter storms and severe wind events will impact some utilities and infrastructure. Reducing risks will help reduce losses to utilities and infrastructure.	Infrastructure includes roads and the utilities within roadways. Resilient corridor identification and development will help protect utilities and infrastructure.
Goal 6: Improve public outreach, education, and warning systems.	Shelter and cooling center awareness is a key part of public education, especially given that not all cooling centers are equally accessible; and some shelters are in adjacent towns	Extreme heat is emerging as a severe public health threat, and public education is critical for reducing injuries and deaths.	More than ever, flood risk communication is needed to ensure that private and public investments are reducing risks; and that people understand how to be safe during flood events.	An all-hazards approach to public education fosters community responses to wildfires, droughts, and severe storms.	Helping community members understand why investment is directed at resilient corridors will help them make choices about preparing for floods and other events.
Goal 7: Improve the emergency response capabilities of the region and its communities.	Making critical facilities such as shelters and cooling centers more resilient will directly benefit emergency response capabilities.	Reducing the impacts of extreme heat may reduce the need to respond during extreme heat events.	Reducing the impacts of floods may reduce the need to respond during flood events.	Reducing the impacts of hazards such as severe winter storms and wind events may reduce the need to respond during these events.	Resilient corridors will directly benefit emergency response capabilities.
Goal 8: Ensure community character and social equity are addressed in mitigation activities.	Critical facilities such as shelters and cooling centers are necessary to support social equity. Actions about transportation and facility operations will help ensure equity in usage is achieved.	Extreme heat often highlights the inequities in extreme heat management. Actions that reduce heat exposure such as trees, and actions that increase heat management such as cooling centers, can help achieve equity while also benefiting community character.	Flood damage often highlights the inequities in floodplain management. Actions that reduce flood risk such as providing more resilient housing opportunities and setting aside floodplains for conservation can help achieve equity while also benefiting community character.	Losses from other hazards (e.g., power outages) often highlight social inequities. Actions that reduce risks can help achieve equity while also benefiting community character.	Resilient corridor concepts can help advance social equity by fostering deliberate investment in specific corridors rather than responding to unplanned development pressures or requests from specific neighborhoods to invest in roads that are not appropriate for an

Goals from last edition of this hazard mitigation plan	*New Hazard Mitigation and Climate Adaptation Goals*				
	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.**
					enhanced level of investment.
Goal 9: Minimize the economic impact of hazard damages.	Making critical facilities such as shelters and cooling centers more resilient will reduce costs associated with repairs after hazard events.	Reducing the causes of extreme heat exposure may reduce the costs to manage extreme heat (e.g., air conditioning).	Reducing the impacts of floods has a direct economic benefit to property owners and the community.	Reducing the impacts of severe wind, winter storms, and other hazards has a direct economic benefit to property owners and the community.	Resilient corridor concepts can be used to foster development in resilient areas, which has an economic benefit to residents.

Mitigation Action Categories

Individual mitigation projects and actions proposed by the Capitol Region municipalities were categorized into the following types of measures:

- **Education and Awareness –** Projects include measures to inform and educate local residents and businesses, elected and appointed officials, and other stakeholders. Types of outreach include general public informational outreach efforts such as the use of local websites to post information, mailings with tax statements, newspaper advertisements, press releases, email blasts, etc. Other measures in this category include targeted outreach efforts to specific groups, which could include more direct contact such as meetings. Also included are workshops, forums, fairs, seminars, and the like.

- **Natural Resource Protection –** Actions include those that not only minimize hazard losses but also preserve or restore functions of natural systems such as stream corridor restoration, watershed management, wetlands preservation and restoration, and timber management.

- **Preparedness and Emergency Response –** Actions in this category may not be thought of as directly tied to mitigation of damage due to natural disasters, but they are measures vital to public safety and the restoration of normalcy in a community. In this regard, they play an important role in the reduction of losses a community will experience. Measures include improving working relationships and coordination between agencies; securing new equipment, facilities, supplies, and personnel to aid in emergency response; improving procedures related to emergency response; conducting emergency response training; and improving communications systems.

- **Prevention –** Activities in this category generally include government actions or processes that influence the way land and buildings are developed such as zoning regulations, floodplain regulations, building codes, open space preservation, and stormwater regulations. Also included are studies and assessments of risks and vulnerabilities including identifying and improving a community's ability to contact vulnerable populations; improving mapping and data analysis capabilities; and undertaking engineering studies to address drainage, flooding, and power outage issues. Other government actions and programs, such as implementing procedures for improving operations, using tax incentives, and capital improvement programming, are also included in this category.

- **Structural Projects –** Measures in this category include construction projects to reduce the impact of hazards such as installation of improved drainage facilities, culverts, and other stormwater controls as well as undergrounding utilities.

- **Property Protection –** Activities in this category include modifications and retrofits of existing buildings, structures, and infrastructure to protect or remove them from harm such as acquisition, relocation, elevation, floodproofing, installation of shatterproof glass, strengthening roofs, etc. Expanding sheltering capacity and installation of backup power to critical facilities are other measures included in this category.

A number of specific measures could be classified into one or more of these types/categories. For example, strengthening a shelter is property protection as well as a preparedness action. For the

purposes of this planning effort, we chose to identify specific measures as being within only one of these categories. It is important to note that the 2014 edition of this plan aggregated structural projects and property protection projects.

Municipal Strategies and Actions

During the course of the 2017-2018 update process, municipal planning team members evaluated progress made on the mitigation activities proposed in the 2014 Plan. The 38 municipalities in the Capitol Region collectively identified over 700 new mitigation actions to include in the 2019 plan update along with some to carry forward from the 2014 plan. While many actions are unique to the individual communities, there were commonalities among the actions proposed, and all communities proposed a range of activities including public education and awareness; natural resource protection; plans, studies, and regulatory actions; and structural projects and modifications to buildings, facilities, and infrastructure as well as measures to improve preparedness and emergency response. A blueprint for implementing all proposed projects in the 2019 Plan Update was provided in that plan; departments and agencies that will be responsible for carrying out the activities, potential funding sources, and the timeframes for conducting the projects were identified for each mitigation activity.

A similar process was followed for this update. During the course of the 2023-2024 update process, municipal officials evaluated progress made on the mitigation activities proposed in the 2019 Plan. From this effort, insights into means in which to ensure project implementation were gained. As in 2014 and 2019, some of the activities listed in this Plan Update may have also been previously identified in capital improvements programs, annual budgets, and various local plans. Many activities have been newly identified as a result of this planning effort while others were identified for the previous edition of this plan but for various reasons were not fully completed.

As can be seen in the municipal annexes, all communities have proposed a variety of actions to mitigate the damages natural hazards can cause. Most communities have proposed to undertake one or more public education/outreach projects and one or more projects aimed at improving emergency preparedness and response. Most communities have also proposed to undertake structural projects to construct, modify, or relocate buildings, infrastructure, or critical facilities in order to strengthen them or protect them or their functions from the effects of natural disasters. All communities have proposed one or more activities designed to prevent or lessen the impacts of natural hazards. A number of communities have proposed projects designed to protect or restore natural resources or natural functions. Details of each proposed local mitigation activity or project, including responsible agencies, project priorities, project statuses, potential funding sources, and anticipated timeframes, are provided in the municipal annexes.

This Plan helps to focus attention on efforts that can reduce or eliminate the long-term risk to human life or property from natural hazards; however, there are no mandates to undertake these specific activities. The mitigation strategies that follow focus on actions that can be achieved within the 5-year plan period although some activities/projects may require a longer timeframe to be fully implemented. The availability of resources to fund and carry out these activities is crucial to their successful implementation.

Analysis of Mitigation Actions

In considering which projects, processes, and other measures to undertake in the upcoming plan period, municipal and regional officials evaluated the need to address problems and vulnerabilities in their communities against the communities' resources and capabilities. To prioritize mitigation strategies, multiple sets of criteria commonly used by public administration officials and planners were applied to each proposed strategy, including STAPLEE (used in previous versions of this plan), PERSISTS (developed by CIRCA), and the Connecticut Environmental Justice Screening Tool.

STAPLEE

The STAPLEE method is outlined in FEMA planning documents such as Developing the Mitigation Plan (FEMA 386-3) and Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5). STAPLEE stands for the "Social, Technical, Administrative, Political, Legal, Economic, and Environmental" criteria for making planning decisions.

Benefit-cost review was emphasized in the prioritization process. Criteria were divided into potential benefits (pros) and potential costs (cons) for each mitigation strategy. The following questions were asked about the proposed mitigation strategies:

Social:
Benefits: Is the proposed strategy socially acceptable to the community?
Costs: Are there any equity issues involved that would mean that one segment of the community could be treated unfairly? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower-income people? Is the action compatible with present and future community values?

Technical:
Benefits: Will the proposed strategy work? Will it reduce losses in the long term with minimal secondary impacts?
Costs: Is the action technically feasible? Will it create more problems than it will solve? Does it solve the problem or only a symptom?

Administrative:
Benefits: Does the project make it easier for the community to administrate future mitigation or emergency response actions?
Costs: Does the community have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained? Can the community perform the necessary maintenance? Can the project be accomplished in a timely manner?

Political:
Benefits: Is the strategy politically beneficial? Is there public support both to implement and maintain the project? Is there a local champion willing to see the project to completion? Can the mitigation objectives be accomplished at the lowest cost to the community (grants, etc.)?
Costs: Have political leaders participated in the planning process? Do project stakeholders support the project enough to ensure success? Have the stakeholders been offered the opportunity to participate in the planning process?

Legal:
Benefits: Is there a technical, scientific, or legal basis for the mitigation action? Are the proper laws, ordinances, and resolutions in place to implement the action?
Costs: Does the community have the authority to implement the proposed action? Are there any potential legal consequences? Will the community be liable for the actions or support of actions or for lack of action? Is the action likely to be challenged by stakeholders who may be negatively affected?

Economic:
Benefits: Are there currently sources of funds that can be used to implement the action? What benefits will the action provide? Does the action contribute to community goals such as capital improvements or economic development?
Costs: Does the cost seem reasonable for the size of the problem and the likely benefits? What burden will be placed on the tax base or local economy to implement this action? What proposed actions should be considered but be tabled for implementation until outside sources of funding are available?

Environmental:
Benefits: Will this action beneficially affect the environment (land, water, endangered species)?
Costs: Will this action comply with local, state, and federal environmental laws and regulations? Is the action consistent with community environmental goals?

Each proposed mitigation action presented in this plan was evaluated and quantitatively assigned a "benefit" score and a "cost" score for each of the seven STAPLEE criteria from a range of 0 to 2:

- 0 = none or low
- 1 = medium
- 2 = high

Rather than providing a generic description of score assignment as in the previous two edits of this plan, the current approach is provided below.

Social:

- Benefits
    - Shelters and cooling centers were given a 2 (high).
    - Water and sewer infrastructure projects were given a 2 (high).
    - All other actions were given a 1 (medium), as they all have a base level of social benefits.
    - Zeroes were not identified, as all the actions have social benefits.
- Costs
    - All were scored as zero (none or low). This plan purposely does not include actions with adverse social costs.

Technical:

- Benefits
    - Standby power projects were given a 2 (high).
    - Acquisitions and elevations to reduce flood damage were given a 2 (high).

    - Water and sewer infrastructure projects were given a 2 (high).
    - Projects that require a few discrete efforts to work well, such as partnering with a State agency or completing a study, were given a 1 (medium). However, studies that result in prioritization of specific outcomes were given a 2 (high).
    - Zeroes were not identified, as all the actions are believed potentially effective.
- Costs
    - All were scored as zero (none or low), as they are all believed feasible.

Administrative:

- Benefits
    - Regulatory, ordinance, policy, and guidance improvements were given a 2 (high) because they will lead to more straightforward beneficial outcomes.
    - All other actions were given a 1 (medium).
    - Zeroes were not identified, as all the actions have administrative benefits even if they are not immediately realized.
- Costs
    - All were scored as a 1 (medium) except for annually conducted exercises which were scored as a 2 (high).
    - Zeroes were not identified because all actions have administrative costs; none can be conducted without some level of staff and elected official intervention.

Political:

- Benefits
    - All actions were given a 1 (medium), as they all provide moderate benefits to elected officials, commissions, and agencies; they will all involve a local champion; and many will involve some level of grant funding.
- Costs
    - All were scored as zero (low or none). This plan purposely does not include divisive and controversial actions with adverse political costs.

Legal:

- Benefits
    - Regulatory, ordinance, policy, and guidance improvements were given a 1 (medium) because they help grant authority and provide backing in the face of potential legal challenges.
    - Actions that result in formal recognition of a shelter or cooling center were given a 1 (medium) because they help reduce uncertainty and confusion around which facilities are available and appropriate.
    - All other actions were given a 0 (low to none).
- Costs

- All were scored as zero (low to none). This plan purposely does not include actions with adverse legal costs where liability could be increased. Future stages of phased projects will be re-evaluated relative to legal costs.

Economic:

- Benefits
  - Actions that reduce financial losses and damage to property and infrastructure were given a 1 (medium) or 2 (high).
  - The score of 2 (high) was often used for extension of water and sewer systems – especially when fire protection can be provided from water systems – and for other actions that enable smart growth or redevelopment in low-risk areas.
  - Actions related to shelters, cooling center, and critical facilities were generally scored as zero (low). This does not mean economic benefits are absent; instead, the function of the action is more to directly protect people.
  - All other actions were given a 0.
- Costs
  - Ranges from zero to $10,000 were ranked lowest (0).
  - Ranges from $10,000 to $500,000 were ranked moderate (1).
  - Ranges from $500,000 and upward were ranked high (2).

Environmental:

- Benefits
  - Actions that reduce flooding or flood damage were given a 1 (medium) or 2 (high) because floods are a significant cause of water quality impairment in developed areas.
  - Zeroes (low to none) were used mainly for critical facility actions.
- Costs
  - All were scored as zero (low to none). This plan purposely does not include actions with adverse environmental costs.

Technical and economic criteria were double weighted (x2) in the final sum of scores. The total benefit score and cost score for each action were summed to determine each final STAPLEE score.

An evaluation matrix with the total scores from each strategy can be found as Appendix M. While higher-scoring strategies are generally considered to be more achievable and/or important than lower-scoring strategies economically, socially, environmentally, and politically, the priorities of local communities are also considered in the final prioritization of actions. A diversity of scores may be found within specific categories of mitigation actions. For example, one community may find joining the Sustainable CT program to be administratively burdensome while another may not; this will lead to different scores for the same action.

Although a community may implement recommendations as prioritized by the STAPLEE method, an additional consideration is important for those recommendations that may be funded under the FEMA mitigation grant programs. To receive federal funding, the mitigation action must have a benefit-cost

ratio (BCR) that exceeds a value of 1.0. Calculation of the BCR is conducted using FEMA's Benefit Cost Analysis (BCA) toolkit. The calculation method may be complex and vary with the mitigation action of interest. Calculations are dependent on detailed information such as property value appraisals, design and construction costs for structural projects, and tabulations of previous damages or NFIP claims.

The BCR scoring system used is outlined in the table below:

Table 69. Benefit-Cost Ratio Scoring Definitions

Scoring	Benefits	Costs
Low: 0-1 points	Few would benefit; the impacts being addressed are not severe; benefits may be short term	Likely to be done by existing personnel with little impact on budget; not complicated to accomplish. Costs to implement are likely to be under $10,000.
Medium: 2-3 points	Benefits may be felt by many in the community; the action may solve a problem or otherwise benefit the community for a number of years	May need additional funding or studies; may require change in practices; costs to implement may be between $10,000 and $100,000
High: 4-5 points	Benefits would accrue to many in the community; benefits may accrue to the most vulnerable or those not able to recover on their own; benefits would be long term and may permanently protect from damages	Likely to cost over $100,000 and require obtaining funding outside of operating budget; complicated, lengthy process to implement

The STAPLEE method accounts for cost-benefit considerations both directly (through the "Economic" category) and indirectly (through general consideration of costs and benefits of actions). Additionally, the range of estimated costs of each strategy are included in the STAPLEE table. The assumed costs of projects and generalized presentation of the benefits accruing from them are not based on specific detailed cost estimates as that level of analysis is not appropriate for this type of planning effort. For some projects, such as routine or recurring operations that are established practices and conducted with municipal general operating funds and existing staff, the STAPLEE results can be the only explicit comparison of costs and benefits. For projects for which bonding and/or grant funding will be sought, more in-depth evaluations of costs and benefits will be required. As project scopes are detailed, benefits and costs can be identified with more precision, and the benefit-cost ratio which results from a full benefit-cost analysis may differ from the planning-level STAPLEE results presented here.

It should be noted that higher BCRs do not necessarily correspond to high priorities, nor do low BCRs or BCRs under 1.0 correspond to low-priority projects. An important project with a high priority to the community may have a lower BCR because of its complexity, assumed high expense, and other costs. Communities should not be discouraged or deterred from further consideration of projects that have low BCRs or BCRs less than 1.0 until additional, more specific evaluations of the costs and benefits have been undertaken.

PERSISTS

To help further evaluate proposed actions in a climate adaptation framework, CIRCA's "PERSISTS" methodology was also utilized. According to CIRCA, PERSISTS is a multi-criteria framework developed in collaboration with stakeholders during the Resilient Connecticut Phase I workshop of May 2019.

PERSISTS helps project developers evaluate climate resilience actions and strategies for their potential to balance multiple goals and priorities among stakeholders. PERSISTS is comprised of eight categories:

- Permittable – Can be authorized through necessary Federal, State, and local permits
- Equitable – Ensures that benefits are equitable among populations
- Realistic – Can be realistically engineered and is plausibly fundable
- Safe – Reduces risks to people and infrastructure
- Innovative – Process has considered innovative options
- Scientific – Apply and improve on the best available science
- Transferrable – Can serve as model for other communities
- Sustainable – Socially, economically, and ecologically sustainable and supported by the public and leadership

The approach to scoring is provided below:

Permittable – *Can be authorized through necessary Federal, State, and local permits.*

- 0 = no or none
- 1 = uncertain or minimally
- 2 = somewhat
- 3 = very: All actions were scored a three. This plan purposely does not include actions for which permitting could not be acquired if necessary.

Equitable – *Ensures that benefits are equitable among populations.*

- 0 = no or none: No actions received a 0. This plan purposely did not include actions that would exacerbate inequality.
- 1 = uncertain or minimally: No actions received a 1. This plan purposely did not include actions that would exacerbate inequality.
- 2 = somewhat – Action related to localized infrastructure improvements, staff time, and all other actions not covered in the next bullet point received a 2.
- 3 = very – Actions related to cooling centers and shelters and any critical facility that serves the entire population were scored a 3. Any action that benefits an EJ tract, serves an EJ tract, is located in an EJ Tract or is located in a distressed municipality also received a score of 3.

Realistic – *Can be realistically engineered and is plausibly fundable.*

- 0 = no or none
- 1 = uncertain or minimally
- 2 = somewhat
- 3 = very; All actions were scored a three since this plan purposely did not include actions that could not be realistically implemented.

Safe – Reduces risks to people and infrastructure.

- 0 = no or none: No actions received a 0. This plan purposely did not include actions that do not reduce risk.

- 1 = uncertain or minimally: No actions received a 0. This plan purposely did not include actions that do not reduce risk.
- 2 = somewhat: All Preparedness and Emergency Response actions received a score of 2 since these actions prepare for or respond to the risk rather than mitigate the risk. All Education and Awareness Actions also scored a 2 for the same reason.
- 3 = very: All other actions in the other categories for "Type of Action" (Property Protection; Structural Project; Prevention; Natural Resources Protection; Water & Wastewater Utility Project) received a 3 because these actions directly prevent or reduce risks.

Innovative – *Process has considered innovative options.*

- 0 = no or none: All actions were scored 0 because they are all established risk mitigation strategies.
- 1 = uncertain or minimally
- 2 = somewhat
- 3 = very

Scientific – *Apply and improve on the best available science.*

- 0 = no or none
- 1 = uncertain or minimally
- 2 = somewhat
- 3 = very: All actions were scored a 3 because this plan deliberately does not include actions that are not based in sound science; educational tools and trainings referenced are all based on current climate science.

Transferrable – *Can serve as model for other communities.*

- 0 = no or none
- 1 = uncertain or minimally
- 2 = somewhat: All actions received a two because the strategies applied in the CRCOG region can be applied to other areas with some place-based adjustments.
- 3 = very

Sustainable - *Socially, economically, and ecologically sustainable and supported by the public and leadership.*

- 0 = no or none: No actions were scored 0. This plan purposely did not include actions that would not be supported by municipal staff or that would be detrimental to social, economic, or ecological sustainability.
- 1 = uncertain or minimally: No actions were scored 1. This plan purposely did not include actions that would not be supported by municipal staff or that would be detrimental to social, economic, or ecological sustainability.
- 2 = somewhat: All low and medium priority actions received a 2.
- 3 = very: The high priority actions (indicating strong municipal support) and actions with a carbon mitigation co-benefit received a 3.

Although PERSISTS has been deemed appropriate by various Connecticut State Agencies for use in evaluating climate adaptation projects, the methodology is more geared towards complex sets of solutions that address multiple climate-driven challenges. PERSISTS does not work as well for individual components of projects that have multiple phases. For example, the end result of a project may not be permittable as initially scoped, but the study phases needed to reach that point are not in need of permits. Overall, the points awarded in the PERSISTS evaluation are as follows:

- 0 = no or none
- 1 = uncertain or minimally
- 2 = somewhat
- 3 = very

Environmental Justice Prioritization Process

Each action is also provided with a statement about its nexus to EJ populations. The choices are:

- "Yes," located in EJ tract:
    - "Yes," if located in a state-identified Distressed Municipality or in a census tract with a CT EJScreen Environmental Justice Index Score of 8 or higher, indicating that the community is in the top 20% impacted within the state.
- Benefits an EJ tract (i.e., a nearby shelter)
- Serves EJ census tracts (i.e., a sewer pumping station)
- No – does not serve, does not benefit, and is not located in an EJ tract or distressed municipality

These statements can be used by decisionmakers to help allocate grant funds for studies and projects.

Use of Evaluation Criteria:

The STAPLEE and PERSISTS scores were multiplied for a final score. In general, scores above 100 are considered beneficial, more aligned with the principles of climate adaptation, and mentioned in the annexes for each jurisdiction. However, individual community priorities are not always aligned with the highest products of STAPLEE and PERSISTS. Decisionmakers will need to look at the STAPLEE scores, PERSISTS scores, and EJ statements separately and together when determining where limited resources should be directed.

Below, in Table 70, are the various funding sources that are identified in the STAPLEE matrix. The STAPLEE and PERSISTS criteria are listed for quick reference on the subsequent page in Table 71 and the final evaluation matrix for each proposed action in this Plan Update can be found in Appendix M.

Table 70. STAPLEE and PERSISTS Matrix Funding Source Acronyms

Acronym or Name	Description
CIRCA	Connecticut Institute for Resilience and Climate Adaptation
CWSRF	Clean Water State Revolving Fund
DEEP Climate Resilience Fund	DEEP Climate Resilience Fund - new for 2022-2023; anticipated for 2023-2024

Acronym or Name	Description
DWSRF	Drinking Water State Revolving Fund
EPA 319	Environmental Protection Agency (EPA) grants through Section 319 water quality programs
HHMP	Rehabilitation Of High Hazard Potential Dam Grant Program
HMA	Hazard Mitigation Assistance
BRIC	Building Resilient Infrastructure and Communities
FMA	Flood Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
IIJA	Infrastructure Investment and Jobs Act
AOP	National Culvert Removal, Replacement, and Restoration Grants (Culvert AOP Program)
BIP	Bridge Investment Program
BBFP	Buses and Bus Facilities Program
RFPBR	Restoring Fish Passage through Barrier Removal Grants - may have been 2022 only
SLCGP	State and Local Cybersecurity Grant Program
LISFF	Long Island Sound Futures Fund
LOTCIP	Local Transportation Capital Improvement Program
Municipal CIP Budget	Municipal Capital Improvement Program or equivalent local program
Municipal Operating Budget	Staff time or operational budgets
NOAA/NFWF	National Oceanic and Atmospheric Administration (NOAA) grants administered by the National Fish and Wildlife Foundation
PROTECT	Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Program
Save the Sound	Save the Sound is a resource for partnering to seek grant funds; Save the Sound also has some funding available
SHPO	State Historic Preservation Office
STEAP	Small Town Economic Assistance Program
Transit District	The local transit district (this can vary from community to community, such as Southeast or Windham Region)
USDA/NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
WWW	Windham Water Works

Table 71. STAPLEE and PERSISTS scoring criteria

STAPLEE Scoring Criteria	PERSISTS Scoring Criteria
• Social • Technical • Administrative • Political • Legal • Economic • Environmental	• Permittable • Equitable • Realistic • Safe • Innovative • Scientific • Transferrable • Sustainable

Section V: Plan Implementation and Maintenance

Bringing the Plan to Life

This section describes how this Plan Update will be put into action and how our momentum will be maintained. A Natural Hazard Mitigation Plan is not solely a document but also represents a cyclical process. Revisiting the planning process periodically ensures the mitigation strategies are not overlooked even if there are personnel transitions or organizational changes. Each update process helps to build and strengthen institutional capacity to undertake our mitigation strategies. All projects and activities will be evaluated for their progress and effectiveness and feasibility as mitigation activities during the 5-year cycle (2024-2029) and as work on the next update of this plan is undertaken.

Figure 19. Core Steps in Mitigation Planning Process

Source: http://www.fema.gov/hazard-mitigation-planning-overview

The general schedule and process we will follow to ensure the Capitol Region's 2024-2029 Plan Update is implemented and maintained involves the following steps in Table 72.

Table 72. Schedule for CRCOG HMCAP Plan Update

TASK	2024				2025				2026				2027				2028				2029	
2024-2029 Plan Approval & Adoption																						
FEMA Review & Approval	•	•																				
Local & Regional Adoption		•	•	•																		
Plan Distribution				•																		
Implementation Monitoring																						

TASK	2024				2025				2026				2027				2028				2029	
Annual Status Updates					•				•				•				•					
Initiate Update Process																						
Seek Grant Funding											•											
Policy Board Approval											•											
Municipal Commitments											•											
Develop Next Plan Update																						
Risk Assessment Update																•	•					
Mitigation Strategies Update																•	•	•	•			
Document Preparation, Review & Revision																	•	•	•	•	•	•
Public Outreach & Participation																						
Plan Update Activities																•	•	•	•	•	•	•

Questions or comments regarding the implementation of this Plan Update should be directed to:

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Plan Adoption

This plan update was submitted for review by DEMHS in February 2024. Suggested revisions were made and the State transmitted the Plan Update to FEMA for review in [TBD]. Upon receipt of FEMA's conditional approval on [TBD], each municipality's governing body as well as CRCOG's Policy Board formally adopted the Plan Update (with an initial adoption date of [TBD]. Copies of the municipal adoption resolutions are included in Appendix P.

Strategy Implementation

Implementation of the strategies contained within this plan will depend largely on the availability of resources. Each municipality and CRCOG will have to consider the costs, availability of funding, and economic and other impacts of each mitigation action individually. In general, preference should be given to accomplishing tasks that have positive benefit-cost ratios, and those that are ranked high priority. The groundwork has been set for initiating the proposed mitigation activities: responsible agencies, implementation time frames, and potential funding sources have been identified for each proposed action.

The municipalities' chief executive officials and the designated local coordinators will be responsible for making this plan available to all municipal departments and agencies as a planning tool to be used in

conjunction with other municipal plans, regulations, budgets, capital improvements programs, day-to-day operations, and other processes and projects. The CRCOG Policy Development & Planning Department will be responsible for regional strategies and coordination with CRCOG Public Safety staff. CRCOG will also assist municipalities' efforts to implement local projects by notifying municipal officials of grant funding opportunities as we become aware of them and by writing letters of support for grant applications.

As municipal plans of conservation and development (POCD) are prepared and referred to CRCOG for regional review, the Policy Development & Planning staff will make recommendations for opportunities to incorporate natural hazard mitigation planning into the POCD. CRCOG has made such comments regarding municipal plans of conservation and development reviewed in all those reviewed from 2013 through 2023. Table 43 can be used to help guide the reviews of local POCDs, as it notes how each already addresses hazard mitigation.

The 2024-2034 Capitol Region regional plan of conservation and development has incorporated natural hazard mitigation policy recommendations and future updates will continue to do.

Implementation Monitoring

CRCOG staff will be responsible for conducting annual outreach to each participating community's chief elected official. This annual email, with templates found in Appendix H, will serve as a reminder to those that an annual review should be conducted to monitor the progress of the HMP. A similar template is provided for outreach to environmental justice organizations at regular intervals to gather input during these annual reviews. CRCOG will also ensure that annual HMCAP reviews are an agenda item at one monthly meeting; CIRCA will attend this meeting to assist in conversations around specific actions or emerging funding sources.

The following instructions shall be followed by the local coordinators of this HMP as identified in each community annex. The local coordinators will be responsible for monitoring the successful implementation of this HMP in their community. The coordinators will provide the linkage between the multiple departments involved in hazard mitigation at the local level relative to communication and participation. As the plans will be adopted by each local government, coordination is expected to be able to occur without significant barriers.

Site reconnaissance for Specific Recommendations – Local coordinators, with the assistance of appropriate department personnel, will annually perform reconnaissance-level inspections of sites that are subject to specific recommendations. This will ensure that these actions remain viable and appropriate. Examples include building acquisitions or elevations, structural projects such as culvert replacements, roadway elevations in coastal areas, and water main extensions for increased fire suppression capabilities. The worksheet in Appendix J will be filled out for specific project-related recommendations.

The local coordinators will be responsible for obtaining a current list of repetitive loss properties in the community each year. This list is available from FEMA. These properties shall be subject to a windshield survey at least once every two years to ensure that the list is reasonably accurate relative to addresses

and other basic information. Some of the reconnaissance-level inspections could occur incidentally during events such as flooding when response is underway.

Annual Reporting and Meeting – Each local coordinator will be responsible for holding an annual meeting to review the plan. Matters to be reviewed on an annual basis include the goals and objectives of the HMCAP, hazards or disasters that occurred during the preceding year, hazard mitigation and climate adaptation activities that have been accomplished to date, a discussion of reasons that implementation may be behind schedule, and recommendations for new projects and revised activities. Results of site reconnaissance efforts will be reviewed. A meeting should be conducted in spring each year, at least five to six months before the annual application cycle for pre-disaster grants under the HMA program. This will enable a list of possible projects to be circulated to applicable local departments to review and provide sufficient time to develop a grant application. The local coordinator shall prepare and maintain documentation and minutes of this annual review meeting.

Post-Disaster Reporting and Metering – Subsequent to federally declared disasters in the State of Connecticut, a meeting shall be conducted by each local coordinator and representatives of appropriate departments to develop a list of possible projects for developing an HMGP application. The local coordinator shall prepare a report of the recent events and ongoing or recent mitigation activities for discussion and review at the HMGP meeting. Public outreach shall be solicited for HMGP applications at a *separate* public meeting.

Continued Public Involvement – Continued public involvement will be sought regarding the monitoring, evaluating, and updating of the HMCAP. Public input will primarily occur through input to web-based information gathering tools. Public comment on changes to the HMCAP may be sought through posting of public notices and notifications posted on local websites and the CRCOG website.

Table 73. Natural Hazard Mitigation Plan Update Primary Municipal Contacts (Local Coordinators)

Municipality	Local Coordinator Name	Local Coordinator Title
Andover	Eric Anderson	Town Administrator
Avon	Bruce Appell	Fire Marshal, Emergency Manager
Berlin	Rich Cop	Fire Marshal, Emergency Manager
Bloomfield	Jon Colman	Assistant Director, Building & Land Use
Bolton	Patrice L. Carson	Director of Community Development
Canton	Chris Arciero	Emergency Management Director
Columbia	Jennifer LaVoie	Executive Administrative Assistant
Coventry	James Drumm	Town Manager
East Granby	Kenneth Beliveau	Fire Marshal and Emergency Management Director
East Hartford	Steve Hnatuk	Deputy Development Director
East Windsor	Ruthanne Calabrese	Town Planner
Ellington	Lisa Houlihan	Town Planner
Enfield	Laurie Whitten	Director of Planning
Farmington	Arnold Russell	Director of Public Works / Town Engineer
Glastonbury	Jonathan Luiz	Glastonbury Town Manager

Municipality	Local Coordinator Name	Local Coordinator Title
Granby	Abigail St. Peter Kenyon	Community Development Director
Hartford	Christopher Hayes	Director of Public Works
Hebron	Matthew Bordeaux	Director of Planning and Development
Manchester	Emma Peterson	Principal Comprehensive Planner
Mansfield	Adam Libros	Emergency Management Director
Marlborough	Peter Hughes	Director of Planning and Development
New Britain	Mark Moriarty and Raul Ortiz	Director of Public Works/Fire Chief and Emergency Management Director
Newington	Paul Dickson	Town Planner
Plainville	Mark S. DeVoe	Planning Director
Rocky Hill	Mike Garrahy	Fire Chief
Simsbury	Thomas Roy	Town Engineer
Somers	Todd Rolland	Director of Public Works
South Windsor	Marco Mucciacciaro	Superintendent of Streets
Southington	Mark Sciota	Southington Town Manager
Stafford	Jim Desso	Emergency Management Director
Suffield	Bill Hawkins	Director of Planning and Development
Tolland	David Corcoran	Planning Director
Vernon	Michael Purcaro	Town Manager
West Hartford	Duane Martin	Director of Community Development
Wethersfield	Denise Bradley	Town Planner
Willington	Stuart Cobb	Emergency Management Director
Windsor	Suzanne Choate	Town Engineer
Windsor Locks	Phil Sissick	Director of Public Works

Plan Updates

In the previous two editions of this plan, the narrative stated that updates to the plan would be coordinated by CRCOG; the plan would be considered current for a period of five years from the date of adoption of the first community to adopt the plan; and CRCOG would be responsible for compiling the funding required to update the plan in a timely manner such that the current plan would not expire. While these statements remain true, this HMCAP is the first edition of the CRCOG hazard mitigation plan to separate five-year updates from routine updates or “amendments” that are both desired and necessary from time to time.

Routine Updates and Amendments

Communities have generally believed that hazard mitigation plans are difficult to update, but this is not necessarily the case. The new Local Mitigation Plan Policy Guide (effective April 2023) describes the

amendment process; refer to the text box below. In addition, adoption resolutions allow updates as needed.

CRCOG has developed a template that can be used by its member municipalities to document routine updates and amendments to this HMCAP. Refer to Appendix I for a copy. CRCOG will provide copies of this worksheet to the chief elected officials at the monthly COG meetings at least one time each year in the timeframe corresponding to the anniversary of this HMCAP approval.

From the Local Mitigation Plan Policy Guide

A mitigation plan may need to be amended after it is approved by FEMA and adopted by the local government. Amending an approved and adopted plan does not necessarily result in the need to reevaluate the entire plan against all requirements. FEMA expects local governments to conduct regularly scheduled reviews and amendments to their mitigation plan. This may result in modifications to the risk assessment or adding/removing mitigation actions, especially in preparation for submitting applications to FEMA for assistance and ensuring the project conforms with the mitigation plan. Participants are encouraged to keep the state and FEMA informed, but these amendments do not need to be reviewed and approved by the state and FEMA. If these changes identify new mitigation actions that might be eligible for FEMA assistance programs, then advise FEMA and the state. FEMA will acknowledge and note the receipt of the added action(s), where appropriate, but does not need to formally review or approve the action(s).

Five-Year Update

To update the entire HMCAP, the CRCOG or its consultant will coordinate the appropriate group of local officials consisting of representatives of many of the same departments solicited for input to this HMCAP. In addition, local business leaders, community and neighborhood group leaders, relevant private and nonprofit interest groups, and the neighboring municipalities will be solicited for representation, including representatives from communities adjacent to CRCOG communities but not part of CRCOG.

The action worksheets prepared by the local coordinators and annual reports described above for each municipality will be reviewed. In addition, the following questions will be asked of each community:

- Do the hazard mitigation and climate adaptation goals still reflect the concerns of local residents, business owners, and officials?
- Have local conditions changed so that findings of the risk and vulnerability assessments should be updated?
- Are new sources of information available that will improve the risk assessment? For example, has CIRCA developed new vulnerability and risk assessment tools?
- Has the State of Connecticut modified any of its climate adaptation priorities? For example, extreme heat is a priority in 2023, but may not be a priority in 2027-2028.
- If State priorities or risks and vulnerabilities have changed, do the goals and actions still reflect the risk assessment?
- What hazards have caused damage locally since the last edition of the HMCAP was developed? Were these anticipated and evaluated in the HMCAP, or should these hazards be added to the plan?
- Are current personnel and financial resources at the local level sufficient for implementing mitigation actions?
- For each hazard mitigation and climate adaptation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles?
- For each action that has been completed, was the action effective in reducing risk?

- What hazard mitigation and climate adaptation actions should be added to the plan and proposed for implementation? For example, numerous actions about cooling centers were added in 2023; these actions were absent from prior editions.
- If any proposed actions should be deleted from the plan, what is the rationale?

Future HMP updates may include deleting recommendations as projects are completed, adding recommendations as new hazard effects arise, or modifying hazard vulnerabilities as land use changes. In addition, the lists of shelters, cooling centers, and other critical facilities should be updated as necessary or at least during each HMP update.

All monitoring and updating activities will incorporate public involvement through open meetings, public notices, posting documents on CRCOG's website and providing ample opportunities for public comment.

Section VI: References

References

Boston College, Weston Observatory, http://www.bc.edu/content/bc/research/westonobservatory/northeast.html

Capitol Region Council of Governments, *2014-2024 Capitol Region Plan of Conservation and Vibrant. Green. Connected. Competitive,* http://www.crcog.org/community_dev/regional_plan.html

Capitol Region Council of Governments, *Capitol Region Natural Hazard Mitigation Plan*, 2019-2024 Plan Update, https://crcog.org/natural-hazards-mitigation-planning/

Capitol Region Council of Governments Policy Board, https://crcog.org/policy-board/

Connecticut Council on Environmental Quality, *Environmental Quality in Connecticut, 2022 Annual Report*, 2022, https://portal.ct.gov/CEQ/AR-22-Gold/2022-CEQ-Annual-Report-eBook

Connecticut Department of Economic and Community Development, Distressed Municipalities, https://portal.ct.gov/DECD/Content/About_DECD/Research-and-Publications/02_Review_Publications/Distressed-Municipalities

Connecticut Department of Economic and Community Development, State Historic Preservation Office, https://portal.ct.gov/DECD/Services/Historic-Preservation

Connecticut Department of Energy and Environmental Protection, DEEP Climate Resilience Fund, https://portal.ct.gov/connecticutclimateaction/executive-order/deep-climate-resilience-fund

Connecticut Department of Energy and Environmental Protection, Natural Diversity Data Base (NDDB) Maps, http://www.ct.gov/deep/cwp/view.asp?a=2702&q=323464&deepNav_GID=1628

Connecticut Department of Energy & Environmental Protection, Dams, http://www.ct.gov/deep/cwp/view.asp?a=2720&q=325634&deepNav_GID=1625

Connecticut Department of Energy & Environmental Protection, High Hazard & Significant Hazard Dams in Connecticut, http://www.ct.gov/deep/cwp/view.asp?a=2720&q=394032&deepNav_GID=1625

Connecticut Department of Energy & Environmental Protection, GIS Data, https://ct-deep-gis-open-data-website-ctdeep.hub.arcgis.com/

Connecticut Environmental Justice Screening Tool 2.0, 2023, https://connecticut-environmental-justice.circa.uconn.edu/

Connecticut Flood Recovery Committee, Report of the Connecticut Flood Recovery *Committee to Governor Abraham Ribicoff*, November 3, 1955, Connecticut State Library, http://www.cslib.org/floodrecov.pdf

Connecticut Institute for Resilience and Climate Adaptation, https://circa.uconn.edu/

Connecticut Institute for Resilience and Climate Adaptation, Climate Change Vulnerability Index, https://resilientconnecticut.uconn.edu/ccvi/

Connecticut Institute for Resilience and Climate Adaptation, Resilient Connecticut, https://resilientconnecticut.uconn.edu/

Connecticut Office of Policy and Management, Equalized Net Grand List by Municipality, https://portal.ct.gov/OPM/IGPP/Publications/Equalized-Net-Grand-List-By-Town

Connecticut Office of Policy & Management, Municipal Fiscal Indicators, http://www.ct.gov/opm/cwp/view.asp?a=2984&q=383170&opmNav_GID=1807

Connecticut Physical Climate Science Assessment Report, 2019, https://circa.uconn.edu/ct-climate-science/

Connecticut Secretary of the State, *Connecticut State Register & Manual, https://portal.ct.gov/SOTS/Register-Manual/Register-Manual/Connecticut-State-Register--Manual*

Connecticut State Building Code, https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Connecticut-State-Building-Code/Regulations

Connecticut State Division of Emergency Management and Homeland Security, *2023 Natural Hazard Mitigation Plan Update*, https://portal.ct.gov/DEMHS/Emergency-Management/Resources-For-Officials/Hazard-Mitigation-and-Resiliency/Hazard-Mitigation-and-Resiliency/2023-State-Natural-Hazard-Mitigation-Plan-Update

CTRail, Hartford Line: https://www.hartfordline.com/

Federal Emergency Management Agency, Community Status Book Report – Connecticut, http://www.fema.gov/cis/CT.html

Federal Emergency Management Agency, Disaster Declarations, http://www.fema.gov/disasters

Federal Emergency Management Agency, Hazus® User and Technical Manuals, https://www.fema.gov/flood-maps/tools-resources/flood-map-products/hazus/user-technical-manuals

Federal Emergency Management Agency, *Local Mitigation Planning Handbook*, 2023, https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-handbook_052023.pdf

Federal Emergency Management Agency, OpenFEMA, https://www.fema.gov/about/reports-and-data/openfema

Federal Emergency Management Agency, National Flood Insurance Program, Community Rating System, A Local Official's Guide to Saving Lives, Preventing Property Damage, Reducing the Cost of Flood Insurance. *http://www.fema.gov/media-library/assets/documents/16104?id=3655*

Federal Emergency Management Agency, National Risk Index, https://hazards.fema.gov/nri/data-resources

Fourth National Climate Assessment, 2018, https://www.globalchange.gov/our-work/fourth-national-climate-assessment

Governor's Council on Climate Change, https://portal.ct.gov/DEEP/Climate-Change/GC3/Governors-Council-on-Climate-Change

Governor's Council on Climate Change, Phase 1 Report: Near-Term Actions, 2021, https://portal.ct.gov/-/media/DEEP/climatechange/GC3/GC3_Phase1_Report_Jan2021.pdf

Insurance Institute for Business & Home Safety (IIBHS), Commercial Roof Snow Load Risks, https://disastersafety.org/ibhs/snow-load-risks-commercial/

The Metropolitan District (MDC), Clean Water Project, http://www.thecleanwaterproject.com/

National Centers for Environmental Information (NCEI), Storm Events Database, http://www.ncdc.noaa.gov/stormevents/

National Drought Mitigation Center, University of Nebraska-Lincoln, http://drought.unl.edu/

National Institute of Building Sciences, Multihazard Risk Assessment/HAZUS, *About Hazus*, http://www.nibs.org/?page=hazus&hhSearchTerms=about+and+hazus

National Oceanic and Atmospheric Administration, Global and Regional Sea Level Rise Scenarios for the United States, 2017, https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

National Oceanic and Atmospheric Administration, National Centers for Environmental Information, http://www.ncdc.noaa.gov/

National Weather Service, National Hurricane Center, http://www.nhc.noaa.gov

National Weather Service, Storm Prediction Center, http://www.spc.noaa.gov

Region 3, Regional Emergency Support Plan, June 2018, https://crcog.org/wp-content/uploads/2018/07/R-3-RESP-3-2012-reviewed-June-2018.pdf

Southeastern Connecticut Council of Governments, *Hazard Mitigation and Climate Adaptation Plan,* 2023, http://seccog.org/2023-hmp

State of Connecticut Water Status, http://ct.gov/waterstatus/site/default.asp

The Tornado Project, http://tornadoproject.com/

Tornado Archive, https://tornadoarchive.com/home/

University of Connecticut, Center for Land Use Education and Research, Connecticut's Changing Landscape, Download Data, http://clear.uconn.edu/projects/landscape/download.asp

University of Connecticut Map and Geographic Information Center (MAGIC), Connecticut GIS Data, http://magic.lib.uconn.edu/connecticut_data.html

U.S. Army Corps of Engineers, Flood Risk Management Program, http://www.iwr.usace.army.mil/Missions/FloodRiskManagement/FloodRiskManagementProgram.aspx

U.S. Army Corps of Engineers, National Levee Database, http://nld.usace.army.mil

U.S. Census Bureau, http://www.census.gov/

USDA Disaster Assistance Programs, https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index

USGS Earthquakes Hazards Program, Connecticut Earthquake Information, http://earthquake.usgs.gov/earthquakes/states/?region=Connecticut

USGS Geologic Hazards Science Center, https://geohazards.usgs.gov/ and "2009 Earthquake Probability Mapping", https://geohazards.usgs.gov/eqprob/2009/index.php

USGS, New England Water Science Center – Connecticut Office, http://ct.water.usgs.gov/

Vermont Agency of Natural Resources, River Management Program, *Municipal Guide to Fluvial Erosion Hazard Mitigation*, www.anr.state.vt.us/dec/waterq/rivers/docs/rv_**municipalguide**.pdf

Wikipedia, http://en.wikipedia.org/wiki/Main_Page

Municipal Websites

For most municipalities, plans of conservation and development; zoning, inland wetlands and floodplain regulations; annual budgets; and capital improvements programs can be found on municipal websites.

Andover, http://andoverct.org/
Avon, http://www.town.avon.ct.us/Public_Documents/index
Bloomfield, http://www.bloomfieldct.org/Plugs/home.aspx
Bolton, http://www.bolton.govoffice.com/
Canton, http://www.townofcantonct.org/
East Granby, http://www.eastgranbyct.org/
East Hartford, http://easthartfordct.gov/Public_Documents/index
East Windsor, http://www.eastwindsor-ct.gov/Public_Documents/Home

Ellington, http://www.ellington-ct.gov/Plugs/homepage.aspx
Enfield, http://www.enfield-ct.gov/
Farmington, http://www.farmington-ct.org/
Glastonbury, http://www.glasct.org/index.aspx?page=1
Granby, http://www.granby-ct.gov/Public_Documents/index
Hartford, http://www.hartford.gov/
Hebron, http://www.hebronct.com/
Manchester, http://www.townofmanchester.org/
Marlborough, http://www.marlboroughct.net/index.php
Newington, http://www.newingtonct.gov/
Rocky Hill, http://www.rockyhillct.gov/
Simsbury, http://www.simsbury-ct.gov/
Somers, http://www.somersct.gov/
South Windsor, http://www.southwindsor.org/Pages/index
Stafford, http://www.staffordct.org/
Suffield, http://www.suffieldtownhall.com/
Tolland, http://www.tolland.org/
Vernon, http://www.vernon-ct.gov/
West Hartford, http://www.west-hartford.com/
Wethersfield, http://wethersfieldct.com/
Windsor, http://www.townofwindsorct.com/
Windsor Locks, http://www.windsorlocksct.org/

Regional Planning Agency Websites

Capitol Region Council of Governments, http://crcog.org/
Southeastern Connecticut Council of Governments, http://seccog.org/
Lower Connecticut River Valley Council of Governments, http://rivercog.org/
Pioneer Valley Planning Commission, http://www.pvpc.org/
New England's Sustainable Knowledge Corridor, http://knowledgecorridor.org/

Appendices

The following appendices can be found on the Plan Update webpage:

Appendix A: Local planning meeting materials

Appendix B: Regional workshop materials

Appendix C: Utility and lifeline meeting materials

Appendix D: Public meeting materials

Appendix E: Internet based survey results

Appendix F: Copies of communications related to planning process

Appendix G: Draft plan presentation materials

Appendix H: Templates for annual emails to jurisdictions and organizations that serve socially vulnerable populations

Appendix I: Worksheet to document plan updates and amendments

Appendix J: Action monitoring form

Appendix K: CIRCA climate change fact sheets

Appendix L: DCRF fact sheet

Appendix M: Active mitigation strategies and actions: 2024-2029

Appendix N: Planning process for the 2019 CRCOG HMP Update

Appendix O: HAZUS results

Appendix P: Adoption resolutions